

**Teachers' perceptions of structured problem-solving for assessing and enhancing
higher-order thinking skills in Grade 6 Mathematics**

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ABSTRACT

Developing higher-order thinking skills has become a major goal of mathematics education because learners are expected to analyze, evaluate, and solve complex problems rather than rely on memorization. However, despite the recognized value of structured problem-solving, limited local evidence exists on its effectiveness in assessing and enhancing the higher-order thinking skills of Grade 6 pupils in public elementary schools. This study investigated the implementation and effectiveness of structured problem-solving strategies in Mathematics 6 in San Manuel District, Isabela. A descriptive-normative research design was employed involving 25 Grade 6 teachers selected through total population sampling. Data were gathered using a researcher-made questionnaire, documentary analysis, and unstructured interviews, and were analyzed using frequency, percentage, and weighted mean. The findings revealed that teachers consistently implemented structured problem-solving strategies and perceived them to be highly effective in assessing and enhancing pupils' higher-order thinking skills. Although teachers identified challenges related to learner motivation, classroom diversity, time, and resources, the results suggest that structured problem-solving remains a valuable instructional approach for improving mathematics instruction and fostering meaningful learning.

Keywords: Structured problem-solving, higher-order thinking skills, Mathematics 6, mathematics instruction, Grade 6 teachers.

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INTRODUCTION

Mathematical problem solving plays a fundamental role in developing learners' conceptual understanding and critical thinking skills. Rather than relying solely on memorization or routine procedures, effective mathematics instruction encourages learners to analyze situations, identify relationships, and apply appropriate mathematical concepts to solve authentic problems (Herawati & Amelia, 2021; Ishartono et al., 2021). Through this process, learners deepen their understanding of mathematics while strengthening their reasoning and decision-making abilities. Problem solving also enables learners to connect

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mathematical ideas across different contexts, thereby promoting meaningful and transferable learning (Syaiful et al., 2020; Klang et al., 2021).

Higher-order thinking skills (HOTS) refer to advanced cognitive processes that extend beyond remembering and understanding. These include analyzing, evaluating, and creating, as well as reasoning, reflection, creativity, and problem solving (Hasan, 2019; Putri & Zulkardi, 2018). Learners who possess these skills are better equipped to solve complex problems, make informed decisions, and apply their knowledge in unfamiliar situations (Yayuk et al., 2020). Consequently, cultivating HOTS has become one of the major goals of contemporary mathematics education because these competencies are essential for lifelong learning and success in science, technology, engineering, and mathematics (STEM) fields (Maulidiya & Nurlaelah, 2019).

Assessing higher-order thinking skills requires assessment methods that go beyond traditional paper-and-pencil tests. Authentic and performance-based assessments provide opportunities for learners to demonstrate reasoning, creativity, and conceptual understanding through open-ended mathematical tasks (Yunita et al., 2018). Teachers play a crucial role in designing learning experiences that encourage learners to analyze problems, justify their solutions, and reflect on their thinking processes (Kaiser, 2017; Karim & Puteh, 2019). Such assessment practices better capture learners' mathematical competence and provide valuable information for improving instruction.

One instructional approach that supports the assessment and development of higher-order thinking skills is structured problem solving. This approach guides learners through a systematic sequence of understanding the problem, selecting appropriate strategies, implementing solutions, and evaluating the results (Azinar et al., 2020; Klang et al., 2021). By engaging learners in reflective and organized thinking, structured problem solving promotes metacognitive awareness, logical reasoning, perseverance, and conceptual understanding (Mangarin & Caballes, 2024). Moreover, it enables learners to become independent problem solvers capable of applying mathematical knowledge to real-life situations (Kaiser, 2017).

International studies have consistently reported that structured problem solving significantly improves learners' higher-order thinking skills and mathematical achievement (Suparman et al., 2021). However, many Filipino elementary learners continue to experience difficulty in solving non-routine mathematical problems because classroom instruction often emphasizes procedural knowledge and memorization rather than conceptual understanding and analytical reasoning. This situation highlights the need for assessment approaches that effectively measure and develop higher-order thinking skills within authentic classroom settings.

In response to this need, the present study investigates the use of structured problem solving in assessing and enhancing the higher-order thinking skills of Grade 6 pupils in public elementary schools in San Manuel District, Isabela. Specifically, the study seeks to determine how structured problem-solving influences learners' abilities to analyze, evaluate, and create mathematical solutions. It also examines learners' conceptual understanding, reasoning abilities, and problem-solving strategies while providing evidence that may guide curriculum enhancement, instructional improvement, and teacher professional development in mathematics education.

