Al-Bidayah : jurnal pendidikan dasar Islam
Volume 16, Number 1, June 2024
ISSN: 2549-3388 (online)
Available online at https://ejournal.uin-suka.ac.id/tarbiyah/albidayah
Submitted: July 15, 2024, Accepted: June 30, 2024

UNVEILING THE REASONING ABILITY OF MODERATELY-SKILLED ELEMENTARY SCHOOL STUDENTS IN LEARNING MATHEMATICS THROUGH THE CONTEXT OF ECO-MATHEMATICS

Sunyoto Hadi Prayitno[1], Feny Rita Fiantika[2], Dwimartin Bella Hapsari[3]

Universitas PGRI Adi Buana Surabaya, Indonesia[1,2,3]
E-mail: nyoto_hp@unispasby.ac.id[1], fentfeny@gmail.com[2],
dwimartinbellahapsari03@gmail.com[3]

DOI: 10.14421/al-bidayah.v16i1.9458

ABSTRACT

Mathematical reasoning ability is one of the critical elements of mathematical learning, particularly in solving daily problems and coming to conclusions. Based on preliminary studies, students have difficulty solving mathematical problems, which are difficulty understanding a problem, planning a solution, and concluding a piece of information. Thus, a contextual approach focusing on mathematical objects in daily life's economic and cultural contexts is needed. This study aimed to identify the extent of the mathematical reasoning ability of fifth-grade students in Class V-B of Ketintang 1/409 Elementary School of Surabaya in solving multiplication problems presented in the context of eco-mathematics (economy, culture, object of mathematics). This study applied a qualitative research method with an exploratory, descriptive approach, which describes or depicts a particular phenomenon's condition. Data in the study were collected through written tests, interviews, observations, and documentation. The subjects of this research were students, each of whom had high, medium, and low abilities. The data analysis technique involved credibility testing, dependability testing, confirmability testing, and transferability testing. There are three subjects: high, medium, and low ability. The results of this study indicated that the subjects had moderate abilities during the learning process in the classroom; they were active in answering all questions given by the researchers but still lacked precision. The subjects could explore their learning abilities by discovering new things around them and obtained scores ranging from 39 to 95.

Keywords: eco-mathematics; elementary schools; mathematical reasoning ability; moderate category

INTRODUCTION

Mathematics education in Indonesia has developed in line with the development of mathematics education worldwide.[1] The curriculum determines the objectives of education because the curriculum covers a set of learning plans for the material to be studied as well as the process of learning, and the curriculum also directs how to evaluate as a measure of the success of learners in mastering learning.[2] The essence of mathematics learning is a deliberately designed process to create an environment that allows someone (students) to carry out mathematical learning activities. Mathematics learning must

[1] Karso, & Dkk. Pendidikan Matematika. *Pendidikan Matematika*. (2009). 39–40.

[2] Fianingrum, F., Novaliyosi, N., & Nindiasari, H. Kurikulum Merdeka pada Pembelajaran Matematika. *Edukatif : Jurnal Ilmu Pendidikan*, *5*(1). (2023). 132–137. https://doi.org/10.31004/edukatif.v5i1.4507

Creative Commons Non Commercial CC BY-NC: This article is distributed under the terms of the Creative Commons Attribution Non Commercial 4.0 License (http://www.creativecommons.org/licenses/by-nc/4.0/) which permits noncommercial use, reproduction and distribution of the work without further permission provided the original work is attributed as specified on the Al-Bidayah : jurnal pendidikan dasar Islam and Open Access pages

provide opportunities for students to strive and seek experiences in mathematics[3]. The ideal reasoning ability of elementary school students can be shown when students can solve mathematical problems according to relevant facts and information. Humans often find problems requiring them to find solutions and conclusions.[4] A conclusion can be drawn through reasoning by looking at every relation of the available arguments or information.

Therefore, reasoning ability must be developed from early childhood through a designed learning process at school. Through reasoning development exercises, students can see the problem and the adequacy of information to conclude. When the students see that the information is inadequate, they can draw an initial conclusion suggesting the need for additional information. Further, they can look for additional information by utilizing their existing knowledge as long as the information can be derived from the given problem. Therefore, the teacher must know how far the students understand the information. However, some students do not highly favor learning mathematics because it is perceived as boring and complicated. Therefore, educators or teachers need to prepare teaching methods that can help foster students' creativity.[5]

Based on preliminary studies, students have difficulty solving mathematical problems, which are difficulty understanding a problem, planning a solution, and concluding a piece of information. It is a problem; the learning approach is needed to package the information into contextual problems that students can solve. Problem-based learning is one approach that suits problem-solving and is packed contextually. Through problem-solving, students do their reasoning development exercises; students can see the problem and the adequacy of information to conclude. The problem-based learning (PBL) method can be described as a learning approach emphasizing task accomplishment, especially using a project-based model that encourages students to participate actively in

[3] James W, Elston D, T. J. et al. Bab II Kajian Pustaka. *Universitas Kristen, Satya Wacana*, 7–23. (2016)

[4] Saleh, M., Charitas, R., Prahmana, I., & Isa, M. Improving the Reasoning Ability of Elementary School Student Through the Indonesian Realistic. *Journal on Mathematics Education*, *9*(1). (2018). 41–54. https://ejournal.unsri.ac.id/index.php/jme/article/view/5049

