JMPM: Jurnal Matematika dan Pendidikan Matematika
10 (2), 178-186
https://www.journal.unipdu.ac.id/index.php/jmpm

Print-ISSN : 2502-986X
Online-ISSN : 2502-9878
JMPM
Jurnal Matematika dan Pendidikan Matematika
Journals of Mathematics and Mathematics Education

Pre-Service Elementary Teachers' Difficulties in Solving Mathematical Problems Containing Contradictory Information

Fida Rahmantika Hadi[1]*, Ferri Ardianzah
[1]Pendidikan Guru Sekolah Dasar, Universitas PGRI Madiun – Jl. Setia Budi No.85: Madiun, Jawa Timur, Indonesia
[2]Pendidikan Agama Islam, STAI Maarif Magetan – Jl Raya Maospati-Ngawi, Kec. Karangrejo, Magetan, Jawa Timur, Indonesia
*Corresponding author's email: fida@unipma.ac.id

Received: 29 August 2025 | Revised: 13 October 2025
Accepted: 14 October 2024 | Published: 30 October 2024

Abstract

This study investigates the difficulties experienced by pre-service elementary teachers in solving mathematical problems containing contradictory information. Such problems require reflective reasoning and verification beyond procedural fluency. Using a qualitative descriptive case study, 33 fifth-semester students from the Elementary Teacher Education program at Universitas PGRI Madiun participated. Data were collected through problem-solving tests, think-aloud protocols, and interviews, and analyzed through reduction, display, and conclusion drawing with triangulation. The findings revealed three interrelated types of difficulties: cognitive, metacognitive, and affective. Cognitive difficulties dominated as students relied on formulas without validating data accuracy; metacognitive difficulties appeared in poor regulation and limited strategy adjustment; while affective difficulties involved anxiety and low confidence. The study highlights that students' challenges extend beyond conceptual understanding and suggests integrating contradictory-information tasks and metacognitive scaffolding to promote reflection and resilience in teacher education.

Keywords: *contradictory information; mathematical problem solving; pre-service teachers*

How to cite: Hadi, F. R. (2025). Pre-service elementary teachers' difficulties in solving mathematical problems containing contradictory information. *JMPM: Jurnal Matematika dan Pendidikan Matematika*, *10*(2), 178-186. https://dx.doi.org/10.26594/jmpm.v10i2.5936.

INTRODUCTION

Education in the 21st century emphasizes not only the mastery of content knowledge but also the development of higher order thinking skills, such as problem solving, critical thinking, collaboration, and creativity (Alahmad et al., 2021; Lai, 2011). Among these competencies, mathematical problem solving plays a central role in fostering logical reasoning, decision making, and adaptability, which are essential for future teachers. In mathematics education, problem solving requires learners to interpret information, identify relevant data, design solution strategies, monitor their reasoning process, and verify the accuracy of results (Schoenfeld, 2016). These steps become more complex when the problems involve contradictory information that appears inconsistent within the task.

Contradictory information refers to data or statements that conflict with each other in a problem context. Such problems mirror authentic situations in daily life and professional practice, where individuals are often confronted with uncertainty, incomplete evidence, or misleading information (Kurniati et al., 2019). Unlike routine textbook problems, contradictory information problems cannot be solved simply by recalling formulas or applying algorithms (Sidenvall et al., 2015). Instead, they demand deeper inquiry, critical verification, and analytical reasoning. For pre-service teachers, especially those preparing to teach mathematics at the elementary level, engagement with contradictory problems is important because it helps them build resilience when dealing with uncertainty, enhances their inquisitiveness, and equips them to guide their future students in developing critical thinking dispositions (Demiray & Işıksal Bostan, 2017; Doruk, 2019; Stouraitis et al., 2017)

In the Indonesian context, however, mathematics instruction in teacher education programs often remains dominated by procedural approaches that emphasize formula memorization and step-by-step solutions. Many pre-service elementary teachers rely heavily on formula-based strategies without evaluating the validity of the given data, assuming all information in a problem is always consistent and correct (Hadi et al., 2025). Consequently, when confronted with contradictory or inconsistent data, they struggle to identify errors, verify their reasoning, and maintain logical coherence in problem-solving. This limitation reflects a broader issue in mathematics education where conceptual understanding and higher-order thinking skills are often underemphasized compared to procedural fluency (Csanadi et al., 2021; Kim et al., 2014).