This study is anchored on several interrelated theoretical and empirical foundations that support the use of structured problem-solving in developing and assessing higher-order thinking skills (HOTS) among elementary learners. These theories and studies provide the conceptual basis for examining how structured problem-solving strategies contribute to the enhancement of learners' mathematical reasoning and cognitive development.

The study is primarily grounded in Piaget's Cognitive Development Theory (Piaget, 1972), which posits that children in the late elementary years are transitioning from the

concrete operational stage to the formal operational stage of cognitive development. During this transition, learners gradually develop the capacity for abstract reasoning, logical thinking, and systematic problem-solving. Oktaviani et al. (2023) emphasized that cognitive development is fundamental to fostering critical thinking and mathematical understanding, particularly when learners are engaged in activities that challenge their reasoning and conceptual understanding.

Likewise, the study is guided by Bloom's Taxonomy of Educational Objectives (Bloom, 1956), which classifies cognitive learning into hierarchical levels. This research focuses on the higher cognitive processes of analyzing (C4), evaluating (C5), and creating (C6), collectively referred to as higher-order thinking skills. Consistent with this framework, Yunita et al. (2018) demonstrated that assessment tasks designed around Bloom's higher cognitive levels effectively measure and promote higher-order thinking in mathematics.

Another important foundation of this study is the Structured Problem-Solving Framework, which provides learners with a systematic process for solving mathematical problems. According to Singer and Voica (2013), this framework involves sequential stages such as understanding the problem, representing relevant information, processing possible solutions, and implementing appropriate strategies. By breaking complex problems into manageable steps, structured problem-solving enables learners to strengthen their analytical reasoning, conceptual understanding, and decision-making skills.

Empirical evidence further supports the integration of structured problem-solving into classroom assessment. Azid et al. (2022) found that embedding higher-order thinking skills in school-based mathematics assessments significantly improved learners' academic achievement, engagement, and critical thinking. Their findings suggest that structured problem-solving serves not only as an effective instructional strategy but also as a valid assessment approach for evaluating learners' deeper conceptual understanding and higher-order thinking skills.

Taken together, these theoretical and empirical perspectives establish a strong conceptual foundation for the present study. They support the assumption that structured problem-solving is an effective approach for both assessing and enhancing higher-order thinking skills in Mathematics 6. By aligning instructional practices and assessment strategies with learners' cognitive development and the principles of higher-order thinking, teachers can foster deeper conceptual understanding, critical reasoning, and creative problem-solving among Grade 6 pupils.

This study adopts the Input–Process–Output (IPO) Model as its conceptual framework. The input consists of the respondents' demographic profile, including age, gender, civil status, highest educational attainment, present position, latest performance rating, length of service, and level of in-service training attended. It also includes the implementation of structured problem-solving strategies in Mathematics 6, particularly their key components, extent of utilization, perceived benefits and drawbacks, and the challenges encountered by teachers during implementation.

The process involves examining the implementation of structured problem-solving strategies and determining their influence on assessing and enhancing the higher-order thinking skills of Grade 6 pupils in public elementary schools in San Manuel District, Isabela.

The output of the study is the enhanced higher-order thinking skills of Grade 6 pupils through the effective implementation of structured problem-solving strategies in Mathematics 6. The findings are likewise expected to provide valuable inputs for improving classroom instruction, strengthening assessment practices, and designing future professional development programs for mathematics teachers. Feedback generated from the results of the

study may also serve as a basis for refining the implementation of structured problem-solving strategies in other elementary schools.

Statement of the problem

This study aimed to determine the effectiveness of structured problem solving in assessing and enhancing the higher order thinking skills of Grade 6 pupils in Mathematics in public elementary schools in San Manuel District, Isabela, during the School Year 2025–2026. Specifically, it sought to answer the following research questions:

1. What is the profile of the respondents in terms of age, gender, civil status, highest educational attainment, present position, latest performance rating, length of service, and level of in service training attended?
2. To what extent do Mathematics 6 teachers implement the key components of structured problem solving strategies in the classroom?
3. To what extent are structured problem solving strategies utilized in teaching Mathematics 6 to Grade 6 pupils?
4. What are the perceived effects of structured problem solving strategies on the assessment of higher order thinking skills and the enhancement of the higher order thinking skills of Grade 6 pupils?
5. What are the perceived benefits and drawbacks of using structured problem solving strategies in teaching Mathematics 6?
6. To what extent do teachers encounter challenges in implementing structured problem solving strategies in teaching Mathematics 6?