[5] Prayitno, S. H., & Utami, H. P. D. Differences of student mathematics learning results with discovery learning and problem based learning from emotional intelligence. *Math Didactic: Jurnal Pendidikan Matematika*, *7*(2), 159–169. (2021). https://doi.org/10.33654/math.v7i2.1238

writing and collecting information. However, each project must be different from the others.[6]

Based on the findings of [7] (on fifth-grade students at Curup 15 Elementary School) stated that in solving integer operations, 76.8% faced difficulty with facts, 76.8% with concepts, 79.4% with operations, and 79.4% with principles. The contributing factors were (1) students were struggling to write integer addition and draw on the number line, (2) students did not comprehend the basic concepts of subtraction operations and mixed integer numbers, (3) students finding it difficult to determine the result of subtracting integer numbers, and (4) students having difficulty creating mathematical models from essays. Therefore, there is a greater emphasis on arithmetic or calculations that can be used daily in elementary mathematics education. The researchers' observations also indicated that out % of 28 students, 53.5% experienced difficulties when solving multiplication problems. Refers to studies[8] Findings were used for problem-solving in mathematics; the average % of students meeting the low requirement is 59.72 %. Furthermore, children with high expectations can thoroughly, meticulously, and systematically solve difficulties. Understanding the problem remains a struggle for pupils who reach intermediate standards and have yet to complete the problem's solution.

The application of mathematics is closely related to everyday life. Mathematics serves various functions, such as comparing allowances, measuring the weights of objects, and resolving various disputes.[9] Learning mathematics teaches us to think analytically, solve problems, and identify patterns.[10] Thinking logically proves helpful in everyday situations, such as making important decisions, problem-solving, and planning.

[6] Penelitian, J., & Riani, N. All Fields of Science J-LAS Efektifitas Project Based Learning (Pjbl) Sebagai Bentuk Implementasi Kurikulum Merdeka dalam Pembelajaran Matematika Analysis of Parking Characteristics on Sudirman Street, Binjai City. *AFoSJ-LAS*, *3*(3). (2023). 24–31.

[7] Mandasari, N., & Rosalina, E. Analisis Kesulitan Siswa dalam Menyelesaikan Soal Operasi Bilangan Bulat di Sekolah Dasar. *Jurnal Basicedu*, *5*(3). (2021). 1139–1148.

[8] Cahyadi, W., Aswita, D., & Ningsih, T. Z. Analysis of The Development of Non-Cognitive Assessment Instrument to Support Online History Learning in Jambi City High School. *AL-ISHLAH: Jurnal Pendidikan*, *14*(3). (2022). 3265–3274. https://doi.org/10.35445/alishlah.v14i3.2044

[9] Tampubolon, J., Atiqah, N., & Panjaitan, U. I. Pentingnya Konsep Dasar Matematika pada Kehidupan Sehari-Hari Dalam Masyarakat. *Program Studi Matematika Universitas Negeri Medan*, *2*(3). (2020). 1–10.

[10] Penelitian, J., & Riani, N. All Fields of Science J-LAS Efektifitas Project Based Learning (Pjbl) Sebagai Bentuk Implementasi Kurikulum Merdeka dalam Pembelajaran Matematika Analysis of Parking Characteristics on Sudirman Street, Binjai City. *AFoSJ-LAS*, *3*(3). (2023). 24–31.

Mathematical reasoning is the ability to reason logically and convey arguments honestly and persuasively.[11] This mathematical reasoning involves focusing on the mathematical aspects of an object or event, speculating about the object or event, and then drawing conclusions based on the correlation between these aspects.[12] Reasoning means transforming acquired information to conclude.[13] Collaboration skills are fostered by implementing collaborative learning in teaching and learning. Much education research involving various disciplines has found that collaborative learning is beneficial in terms of "social, psychological, academic, and assessment aspects."[14] It supports the development of higher-level thinking skills and retains information longer.[15] However, this ability often faces challenges when students have to draw conclusions from existing problems and connect them to everyday life.[16,17] Therefore, a contextual approach that links eco-mathematics (economy, culture, object of mathematics) becomes a promising solution. Economic mathematics is an approach to economic analysis where economists use mathematical symbols to express systematic propositions.[18] One way to foster students' creativity is by integrating mathematics and culture in meaningful education to cultivate students' abilities to develop cultural heritage within contemporary contexts using mathematical creative thinking skills.[19] Traditional games can be utilized as

[11] OECD. Pisa 2021 Mathematics Framework (Draft). *Angewandte Chemie International Edition, 6(11). (2018). 951–952.*, 5–24.

[12] Sholikhah, O. H., & Chamidah, A. Penalaran Matematis: Pembiasaan Soal High Order Thinking Pada Siswa Usia Sekolah Dasar Mathematic Reasoning: The Habitation of High Order Thinking Questions in Elementary School Students. *Jurnal Pendidikan Dan Kebudayaan*. (2021). 216–224.