Previous research has highlighted the role of inquisitiveness, defined as the disposition to seek deeper information, question assumptions, and verify accuracy, in supporting problem solving and learning from complex texts (Martin, 2023; Peterson & Cohen, 2019). Inquisitive learners are more likely to notice inconsistencies, engage in reflective reasoning, and persist in resolving problems despite initial difficulties (Du Plessis, 2020). Recent studies also provide empirical support: students' inquisitive questions predict their comprehension of mathematical texts (Umah et al., 2023), while bibliometric analysis shows a growing trend of research on inquisitiveness in education over the last decade (Hadi & Mulyadi, 2025). However, studies focusing specifically on how pre-service elementary teachers handle contradictory mathematical information remain scarce, particularly in the Indonesian context. Most prior studies have examined general problem-solving strategies, critical thinking skills, or epistemic beliefs, but few provide a detailed account of the specific cognitive, metacognitive, and affective difficulties students face when confronted with contradictory problems.

The novelty of this study lies in its integrated examination of cognitive, metacognitive, and affective dimensions of difficulty when pre-service elementary teachers solve mathematical problems containing contradictory information, a type of problem rarely explored empirically. Unlike previous works that mainly address procedural or conceptual errors, this study provides a multidimensional analysis that connects students' inquisitiveness with their problem-solving behavior in contradictory contexts. Furthermore, it situates these findings within the Indonesian teacher education landscape, offering a culturally relevant perspective that has been largely absent in prior literature.

Therefore, this study seeks to address this research gap by describing the difficulties experienced by pre-service elementary school teachers in solving mathematical problems with contradictory information. Specifically, the study explores cognitive, metacognitive, and affective challenges as revealed through problem-solving tests, think-aloud protocols, and interviews. The findings are expected to contribute both theoretically and practically: theoretically, by enriching the literature on problem solving and inquisitiveness in mathematics education; and practically, by providing insights for mathematics lecturers in designing learning strategies that foster resilience, reflection, and critical evaluation among teacher education students.

METHODS

This research employed a qualitative descriptive approach with a case study design. The case study method was selected because it enables an in-depth and contextual understanding of a specific group's experiences when confronted with complex, real-world problems that cannot be fully captured through quantitative measurement. In this study, the case design was appropriate to examine how pre-service teachers individually and collectively deal with contradictory mathematical information, uncovering not only the observable problem-solving processes but also the underlying cognitive, metacognitive, and affective factors influencing their reasoning. The participants consisted of 33 fifth-semester students enrolled in one class of the Elementary Teacher Education program at Universitas PGRI Madiun. This group was selected purposively because they had completed foundational mathematics courses and were considered capable of attempting non-routine mathematical problems.

Data were collected using problem-solving tests, think-aloud protocols, and semi-structured interviews. The test was administered individually under examination conditions. During the think-aloud sessions, six students were asked to solve the problems while verbalizing their reasoning; these sessions were audio-recorded. Subsequently, ten students representing different response patterns were interviewed to elaborate on the challenges they encountered. Data were analyzed qualitatively through three stages: (1) Data Reduction, by identifying and coding students' difficulties from tests, think-aloud transcripts, and interviews; (2) Data Display, by organizing the findings into cognitive, metacognitive, and affective categories; and (3) Conclusion Drawing, by interpreting emerging patterns to construct a holistic understanding of the observed difficulties. To ensure validity, methodological triangulation involving test results, think-aloud data, and interviews was implemented.

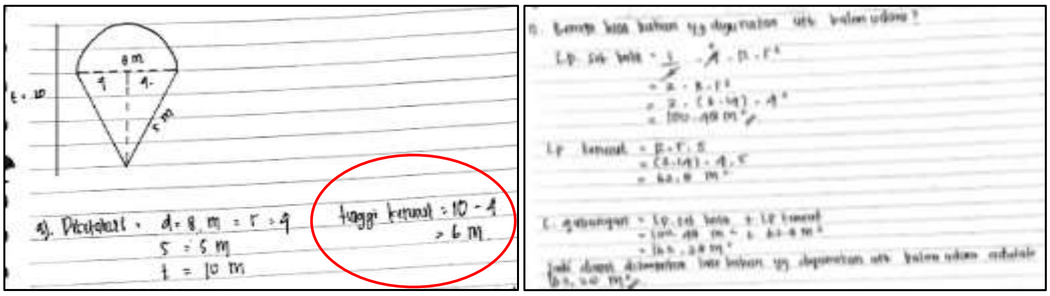
RESULTS AND DISCUSSION

The analysis revealed that prospective elementary school teachers experienced three major types of difficulties when solving mathematical problems containing contradictory information: cognitive, metacognitive, and affective. These categories provide insight into the ways students process information, regulate their reasoning, and respond emotionally to challenges.