METHODOLOGY

Research design

This study employed the descriptive-normative research design to assess teachers' perceptions of the effect of structured problem-solving in teaching Mathematics 6 to Grade 6 pupils in public elementary schools in San Manuel District, Isabela, during the School Year 2025–2026. The descriptive method was deemed appropriate because it describes, analyzes, and interprets existing conditions, practices, and relationships among variables (Best, 1981; Good & Scates, 1972; Van Dalen & Meyer, 1979; Whitney, 1960). It enabled the researcher to describe the current implementation of structured problem-solving strategies and examine teachers' perceptions regarding their effectiveness.

Locale of the study

The study was conducted in the 18 public elementary schools in San Manuel District, Isabela. These schools served as the research locale because they implement the Mathematics 6 curriculum and employ Grade 6 teachers who were the primary respondents of the study.

Respondents of the study

The respondents of the study were 25 Grade 6 teachers from the 18 public elementary schools in San Manuel District, Isabela. The respondents were selected using total population sampling, allowing all eligible Grade 6 teachers in the district to participate in the study.

Data gathering instruments

The study utilized three data-gathering instruments: (1) a researcher-made questionnaire, (2) documentary analysis, and (3) unstructured interviews. The questionnaire served as the primary instrument and was developed based on professional books, scholarly journals, theses, and dissertations. It consisted of six parts: (1) respondents' profile; (2) extent of implementation of the key components of structured problem-solving; (3) extent of utilization of structured problem-solving strategies in Mathematics 6 instruction; (4) perceived effects of structured problem-solving on assessing and enhancing higher-order thinking skills; (5) perceived benefits and drawbacks of structured problem-solving; and (6) challenges encountered by teachers in implementing structured problem-solving strategies.

Prior to its administration, the questionnaire underwent a try-out among selected Grade 6 Mathematics teachers from a nearby municipality. It was subsequently reviewed by the researcher's adviser and the Dean of the Graduate School. Their comments and suggestions, together with the feedback obtained during the pilot testing, were incorporated into the final version of the instrument.

To validate and clarify selected responses, unstructured interviews were conducted with some respondents. In addition, documentary analysis was employed to verify and support the information gathered through the questionnaire.

Data Gathering Procedure

Before conducting the study, the researcher secured the necessary approvals from the Office of the Schools Division Superintendent and the respective school administrators. Following the validation and final revision of the questionnaire, the researcher personally administered and retrieved the survey instruments from the respondents. The collected data were then organized, tabulated, analyzed, and interpreted.

Statistical Treatment of Data

The data were processed using appropriate descriptive statistical techniques. Specifically, the following statistical tools were employed. Frequency and Percentage were used to describe the demographic profile of the respondents. Weighted Mean was utilized to determine the extent of implementation and utilization of structured problem-solving strategies, the perceived effects on higher-order thinking skills, the perceived benefits and drawbacks, and the challenges encountered by teachers in implementing structured problem-solving strategies.

RESULTS AND DISCUSSION

Profile of the respondents

The study involved 25 Grade 6 teachers from the public elementary schools in San Manuel District, Isabela. Most respondents belonged to the 36–40, 41–45, and 51–55 age groups (20% each), indicating that the participants were generally experienced educators in their mid-career and late-career stages. The teaching force was predominantly female (80%) and married (80%), reflecting the demographic profile commonly observed in the Philippine basic education sector.

In terms of educational qualifications, 92% had pursued graduate studies, with 44% having earned master's units, 36% holding a master's degree, and 12% taking doctoral units. This suggests that the respondents were committed to professional development and continuing education, which may have strengthened their instructional competence and capacity to implement innovative teaching strategies. Likewise, 80% occupied Teacher III positions, 92% received Outstanding performance ratings, and the largest group (32%) had 11 to 15 years of teaching experience, indicating a highly qualified and experienced group of teachers. All respondents had participated in school- and district-level in-service training, while several had attended division, regional, national, and international professional development programs. These findings indicate that the respondents possessed the academic preparation and professional experience necessary to provide informed judgments regarding structured problem-solving strategies.

Implementation of the key components of structured problem-solving

Teachers reported that the key components of structured problem-solving were fully implemented, with an average weighted mean of 4.70. The highest-rated practice was guiding pupils to identify known facts, determine what is being asked, and analyze the given information before solving mathematical problems.