[13] Fiantika, F. R., & Setyawati, S. P. Representation, representational transformation and spatial reasoning hierarchical in spatial thinking. *Journal of Physics: Conference Series*, *1321*(2). (2019). https://doi.org/10.1088/1742-6596/1321/2/022056

[14] Albay, E. M. Analyzing the effects of the problem solving approach to the performance and attitude of first year university students. *Social Sciences and Humanities Open*, *1*(1). (2019). 100006. https://doi.org/10.1016/j.ssaho.2019.100006

[15] Senna, L. A. G. Text production, representation of thought and discursive genders in elementary school classes. *Social Sciences and Humanities Open*, *1*(1). (2019). 100007. https://doi.org/10.1016/j.ssaho.2019.100007

[16] Vuong, Q. H., Bui, Q. K., La, V. P., Vuong, T. T., Ho, M. T., Nguyen, H. K. T., Nguyen, H. N., Nghiem, K. C. P., & Ho, M. T. Cultural evolution in Vietnam's early 20th century: A Bayesian networks analysis of Hanoi Franco-Chinese house designs. *Social Sciences and Humanities Open*, *1*(1). (2019). 100001. https://doi.org/10.1016/j.ssaho.2019.100001

[17] Rind, I. A., & Malik, A. The examination trends at the secondary and higher secondary level in Pakistan. *Social Sciences and Humanities Open*, *1*(1). (2019). 100002. https://doi.org/10.1016/j.ssaho.2019.100002

[18] Ahmad, A. M. Konsep-Konsep Dasar Matematika Dalam Ekonomi. *MEGA: Jurnal Pendidikan Matematika*, *2*(1). (2021). 77–85. https://doi.org/10.59098/mega.v2i1.428

[19] Wulandari, IG. A. Pt. A., & Puspadewi, K. adek R. Budaya dan Implikasinya Terhadap Pembelajaran Matematika yang Kreatif. *Jurnal Santiaji Pendidikan*, *6*(1). (2016). 31–37.

innovative learning media when applied and utilized appropriately, systematically, and practically. They serve as a learning tool across various subjects according to their characteristics to stimulate students' motivation and interest in achieving learning objectives.[20] Meanwhile, the object of mathematics, the direct object of mathematical learning in schools, encompasses facts, concepts, principles, and skills.[21]

This study aimed to identify the extent of mathematical reasoning ability of fifth-grade students in solving multiplication problems presented in the context of eco-mathematics (economy, culture, object of mathematics).

RESEARCH METHODS

This study aimed to identify the extent of the mathematical reasoning ability of fifth-grade students in Class V-B of Ketintang 1/409 Elementary School of Surabaya in solving multiplication problems presented in the context of eco-mathematics (economy, culture, object of mathematics). The subjects of this research were students, each of whom had high, medium, and low abilities. This study was exploratory, descriptive research with a qualitative approach. Descriptive research aims to describe the nature of something ongoing when the research is conducted and to examine the causes of a particular phenomenon.[22] Meanwhile, exploratory research aims to deepen knowledge and seek new ideas, formulate problems in detail, and decide whether further research is needed. Exploratory, descriptive research aims to describe or depict the condition of a particular phenomenon.[23]

Qualitative research is a research procedure that generates descriptive data in the form of written or spoken words from individuals and observable behaviors.[24] A qualitative approach is constructing knowledge statements based on a constructive view.[25] According to Sugiyono, qualitative research serves as a human instrument that

[20] Hariastuti, R. M., Fitriyani, H., Maf'ulah, S., Yudianto, E., & Fiantika, F. R. (2024). Ethnomathematics and Ethnosport in Traditional Games for Thematic Learning. *AIP Conference Proceedings*, *3046*(1). (2024). https://doi.org/10.1063/5.0194565

[21] Soemoenar, S., & Noornia, A. (2014). Objek Pembelajaran Matematika Sekolah. *Modul Penerapan Matematika Sekolah*. (2014). 1–40.

[22] Rais, M. *BAB III METODE PENELITIAN*. (2018). 9–25.

[23] Rais, M. *BAB III METODE PENELITIAN*. (2018). 9–25.

[24] Tazami. BAB III METODOLOGI PENELITIAN. *Jambi : Fakultas Kedokteran Dan Ilmu Kesehatan Universitas Jambi*. (2015). 34–42.

[25] Fiantika, F. R., Kusmaharti, D., & Rusminati, S. H. Deskripsi Penalaran Spasial Mahasiswa Calon Guru Bergaya Belajar Visual. *Jurnal Magister Pendidikan Matematika (JUMADIKA)*, *4*(1). (2022). 29–36. https://doi.org/10.30598/jumadikavol4iss1year2022page29-36

establishes research focus, selects data source information, conducts data collection, assesses data quality, analyzes data, interprets data, and draws conclusions from findings.[26] Indicators of Eco-mathematics are described below.

Table 1
The Eco-mathematics indicators that will be observed in solving multiplication problems

No.	Component	Indicator Observed
1	Economy	Planning, considering, and concluding simple financial decisions.
2	Culture	Planning and formulating creative and alternative thoughts when solving mathematical problems rather than following existing patterns.
		Reorganizing information from various sources or past experiences to find innovative solutions.
3	Object Of Mathematics	The ability to understand and manipulate abstract concepts such as numbers and mathematical symbols.
		The ability to express information in mathematical sentences.