Cognitive Difficulties

To illustrate the nature of students' cognitive difficulties, an example of student work is presented in Figure 1. Figure 1 illustrates the work of Student S-1, who calculated the height of the cone by subtracting the radius of the hemisphere from the total height of the solid. This response demonstrates a procedural orientation in which the student relied on direct numerical operations without verifying whether the reasoning was mathematically valid. Instead of applying the Pythagorean theorem to determine the cone height accurately, the student assumed that the difference between the total height and the hemisphere's radius represented the cone's height.

https://dx.doi.org/10.26594/jmpm.v10i2.5936



(a) **(b)**

Figure 1. Student S-1's solution illustrating cognitive difficulty

English translation:

"Given: diameter = 8 m → radius = 4
slant height = 5 m
total height = 10 m
Height of the cone = 10 – 4 = 6 m."

(a)

What is the total surface area of the material used to make the hot air balloon?
Solution: Surface area of the half sphere:
Conclusion: Therefore, the total surface area of the material required to make the hot air balloon is 163.28 m².

(b)

Other students showed similar patterns. For example, several used the stated side length directly as the triangle's height, even when it contradicted the Pythagorean relationship. Interviews revealed that they tended to assume all numbers in the problem must be correct:

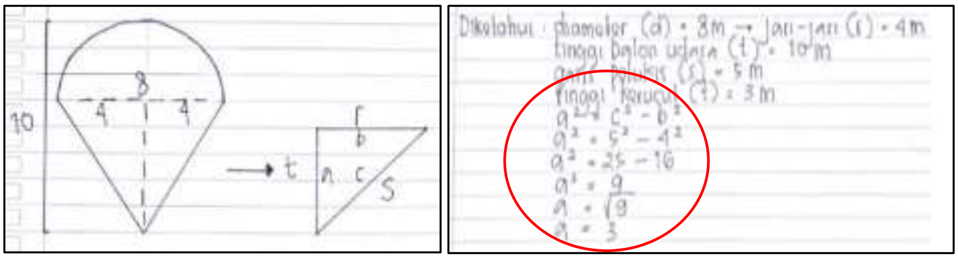
> *"I thought the number in the problem must be correct, so I just used it without checking."*
> *"If the problem already gave numbers, I just followed them because I believed they were always right."*

This category reflects cognitive difficulties, namely reliance on procedural strategies, failure to detect inconsistencies, and unquestioned acceptance of given information. The results indicate that the majority of students relied on direct procedural calculations without verifying whether such reasoning was mathematically valid. This finding is consistent with (Sudiarta & Nugraha, 2019) who reported that Indonesian students tend to emphasize procedural fluency rather than conceptual understanding. Similarly, Schoenfeld (2016) emphasized that effective mathematical problem solving requires not only the possession of formulas but also the ability to evaluate their appropriateness. Moreover, Karbowniczek, (2021) argued that inquisitiveness is crucial to push learners beyond formulaic reliance toward deeper reasoning. Teacher education programs should integrate contradictory information tasks to encourage students to verify assumptions and evaluate data validity, thereby fostering inquisitiveness and conceptual understanding.

Metacognitive Difficulties

Beyond cognitive errors, some students displayed awareness of inconsistencies but were unable to resolve them, reflecting metacognitive difficulties.

https://dx.doi.org/10.26594/jmpm.v10i2.5936



(a) **(b)**

Figure 2. Student S-2's solution illustrating metacognitive difficulty

English translation:

The figure shows the shape of a hot air balloon consisting of a hemisphere on top and a cone beneath it. The diameter of the hemisphere is 8 meters, so the radius is 4 meters. The total height of the balloon is 10 meters. To determine the height of the cone, a right triangle is drawn

(a)

Given:Diameter of the balloon (d) = 8 m →
Radius (r) = 4 m
Height of the hot air balloon (t) = 10 m
Slant height (s) = 5 m
Height of the cone (h) = 3 m
To find the height of the cone, the Pythagorean theorem is used:
a=3

(b)

Figure 2 shows the work of a student who initially tried to check the cone's height using the Pythagorean theorem, but the result did not match the given values. Although the student realized the inconsistency, they chose to ignore it and proceed with the initial calculation (h = 6).