This finding indicates that teachers consistently employ a systematic approach to problem solving rather than allowing pupils to proceed directly to computation. By emphasizing problem analysis, strategy selection, implementation, and solution verification, teachers cultivate disciplined mathematical thinking and encourage learners to develop sound reasoning habits. Such practices provide a strong foundation for higher-order thinking because pupils are required to understand the problem before attempting to solve it.

Utilization of structured problem-solving strategies

The respondents reported that they very often utilized structured problem-solving strategies in Mathematics 6 instruction, obtaining an average weighted mean of 4.28. Among the strategies, the Seven-Step Problem-Solving Process emerged as the most frequently used.

The frequent use of structured problem-solving demonstrates that teachers have moved beyond traditional procedural instruction toward learner-centered approaches that encourage analysis, reasoning, and reflection. Rather than focusing solely on obtaining correct answers, teachers guide pupils through the thinking process, allowing them to examine multiple solution paths and evaluate the appropriateness of their strategies. This instructional practice aligns well with current educational goals that emphasize critical thinking and problem-solving competencies.

Effect on the assessment of higher-order thinking skills

Teachers strongly agreed that structured problem-solving is effective in assessing higher-order thinking skills, as reflected in an average weighted mean of 4.58. The highest-rated indicator was its ability to assess whether pupils could evaluate the correctness of their own solutions.

The findings suggest that structured problem-solving enables teachers to assess much more than the accuracy of pupils' answers. It provides evidence of learners' reasoning processes, conceptual understanding, decision-making, and ability to justify their solutions. Consequently, assessment becomes a means of understanding how pupils think rather than merely determining whether their final answers are correct.

Effect on the enhancement of higher-order thinking skills

The respondents likewise strongly agreed that structured problem-solving enhances higher-order thinking skills, obtaining an average weighted mean of 4.49. Teachers perceived that the strategy particularly strengthens pupils' critical thinking, reasoning, collaboration, and ability to relate mathematical concepts to real-life situations.

This finding suggests that structured problem-solving contributes not only to cognitive development but also to learners' confidence and perseverance when confronted with challenging mathematical tasks. By encouraging pupils to analyze situations, evaluate alternatives, and defend their solutions, the strategy promotes deeper understanding and meaningful learning rather than rote memorization.

Overall effect of structured problem-solving

The overall assessment yielded an average weighted mean of 4.54, indicating that teachers strongly agreed that structured problem-solving is highly effective in both assessing and enhancing higher-order thinking skills among Grade 6 pupils. Assessment obtained a slightly higher rating than enhancement, suggesting that teachers viewed structured problem-solving primarily as an effective means of revealing pupils' thinking processes while simultaneously supporting their cognitive development.

Benefits of structured problem-solving

Teachers strongly agreed on the benefits of structured problem-solving, which obtained an average weighted mean of 4.64. The most highly rated benefit was its ability to help pupils analyze, evaluate, and create solutions instead of relying on memorized procedures.

These findings indicate that structured problem-solving transforms mathematics learning into an active process in which learners construct understanding through reasoning and exploration. Instead of simply recalling formulas, pupils are encouraged to examine relationships, justify their thinking, and connect mathematical concepts with authentic situations. Such experiences are essential in developing higher-order thinking skills and promoting lasting conceptual understanding.

Drawbacks of Structured Problem-Solving

Despite its positive effects, teachers acknowledged several limitations, with an average weighted mean of 3.97, interpreted as Agree. The most notable drawback was that structured problem-solving demands extensive preparation and planning from teachers. This finding highlights that implementing structured problem-solving effectively requires substantial instructional preparation. Teachers must carefully design meaningful tasks, anticipate possible solution strategies, and facilitate classroom discussions that encourage reasoning. Although these demands increase teachers' workload, they also reflect the complexity of providing high-quality mathematics instruction that develops learners' higher-order thinking skills.

Challenges encountered by teachers

The respondents perceived the challenges encountered in implementing structured problem-solving as serious, with an average weighted mean of 3.38. The most pressing concern was pupils' low motivation or lack of interest in solving complex mathematical problems, followed by differences in pupils' ability levels and difficulties in managing large classes.

These findings suggest that the effectiveness of structured problem-solving depends not only on teachers' competence but also on learner readiness and classroom conditions. Diverse learning abilities, limited instructional time, insufficient resources, and varying levels of pupil engagement can reduce the impact of even well-designed instructional strategies. Therefore, successful implementation requires sustained professional development for teachers, adequate instructional resources, and classroom practices that promote active participation and learner motivation.