Source: Personal Document

The above eco-mathematics indicators were used as the basis for the context of learning mathematics and further developed into indicators of mathematical reasoning abilities to explore students' mathematical reasoning in learning mathematics. The indicators of mathematical reasoning ability that have been developed are as follows:

Table 2
Indicators of Mathematical Reasoning Ability

No.	Component	Indicator
1	Mathematical Skill	Solving simple mathematical problems by applying basic principles of mathematics.
2	Reasoning	Identifying cause-and-effect relationships in a problem.
		Formulating arguments logically.

[26] Manurung, Y. Analisis Nilai-Nilai Patriotisme Pada Film Animasi Battle of Surabaya Sebagai Alternatif Pembuatan Media Pembelajaran Ips Mengenai Perjuangan Mempertahankan Kemerdekaan Indonesia. *Universitas Pendidikan Indonesia*. (2023). 21–26.

No.	Component	Indicator
3	Mathematical Reasoning Skill	Think or formulate a truth before conducting analysis.
		Providing corroboration to a statement that is already known to be true.
		Recognizing and solving specific patterns or correlations within problems.
4	Mathematical Questions	Explaining the benefits and application of arithmetic operations in everyday life.
		Applying and utilizing arithmetic operations in real-life situations.

Source: Personal Document

According to Sugiyono, primary data are taken directly from the research object. In contrast, secondary data are obtained indirectly, usually from a second party who processes data for the needs of others.[27] The data in this study include written tests, observations, interviews, and documentation. The observation sheets for students and teachers in this study consisted of 20 Likert scale questions ranging from 1 to 4. The Likert scale measures an individual or group's attitudes, opinions, and perceptions about social phenomena.[28]

The next step is to validate the developed instrument against two mathematics experts and also one mathematics teacher before using it to collect data. The results of the IBM SPSS Statistics 21 calculations from the three validators were as follows: r_{count} = 1.000, P_{value} < 0.0001, N = 7. From the written validation results and the SPSS calculations, there was consistency in the data with a good and valid category.

The stages in this study included (1) formulating the research instrument, (2) determining the research subjects, (3) collecting research data through written tests and interviews, and (4) analyzing the data collected from the written tests and interviews. The grouping of research subjects in this study was conducted by calculating the mean and standard deviation of the written test results, as follows.

[27] Mayssara A. Abo Hassanin Supervised, Affiifi. (2014). BAB II METODE PENELITIAN. *Paper Knowledge . Toward a Media History of Documents*, *5253004*(021). (2014). 1–15.

[28] Septiani, E. (2022). *Efektivitas Pembelajaran Penjas Berbasis Daring Terhadap Tingkat Kemandirian Belajar Siswa*. (2022).

$$\text{Nilai siswa } (\chi_i) = \frac{Skor\ Perolehan}{Skor\ Maksimum} \times 100$$

Figure 1
The Equation for Finding Student Grades
Source: Personal Document

$$\overline{\chi} = \frac{\sum_{i}^{n=1} x_i}{n}$$

Keterangan:

$\overline{x}$: nilai rata-rata siswa

x_i : nilai tengah kelas ke – i

n : jumlah siswa

Figure 2
The Equation for Finding the Mean
Source: Personal Document

$$SD = \sqrt{s\frac{2}{t}}$$

$$SD = \sqrt{\frac{\sum x_t^2 - \frac{(\sum x_t)^2}{n}}{n}}$$

Keterangan :

SD : standar deviasi

$s\frac{2}{t}$: variasi total

x_t : skor total

n : jumlah siswa

Figure 3
The Equation of Standard of Deviation
Source: Personal Document

Table 3
Intervals and Categories of Mathematical Skill Level

Interval	Category
≥ 95	High
$\leq x < 95$	Moderate
≤ 39	Low

Source: Personal Document

The methods employed in analyzing the data in this study included (a) data reduction, which involves analyzing the results of written tests based on mathematical reasoning ability; (b) data presentation, which entails presenting interview transcripts, written test results, and observations, and (c) drawing conclusions or verification, which involves seeking relationships, equations, and differences to conclude the existing issues. This study employed four tests of data validity, namely (1) credibility test, (2) dependability test, (3) confirmability test, and (4) transferability test.[29]

RESULT AND DISCUSSION

This study's results revealed the subjects' moderate mathematical reasoning ability in solving multiplication problems in the context of eco-mathematics. The following are the results of interviews and activities conducted by subject AF in solving multiplication problems in the context of eco-mathematics:

The data presentation of subject AF in solving a multiplication problem of Question 1 within the context of eco-mathematics. The transcript of the interview and activities of AF when solving a multiplication problem in the context of eco-mathematics is presented as follows.