> *"I realized the numbers didn't match, but I didn't know what else to do, so I just continued."*
> *"I was unsure if my answer was correct, but I thought it was better to finish quickly than to check again."*

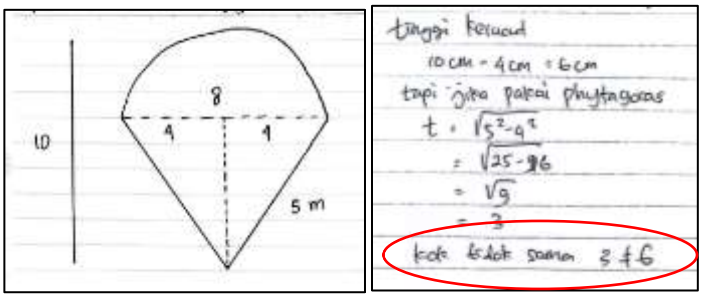
This response exemplifies metacognitive difficulties: students were aware of inconsistencies but failed to regulate or adapt their strategies. They showed weak monitoring and evaluation skills, leading to unresolved contradictions.

This aligns with Kramarski & Mevarech (2003), who noted that effective problem solvers engage in continuous monitoring and evaluation of their strategies. Similarly, Veenman et al. (2006) stressed that metacognitive control is central to problem solving; when weak, students often persist with incorrect strategies despite recognizing contradictions. In line with inquisitiveness should be nurtured alongside reflective engagement so that learners can regulate their strategies effectively. Teacher education should provide explicit scaffolding for metacognitive practices, such as self-checking prompts and guided reflection, so that students can strengthen their monitoring and evaluation skills.

Affective Difficulties

In addition to cognitive and metacognitive challenges, emotional factors also played a significant role in students' problem-solving performance.

https://dx.doi.org/10.26594/jmpm.v10i2.5936



(a) (b)

Figure 3. Student S-3's solution illustrating affective difficulty

English translation:

(a)	(b)
The figure shows the shape of a hot air balloon composed of two parts: a hemisphere at the top and a cone at the bottom. The diameter of the hemisphere is 8 meters, giving a radius of 4 meters. The total height of the balloon is 10 meters, while the slant height of the cone is 5 meters.	*Height of the cone* *10 cm−4cm=6cm* *However, using the Pythagorean theorem: t=3* *Hence, the results are not the same: 3≠6*

Figure 3 demonstrates the work of a student who stopped solving the problem after realizing that the numbers were inconsistent. Rather than continuing or attempting another strategy, the student abandoned the calculation or wrote an estimated answer without certainty.

> *"When I saw the numbers didn't match, I became nervous and stopped working on the problem."*
> *"I felt frustrated because I thought I had followed the steps correctly, but the results didn't make sense."*

Such responses represent affective difficulties, where emotional reactions such as anxiety, nervousness, and lack of confidence hinder persistence and reasoning. This often resulted in incomplete answers or random guesses.

These findings confirm Pekrun et al. (2011), who showed that epistemic emotions such as confusion and frustration significantly shape problem-solving processes. While confusion can sometimes stimulate inquiry, in this study, it frequently led to avoidance and premature abandonment. Denovan et al., (2020) similarly emphasized that negative emotions reduce persistence, while positive emotions foster deeper engagement. Teacher educators should design supportive classroom environments where contradictions are presented as opportunities for inquiry rather than sources of failure. This reframing can reduce affective barriers and encourage students to persevere.

To synthesize the findings, Table 1 presents examples of student responses categorized into cognitive, metacognitive, and affective difficulties.

Table 1. Examples of Student Difficulties in Solving Contradictory Information Problems

Category of Difficulties	Example of Student Answer	Interview Excerpt	Analysis
Cognitive	*h = 10 – 4 = 6; Surface Area = πrs + 2πr² …*	*"I just used the numbers as given."* (S-7)	Reliance on formula, failure to detect contradiction, and unquestioned acceptance of data.
Metacognitive	*Checked with Pythagoras (√(5² − 4²) = 3 ≠ 6), but still continued with 6*	*"I knew it was wrong, but I didn't know how to fix it."* (S-12)	Awareness of inconsistency, but a lack of regulation, weak monitoring, and evaluation.
Affective	*Stopped mid-solution, wrote estimate: ~150 m²*	*"I got nervous when the numbers didn't match, so I gave up."* (S-5)	Anxiety and frustration lead to incomplete answers or guessing.