CONCLUSION

Based on the findings of the study, it is concluded that the Grade 6 Mathematics teachers in San Manuel District, Isabela are generally experienced, professionally competent, and committed to continuous professional development. Most are in their mid- to late-career years, hold Teacher III positions, have pursued graduate studies, have received outstanding performance ratings, and regularly participate in in-service training programs. These characteristics provide a strong foundation for the effective implementation of structured problem-solving strategies in Mathematics 6.

The study further concludes that teachers consistently implement the key components of structured problem-solving and frequently utilize various structured problem-solving strategies in classroom instruction. Their consistent use of these strategies enables pupils to analyze mathematical problems systematically, select appropriate solution methods, and evaluate the correctness of their answers. This demonstrates that structured problem-solving has become an integral instructional approach in Mathematics 6.

The findings also establish that structured problem-solving is highly effective in both assessing and enhancing the higher-order thinking skills of Grade 6 pupils. It enables teachers to evaluate learners' reasoning, conceptual understanding, critical thinking, and decision-making while simultaneously developing pupils' analytical, creative, evaluative, and problem-solving abilities. Likewise, teachers recognize that structured problem-solving promotes meaningful learning by encouraging pupils to analyze, evaluate, and create solutions instead of relying solely on memorization. It also helps learners connect mathematical concepts to real-life situations and develop systematic and logical thinking.

Despite these positive outcomes, the study reveals that teachers encounter several challenges in implementing structured problem-solving, including pupils' low motivation, differences in learning abilities, large class sizes, limited instructional time, inadequate learning resources, and the extensive preparation required for effective implementation. These findings suggest that the success of structured problem-solving depends not only on teachers' competence but also on the availability of adequate institutional support, instructional resources, and favorable classroom conditions.

In light of these conclusions, it is recommended that Mathematics teachers continue strengthening the implementation of structured problem-solving by integrating innovative and learner-centered activities that address the diverse needs and abilities of pupils. School administrators and education supervisors should provide regular professional development programs, workshops, and mentoring activities to enhance teachers' competence in designing, facilitating, and assessing structured problem-solving tasks. Schools should likewise ensure

the availability of adequate instructional materials, learning resources, and classroom support to facilitate effective implementation.

Teachers are also encouraged to adopt motivational strategies, such as authentic real-life applications, collaborative learning experiences, and meaningful problem-solving activities, to increase pupils' engagement, confidence, and perseverance in solving mathematical problems. At the same time, school leaders and teachers should develop effective time-management practices that allow structured problem-solving activities to be integrated into classroom instruction without sacrificing curriculum coverage.

Finally, future researchers are encouraged to replicate the study in other public and private elementary schools and in different educational settings to validate the present findings. Further investigations may also examine the long-term effects of structured problem-solving on pupils' academic achievement, critical thinking, and problem-solving competence through experimental or longitudinal research designs. Such studies would provide stronger empirical evidence to guide instructional improvement and curriculum development in Mathematics education.

REFERENCES

Azid, N., Md. Ali, R., El Khuluqo, I., Purwanto, S. E., & Susanti, E. N. (2022). Higher order thinking skills, school-based assessment and students' mathematics achievement: Understanding teachers' thoughts. *International Journal of Evaluation and Research in Education*, 11(1), 290–302. <https://files.eric.ed.gov/fulltext/EJ1341216.pdf>

Azinar, J. A., Munzir, S., & Bahrin. (2020). Students' logical-mathematical intelligence through the problem-solving approach. *Journal of Physics: Conference Series*, 1460(1), Article 012024. <https://doi.org/10.1088/1742-6596/1460/1/012024>

Best, J. W. (1981). *Research in education* (4th ed.). Prentice-Hall.

Bloom, B. S. (1956). *Taxonomy of educational objectives: The classification of educational goals*. Longmans, Green.

Good, C. V., & Scates, D. E. (1972). *Methods of research: Educational, psychological, sociological*. Appleton-Century-Crofts.