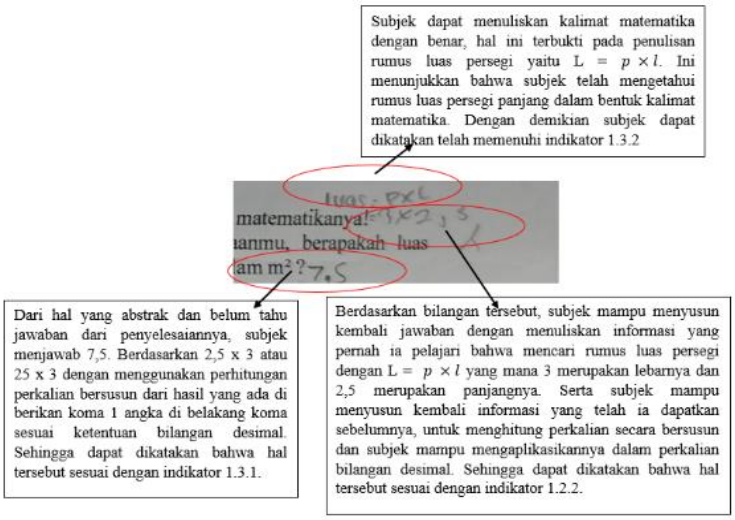

Figure 4
The Answer to Question 1 by Subject AF
Source: Personal Document

[29] Feny Rita Fiantika, Mohammad Wasil, Sri Jumiyati, Leli Honesti, Sri Wahyuni, Erland Mounw, Jonata, Imam Mashudi, Nur hasanah, Anita Maharani, Kusmayra Ambarwati, Resty Noflidaputi, Nuryami, Lu. Waris. (2022). Metodologi Penelitian Kualitatif. In Metodologi Penelitian Kualitatif. In *Rake Sarasin* (Issue Maret).

The subject correctly wrote the formula of a rectangle, that is, L = p x l, and wrote size length = 3 cm and width = 2,5 of rectangle correctly. It showed that the subject identified cause-and-effect relationships in a problem, and the length and width of the rectangular were shown. The subject can correctly substitute length = 3 cm and width = 2,5 cm into the rectangle area formula. This shows that the subject can organize arguments logically, think about the truth before carrying out analysis, and provide reinforcement for a statement that is known to be true. The subject can perform the multiplication operation correctly, namely 3x 2,5 = 7,5. This shows that the subject has good skills in mathematics because the subject solved simple mathematical problems by applying basic principles of mathematics. It refers to the ideal reasoning ability of elementary school students, which can be shown when students can solve mathematical problems according to relevant facts and information. Humans often find problems requiring them to find solutions and conclusions.

Based on subject AF's answer to question number 1, the process of mathematical reasoning ability in the context of eco-mathematics in solving a multiplication problem was obtained. AF wrote that the mathematical sentence in number one was $x, +, -,$:indicating that the mathematical sentence was x and $l = pxl$Was the formula for calculating the area of a square, where l represented area, p represented length, (x) symbolized a multiplication, and the other lRepresented width. So, $l = pxl$ alternatively, 2.5 x 3 was the equation. In this case, subject AF could calculate using consecutive multiplication as he usually does when calculating multiplication. However, this time, he had to add a decimal point to the result later.

Next, the researcher interviewed the subject AF. The results of this interview were used to triangulate the data from AF's written test. The following is an excerpt from the interview between AF and the researcher.

P1: Did you understand the meaning of this question?

AF1: I did. The meaning of question 1a is that we are asked to write down the mathematical sentence and formulate the solution. Meanwhile, question 1b asks us to calculate the arithmetical operation for the mathematical sentence according to the question.

P1: How did you write the solution to question 1 when you have not detailed the mathematical sentences?

Do you even know what a mathematical sentence is?

AF1 I do not know a mathematical sentence, so I guess the answer to the problem is multiplication (x) without writing the formula; I did not hear what you said.

P1: All right then.

Based on the interview excerpt above, AF could write down the mathematical sentence based on the formula of the area of a square that he learned before and calculate decimal multiplication using the usual multiplication method.

The data presentation of subject AF in solving a multiplication problem of Question 2 within the context of eco-mathematics. The transcript of the interview and activities of AF when solving a multiplication problem in the context of eco-mathematics is presented as follows.

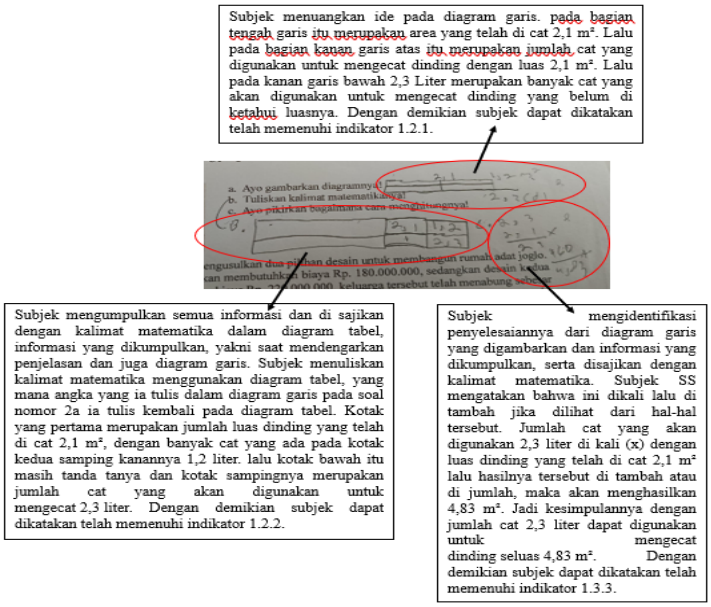

Figure 5
The Answer to Question 2 by Subject AF
Source: Personal Document

Based on subject AF's answer to question number 2, the process of mathematical reasoning ability in the context of eco-mathematics in solving a multiplication problem was obtained. AF depicted a line diagram in which the central portion of the line represented an area that has been painted for 2.1 m², while the upper right portion of the line represented the amount of paint used to paint a wall measuring 2.1 m². On the lower right side of the line, 2.3 liters represented the amount of paint that will be used to paint a wall of an unknown area. AF conducted the calculation by identifying the solution from

the line diagram he had drawn and the available information and presented it in mathematical terms within the line diagram.