The combination of cognitive, metacognitive, and affective difficulties demonstrates that students' struggles are not confined to conceptual misconceptions but also involve deficiencies in monitoring and emotional regulation. This confirms Ennis (2018), who emphasized that higher-order problem solving integrates cognitive, metacognitive, and affective domains. These findings reinforce the results of Hadi & Maharani (2022), who emphasized the importance of cultivating inquisitiveness among prospective teachers as a means to strengthen both cognitive and metacognitive engagement in problem solving. Teacher education programs should therefore design learning experiences that combine contradictory information problems with explicit reflection prompts and supportive classroom environments. Such practices can nurture inquisitiveness and resilience, enabling pre-service teachers to model effective problem-solving behaviors in their future classrooms.

CONCLUSION AND SUGGESTIONS

The findings of this study reveal that pre-service elementary school teachers experience three categories of difficulties when solving mathematical problems with contradictory information: cognitive, metacognitive, and affective. Cognitive difficulties were the most dominant, as many students relied heavily on procedural strategies without questioning the accuracy of given information. Metacognitive difficulties appeared when some students recognized inconsistencies but failed to regulate or adjust their strategies, showing weaknesses in monitoring and evaluation. Affective difficulties were characterized by emotional reactions such as anxiety, frustration, and loss of confidence, which often caused students to stop working on the problem or provide incomplete answers. Taken together, these findings emphasize that problem-solving challenges among pre-service teachers are not limited to conceptual misconceptions but also involve deficiencies in metacognitive control and affective resilience.

Based on these findings, it is suggested that teacher education programs integrate contradictory information problems into mathematics instruction as a means of fostering verification, reflection, and resilience. Mathematics lecturers are encouraged to provide explicit metacognitive training, such as think-aloud activities and reflective questioning, so that students learn to monitor and evaluate their strategies more effectively. Furthermore, creating a supportive classroom environment is important to reduce negative emotions and to frame contradictions as opportunities for inquiry rather than as obstacles. Future research should continue to explore instructional interventions that can strengthen inquisitiveness, resilience, and critical reasoning in pre-service teachers, as well as investigate the long-term development of these dispositions across different educational contexts.

REFERENCES

Alahmad, A., Stamenkovska, T., & Gyori, J. (2021). Preparing Pre-service Teachers for 21st Century Skills Education: A Teacher Education Model. *GiLE Journal of Skills Development*, *1*(1), 67–86. https://doi.org/https://doi.org/10.52398/gjsd.2021.v1.i1.pp67-86

Csanadi, A., Kollar, I., & Fischer, F. (2021). Pre-service teachers' evidence-based reasoning during pedagogical problem-solving: better together? *European Journal of Psychology of Education*, *36*(1), 147–168. https://doi.org/10.1007/s10212-020-00467-4

Demiray, E., & Işıksal Bostan, M. (2017). Pre-service middle school mathematics teachers' evaluations of discussions: the case of proof by contradiction. *Mathematics Education Research Journal*, *29*(1), 1–23. https://doi.org/10.1007/s13394-016-0182-2

Denovan, A., Dagnall, N., Macaskill, A., & Papageorgiou, K. (2020). Future time perspective, positive emotions and student engagement: a longitudinal study. *Studies in Higher Education*, *45*(7), 1533–1546. https://doi.org/10.1080/03075079.2019.1616168

Doruk, M. (2019). Preservice mathematics teachers' determination skills of proof techniques: The case of integers. *International Journal of Education in Mathematics Science and Technology*, *7*(4), 335–348. https://www.ijemst.net/index.php/ijemst/article/view/729

Ennis, R. H. (2018). Critical Thinking Across the Curriculum: A Vision. *Topoi*, *37*(1), 165–184. https://doi.org/10.1007/s11245-016-9401-4

Hadi, F. R., & Maharani, S. (2022). Analysis of Prospective Elementary School Teachers' Inquisitiveness in Solving Mathematics Problems. *QALAMUNA: Jurnal Pendidikan, Sosial, Dan Agama*, *14*(2), 995–1010. https://doi.org/10.37680/qalamuna.v14i2.3854

Hadi, F. R., & Mulyadi, M. (2025). Exploring the Evolution of Inquisitiveness in Education: A Bibliometric Perspective Over the Last Decade. *EDUKASIA: Jurnal Pendidikan Dan Pembelajaran*, *6*(1), 373–384. https://doi.org/10.62775/edukasia.v6i1.1417