Hasan, B. (2019). The exploration of higher order thinking skills: Students' difficulties and scaffolding in solving mathematical problems based on PISA. *Journal of Physics: Conference Series*, 1200(1), Article 012010. <https://doi.org/10.1088/1742-6596/1200/1/012010>

Herawati, S., & Amelia, P. (2021). Analyzing students' mathematical reasoning ability in solving mathematical problems based on higher-order thinking skills (HOTS). *Advances in Social Science, Education and Humanities Research*. <https://doi.org/10.2991/assehr.k.210508.051>

Ishartono, N., Faiziyah, N., Sutarni, S., Putri, A. B., Fatmasari, L. W. S., Sayuti, M., Rahmaniati, R., & Yunus, M. M. (2021). Visual, auditory, and kinesthetic students: How they solve PISA-oriented mathematics problems. *Journal of Physics: Conference Series*, 1720(1), Article 012012. <https://doi.org/10.1088/1742-6596/1720/1/012012>

- Kaiser, G. (Ed.). (2017). *Proceedings of the 13th International Congress on Mathematical Education*. Springer. <https://doi.org/10.1007/978-3-319-62597-3>
- Karim, F. A., & Puteh, M. (2019). The development of higher order thinking skills (HOTS) assessment instrument for word problems. *International Journal of Academic Research in Business and Social Sciences*, 9(6). <https://doi.org/10.6007/IJARBSS/v9-i6/6069>
- Klang, N., Karlsson, N., Kilborn, W., Eriksson, P., & Karlberg, M. (2021). Mathematical problem-solving through cooperative learning: The importance of peer acceptance and friendships. *Frontiers in Education*, 6, Article 710296. <https://doi.org/10.3389/feduc.2021.710296>
- Mangarin, R. A., & Caballes, D. O. (2024). Difficulties in learning mathematics: A systematic review. *International Journal of Research and Scientific Innovation*, 11(9), 401–409. <https://doi.org/10.51244/IJRSI.2024.1109037>
- Maulidiya, M., & Nurlaelah, E. (2019). The effect of problem-based learning on critical thinking ability in mathematics education. *Journal of Physics: Conference Series*, 1157(4), Article 042063. <https://doi.org/10.1088/1742-6596/1157/4/042063>
- Oktaviani, M., Dwihapsari, K., Islami, M. N., Dewi, N. P., Fadhilah, R. N., & Palupi, Z. D. (2023). Cognitive development of elementary school children in developing critical thinking ability and understanding mathematical concepts. *International Education Trend Issues*, 1(3), 134–143. <https://doi.org/10.56442/ieti.v1i3.178>
- Piaget, J. (1972). *The psychology of the child*. Basic Books.
- Putri, R. I. I., & Zulkardi. (2018). Higher-order thinking skill problems on data representation in primary school: A case study. *Journal of Physics: Conference Series*, 948(1), Article 012056. <https://doi.org/10.1088/1742-6596/948/1/012056>
- Singer, F. M., & Voica, C. (2013). Problem-solving in mathematics education: Realistic, complex, and dynamic. *ZDM Mathematics Education*, 45(2), 239–250. <https://doi.org/10.1007/s11858-012-0460-0>
- Suparman, N., Juandi, D., & Tamur, M. (2021). Review of problem-based learning trends in 2010–2020: A meta-analysis study of the effect of problem-based learning in enhancing mathematical problem-solving skills of Indonesian students. *Journal of Physics: Conference Series*, 1722(1), Article 012103. <https://doi.org/10.1088/1742-6596/1722/1/012103>
- Syaiful, S., Kamid, K., Muslim, M., & Huda, N. (2020). Identifying problem-solving abilities in mathematics among junior high school students. *Journal of Education and Learning (EduLearn)*, 14(2), 176–183. <https://doi.org/10.11591/edulearn.v14i2.14861>
- Van Dalen, D. B., & Meyer, W. J. (1979). *Understanding educational research: An introduction* (4th ed.). McGraw-Hill.

Vergara, C. R., & Balquedra, A. B. (2024). Academic success and achievement of freshmen university students in mathematics. *Open Access Library Journal*, 11(7), 1–15. <https://doi.org/10.4236/oalib.1111859>

Whitney, F. L. (1960). *The elements of research*. Prentice-Hall.

Yayuk, E., Purwanto, P., As'ari, A. R., & Subanji. (2020). Primary school students' creative thinking skills in mathematics problem solving. *European Journal of Educational Research*, 9(3), 1281–1295. <https://doi.org/10.12973/eu-jer.9.3.1281>

Yunita, Y., Wahidin, W., & Tsurayya, A. (2018). The development of mathematics higher-order thinking skills instrument for Grade VIII junior high school. *Journal of Physics: Conference Series*, 1088(1), Article 012093. <https://doi.org/10.1088/1742-6596/1088/1/012093>