Next, the researcher interviewed the subject AF. The results of this interview were used to triangulate the data from AF's written test. The following is an excerpt of the interview between AF and the researcher.

P2: Did you understand the meaning of this question?

AF2: Yes, I did; the meaning of question 2a is that we are asked to convey our ideas related to the problem that lies within the question; the drawing of the line diagram was to obtain an insight into how to solve it. In question 2b, we are asked to write down the mathematical sentence by putting it into a table, and in question 2c, we are asked to write how to solve it from the description we have made.

P2: How did you express the ideas you got from question 2a into a line diagram? Moreover, how did you solve it?

AF2: Here is how it goes. First, I understand the problem, then write down the numbers or the ones I know. Then, I draw the line diagram and input those values. To write the mathematical sentences, I created another line diagram to visualize solving it, with us arranging the numbers, and I also captured what you explained earlier.

So, the solution was to multiply (x) between the initially painted area and the weight of the new paint.

P2: All right then.

Based on the interview excerpt above, AF could represent his understanding in a line diagram and present it again using a mathematical sentence.

The data presentation of subject AF in solving a multiplication problem of Question 3 within the context of eco-mathematics. The transcript of the interview and activities of AF when solving a multiplication problem in the context of eco-mathematics is presented as follows.

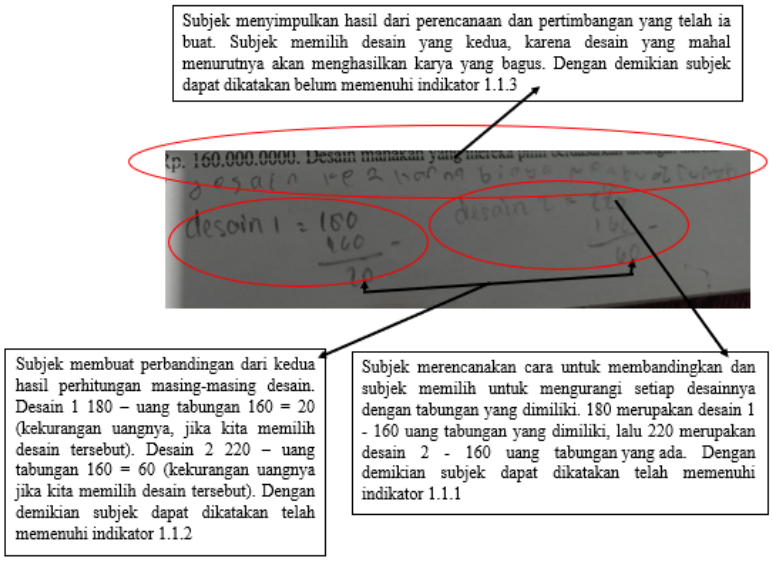

Figure 6
The Answer to Question 3 by Subject AF
Source: Personal Document

Based on subject AF's answer to question number 3, the process of mathematical reasoning ability in the context of eco-mathematics in solving a multiplication problem was obtained. AF compared two designs using the money from his savings by subtracting all designs from his savings. However, when concluding, AF mistakenly took the wrong answer, resulting in the requested answer not being achieved or being less accurate and correct.

Next, the researcher interviewed the subject AF. The results of this interview were used to triangulate the data from AF's written test. The following is an excerpt of the interview between AF and the researcher.

P3: Did you understand the meaning of this question?

AF3: Yes, I did; the meaning of question 3 is to compare the existing savings, which design can be selected in that order.

P3: What was your comparison method before deciding on the second design?

AF3: I chose that design because I thought the expensive one was the proper one.

P3: All right then.

Based on the interview excerpt above, AF can only plan and consider the financial decision from the two existing designs. This is consistent with Setiawan's theory, which argues that reasoning is a thinking procedure to find conclusions and produce new knowledge from several previously proven and known statements, as well as the theory

which argues that mathematical reasoning ability is a person's capability to think logically in concluding solving problems in the process of learning mathematics. These theories have been proven from written tests of mathematical reasoning ability, interviews, and observations.

Given the above, several similarities in subject AF's mathematical reasoning ability have been obtained in solving multiplication problems in eco-mathematics (economy, culture, object of mathematics).