Hadi, F. R., Nusantara, T., Mahanal, S., & Kuswandi, D. (2025). Exploring pre-service teachers' inquisitiveness in contradictory mathematics problems. *Edelweiss Applied Science and Technology*, *9*(4), 2048–2056. https://doi.org/10.55214/25768484.v9i4.6473

Karbowniczek, J. (2021). Philosophical Aspects of Developing Children'S Inquisitiveness in Early School Education-Inspiration for Dialogue, Asking Questions, and Critical Thinking. *Colloquium*, *2*(42), 39–56. http://doi.org/10.34813/13coll2021

Kim, M., Anthony, R., & Blades, D. (2014). Decision Making Through Dialogue: a Case Study of Analyzing Preservice Teachers' Argumentation on Socioscientific Issues. *Research in Science Education*, *44*(6), 903–926. https://doi.org/10.1007/s11165-014-9407-0

Kramarski, B., & Mevarech, Z. R. (2003). Enhancing mathematical reasoning in the classroom: The effects of cooperative learning and metacognitive training. *American Educational Research Journal*, *40*(1), 281–310. https://doi.org/10.3102/00028312040001281

Kurniati, D., Purwanto, As'ari, A. R., Dwiyana, Subanji, & Susanto, H. (2019). Development and validity of problems with contradictory information and no specified universal set to measure the truth-seeking of pre-service mathematics teachers. *TEM Journal*, *8*(2), 545–553. https://doi.org/10.18421/TEM82-30

Lai, E. R. (2011). Critical Thinking: A Literature Review. *Pearson's Research Reports*, *35*(3), 219–225. https://doi.org/10.1046/j.1537-2995.1995.35395184278.x

Martin, A. J. (2023). Integrating Motivation and Instruction: Towards a Unified Approach in Educational Psychology. In *Educational Psychology Review* (Vol. 35, Issue 2). Springer US. https://doi.org/10.1007/s10648-023-09774-w

Pekrun, R., Goetz, T., Frenzel, A. C., Barchfeld, P., & Perry, R. P. (2011). Measuring emotions in students' learning and performance: The Achievement Emotions Questionnaire (AEQ). *Contemporary Educational Psychology*, *36*(1), 36–48. https://doi.org/10.1016/j.cedpsych.2010.10.002

Peterson, E. G., & Cohen, J. (2019). A Case for Domain-Specific Curiosity in Mathematics. *Educational Psychology Review*, *31*(4), 807–832. https://doi.org/10.1007/s10648-019-09501-4

Plessis, E. (2020). Student teachers' perceptions, experiences, and challenges regarding learner-centred teaching. *South African Journal of Education*, *40*(1), 1–10. https://doi.org/10.15700/saje.v40n1a1631

Schoenfeld, A. H. (2016). Learning to Think Mathematically: Problem Solving, Metacognition, and Sense Making in Mathematics. *Journal of Mathematical Behavior*, *41*, 37–50. https://doi.org/10.1177/002205741619600202

Sidenvall, J., Lithner, J., & Jäder, J. (2015). Students' reasoning in mathematics textbook task-solving. *International Journal of Mathematical Education in Science and Technology*, *46*(4), 533–552. https://doi.org/10.1080/0020739X.2014.992986

Stouraitis, K., Potari, D., & Skott, J. (2017). Contradictions, dialectical oppositions and shifts in teaching mathematics. *Educational Studies in Mathematics*, *95*(2), 203–217. https://doi.org/10.1007/s10649-017-9749-4

Sudiarta, I. G. P., & Nugraha, D. G. A. P. (2019). Increasing conceptual understanding and procedural fluency on teaching polyhedrons using blended learning strategy: A case study on 8th grader of SMP N 1 Sukawati. *Journal of Physics: Conference Series*, *1321*(2), 1–6. https://doi.org/10.1088/1742-6596/1321/2/022112

Umah, U., Asari, A. R., Sukoriyanto, & Sisworo. (2023). Students' Inquisitive Questions Predict Their Understanding of Mathematics Texts. *Acta Scientiae*, *25*(6), 29–59. https://doi.org/10.17648/acta.scientiae.7466

Veenman, M. V. J., Van Hout-Wolters, B. H. A. M., & Afflerbach, P. (2006). Metacognition and learning: Conceptual and methodological considerations. *Metacognition and Learning*, *1*(1), 3–14. https://doi.org/https://doi.org/10.1007/s11409-006-6893-0