Table 4
Characteristics of Subject AF in Completing Multiplication Questions in the Context of Eco-Mathematics

Achievement Indicator	Subject AF
Mathematical Skill Component	The research subjects could implement the process of solving arithmetic operations in decimal multiplication material.
Reasoning Component	The research subjects could determine the cause-effect relationship of two different designs, but not by reiterating the conclusions obtained based on the final results.
The Component of Mathematical Reasoning Ability	The research subjects were able to analyze solutions from existing patterns, considering knowledge as evidence of answers.
Math Problem Component	The research subjects were able to explain the benefits of arithmetic operations in the application of decimal multiplication material.

Source: Personal Document

The characteristics presented in Table 4 correspond to the analysis results from written tests, interviews, and observations. These characteristics portray students with moderate abilities, with the hope that teachers can assist students according to their difficulty level.

CONCLUSION

From the discussion presented by the researchers, it can be concluded that the mathematical reasoning abilities of moderately skilled students in solving multiplication problems in the context of eco-mathematics are as follows during the learning process,

the students actively responded to all given questions, but their answers were somewhat inaccurate, and they could not explain the solution method to their peers. The students can explore their reasoning abilities by discovering new things around them. The students received grades ranging from 39 to 95, categorizing them as students with moderate proficiency.

Thus, the study objective has been addressed, which was to describe or provide an overview to teachers regarding the characteristics of the moderately categorized subjects, thus helping to facilitate teachers in determining models, strategies, approaches, methods, techniques, tactics, and learning media. This study can still be developed and used as material for further researchers, hoping that subsequent researchers can categorize and describe mathematical reasoning in eco-mathematics. Thus providing new theories of learning.

ACKNOWLEDGMENT

We want to express our gratitude to the following that Universitas PGRI Adi Buana of Surabaya, Department of Mathematics Education, Universitas PGRI Adi Buana Surabaya, Department of Elementary Teacher Education, Universitas PGRI Adu Buana Surabaya, Ketintang I Elementary School of Surabaya, Margorejo I Elementary School of Surabaya, Kebonagung I Elementary School of Sukodono. That has supported the course of this study.

DECLARATION OF CONFLICTING INTERESTS

Universitas PGRI Adi Buana of Surabaya funded this study. Before being used for the study, the eco-mathematics-based learning instruments were piloted at Kebonagung I Elementary School of Sukodono, Ketintang I Elementary School of Surabaya, and Margorejo I Elementary School of Surabaya. Therefore, the schools mentioned above can use the research results as developed learning instruments.

FUNDING

Universitas PGRI Adi Buana of Surabaya, Adi Buana's Internal Research Grant.

ORCID iD

Sunyoto Hadi Prayitno -

Feny Rita Fiantika https://orcid.org/0000-0001-7632-5563

Dwimartin Bella Hapsari -

REFERENCES

Ahmad, A. M. (2021). Konsep-Konsep Dasar Matematika Dalam Ekonomi. *MEGA: Jurnal Pendidikan Matematika*, *2*(1), 77–85. https://doi.org/10.59098/mega.v2i1.428

Albay, E. M. (2019). Analyzing the effects of the problem-solving approach on the performance and attitude of first-year university students. *Social Sciences and Humanities Open*, *1*(1), 100006. https://doi.org/10.1016/j.ssaho.2019.100006

Cahyadi, W., Aswita, D., & Ningsih, T. Z. (2022). Analysis of The Development of Non-Cognitive Assessment Instrument to Support Online History Learning in Jambi City High School. *AL-ISHLAH: Jurnal Pendidikan*, *14*(3), 3265–3274. https://doi.org/10.35445/alishlah.v14i3.2044

Ezekoka, & Gertrude, K. (2015). Maximizing the Effects of Collaborative Learning through ICT. *Procedia - Social and Behavioral Sciences*, *176*, 1005–1011. https://doi.org/10.1016/j.sbspro.2015.01.571

Feny Rita Fiantika, Mohammad Wasil, Sri Jumiyati, Leli Honesti, Sri Wahyuni, Erland Mounw, Jonata, Imam Mashudi, Nur hasanah, Anita Maharani, Kusmayra Ambarwati, Resty Noflidaputi, Nuryami, Lu. Waris. (2022). Metodologi Penelitian Kualitatif. In Metodologi Penelitian Kualitatif. In *Rake Sarasin* (Issue Maret).

Fianingrum, F., Novaliyosi, N., & Nindiasari, H. (2023). Kurikulum Merdeka pada Pembelajaran Matematika. *Edukatif : Jurnal Ilmu Pendidikan*, *5*(1), 132–137. https://doi.org/10.31004/edukatif.v5i1.4507

Fiantika, F. R., Kusmaharti, D., & Rusminati, S. H. (2022). Deskripsi Penalaran Spasial Mahasiswa Calon Guru Bergaya Belajar Visual. *Jurnal Magister Pendidikan Matematika (JUMADIKA)*, *4*(1), 29–36. https://doi.org/10.30598/jumadikavol4iss1year2022page29-36

Fiantika, F. R., & Setyawati, S. P. (2019). Representation, representational transformation, and spatial reasoning are hierarchical in spatial thinking. *Journal of Physics: Conference Series*, *1321*(2). https://doi.org/10.1088/1742-6596/1321/2/022056

Hariastuti, R. M., Fitriyani, H., Maf'ulah, S., Yudianto, E., & Fiantika, F. R. (2024). Ethnomathematics and Ethnosport in Traditional Games for Thematic Learning. *AIP Conference Proceedings*, *3046*(1). https://doi.org/10.1063/5.0194565

James W, Elston D, T. J. et al. (2016). Bab II Kajian Pustaka. *Universitas Kristen, Satya Wacana*, 7–23.

Karso, & Dkk. (2009). Pendidikan Matematika. *Pendidikan Matematika*, 39–40.

Laal, M., & Ghodsi, S. M. (2012). Benefits of collaborative learning. *Procedia - Social and Behavioral Sciences*, *31*(December 2012), 486–490. https://doi.org/10.1016/j.sbspro.2011.12.091

Mandasari, N., & Rosalina, E. (2021). Analisis Kesulitan Siswa dalam Menyelesaikan Soal Operasi Bilangan Bulat di Sekolah Dasar. *Jurnal Basicedu*, *5*(3), 1139–1148.

Manurung, Y. (2023). Analisis Nilai-Nilai Patriotisme Pada Film Animasi Battle of Surabaya Sebagai Alternatif Pembuatan Media Pembelajaran Ips Mengenai Perjuangan Mempertahankan Kemerdekaan Indonesia. *Universitas Pendidikan Indonesia*, 21–26.

Mayssara A. Abo Hassanin Supervised, Affiifi. (2014). BAB II METODE PENELITIAN. *Paper Knowledge. Toward a Media History of Documents*, *5253004*(021), 1–15.

OECD. (2018). Pisa 2021 Mathematics Framework (Draft). *Angewandte Chemie International Edition, 6(11), 951–952.*, 5–24.

Penelitian, J., & Riani, N. (2023). All Fields of Science J-LAS Efektifitas Project Based Learning (Pjbl) Sebagai Bentuk Implementasi Kurikulum Merdeka dalam Pembelajaran Matematika Analysis of Parking Characteristics on Sudirman Street, Binjai City. *AFoSJ-LAS*, *3*(3), 24–31.

Prayitno, S. H., & Utami, H. P. D. (2021). Differences of student mathematics learning results with discovery learning and problem based learning from emotional intelligence. *Math Didactic: Jurnal Pendidikan Matematika*, *7*(2), 159–169. https://doi.org/10.33654/math.v7i2.1238

Rais, M. (2018). *BAB III METODE PENELITIAN*. 9–25.

Rind, I. A., & Malik, A. (2019). The examination trends at the secondary and higher secondary level in Pakistan. *Social Sciences and Humanities Open*, *1*(1), 100002. https://doi.org/10.1016/j.ssaho.2019.100002

Saini, D. K., & Salim Al-Mamri, M. R. (2019). Investigation of Technological Tools used in Education System in Oman. *Social Sciences and Humanities Open*, *1*(1), 100003. https://doi.org/10.1016/j.ssaho.2019.100003

Saleh, M., Charitas, R., Prahmana, I., & Isa, M. (2018). Improving the Reasoning Ability of Elementary School Student Through the Indonesian Realistic. *Journal on Mathematics Education*, *9*(1), 41–54. https://ejournal.unsri.ac.id/index.php/jme/article/view/5049

Senna, L. A. G. (2019). Text production, representation of thought and discursive genders in elementary school classes. *Social Sciences and Humanities Open*, *1*(1), 100007. https://doi.org/10.1016/j.ssaho.2019.100007

Septiani, E. (2022). *Efektivitas Pembelajaran Penjas Berbasis Daring Terhadap Tingkat Kemandirian Belajar Siswa*.

Sholikhah, O. H., & Chamidah, A. (2021). Penalaran Matematis: Pembiasaan Soal High Order Thinking Pada Siswa Usia Sekolah Dasar Mathematic Reasoning: The Habitation of High Order Thinking Questions in Elementary School Students. *Jurnal Pendidikan Dan Kebudayaan*, 216–224.

Soemoenar, S., & Noornia, A. (2014). Objek Pembelajaran Matematika Sekolah. *Modul Penerapan Matematika Sekolah*, 1–40.

Tampubolon, J., Atiqah, N., & Panjaitan, U. I. (2020). Pentingnya Konsep Dasar Matematika pada Kehidupan Sehari-Hari Dalam Masyarakat. *Program Studi Matematika Universitas Negeri Medan*, *2*(3), 1–10.

Tazami. (2015). BAB III METODOLOGI PENELITIAN. *Jambi : Fakultas Kedokteran Dan Ilmu Kesehatan Universitas Jambi;*, 34–42.

Vuong, Q. H., Bui, Q. K., La, V. P., Vuong, T. T., Ho, M. T., Nguyen, H. K. T., Nguyen, H. N., Nghiem, K. C. P., & Ho, M. T. (2019). Cultural evolution in Vietnam's early 20th century: A Bayesian networks analysis of Hanoi Franco-Chinese house designs. *Social Sciences and Humanities Open*, *1*(1), 100001. https://doi.org/10.1016/j.ssaho.2019.100001

Wulandari, IG. A. Pt. A., & Puspadewi, K. adek R. (2016). Budaya dan Implikasinya Terhadap Pembelajaran Matematika yang Kreatif. *Jurnal Santiaji Pendidikan*, *6*(1), 31–37.