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An investigation of pedagogical strategies for enhancing mathematical problem-solving skills

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A R T I C L E I N F O

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A B S T R A C T

This study examined the strategies employed by mathematics teachers to develop students' problem-solving competence, the challenges they encounter, and the impact of these approaches on learning outcomes. Using qualitative analysis, the findings revealed that teachers employ a variety of strategies, including Polya's four-step method, gamified activities, inquiry-based learning, and technology integration, to make problem-solving more meaningful and engaging. However, limited instructional resources, time constraints, and inadequate training hinder consistent implementation. Teachers emphasized the importance of professional development, administrative support, and access to materials in improving instructional quality. The study concludes that continuous teacher training and institutional support are essential for fostering students' analytical and critical thinking skills through effective problem-solving instruction.

Introduction

Mathematics helps students think straight and deal with problems they meet in daily life. When learners understand math, they typically perform better in school and develop their ability to reason, evaluate options, and make informed decisions. These abilities become increasingly important over time (Boaler, 2016; Ernest, 2010).

Math is often referred to as a universal language, as it enables people everywhere to read, measure, and make sense of the things around them (OECD, 2019). Even outside of school, math trains the mind to follow steps, identify errors, and make informed choices (National Academies of Sciences, Engineering,

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and Medicine, 2021). Since the world is changing rapidly now, schools in many countries are focusing more on math that connects to real-life cases (World Economic Forum, 2020).

In the Philippines, math lessons face significant challenges, including a shortage of textbooks and classrooms, overcrowded classes, and a lack of trained math teachers (DepEd, Philippines). Public schools in towns like Sarrat, Ilocos Norte, feel these gaps harder. Many students struggle with word problems because they lost interest early, missed key lessons in lower grades, and still get teaching styles that do not help them recover (UNESCO).

Numerous studies have demonstrated that combining teaching methods enhances students' ability to solve math problems. Boaler (2016) found that using drawings and tasks that spark curiosity helps students better understand ideas. Gillies (2016) noted that working in groups helps them think more deeply and explain their steps more clearly. Hwang et al. (2017) demonstrate that learning tools, such as apps and simulations, also enhance problem-solving skills.

However, most of these studies were conducted in large urban schools or international settings, focusing mainly on general strategies without considering the local realities faced by teachers in small-town public schools. There remains a lack of research that explores explicitly the teaching strategies used by mathematics teachers in rural Philippine contexts, particularly in towns like Sarrat, Ilocos Norte, to foster students' problem-solving skills. This gap highlights the need to investigate how local teachers apply, adapt, or struggle with different approaches in their actual classroom settings.

This study examines the most effective teaching strategies, the skills students require, and the actual barriers that prevent teachers from utilizing the best methods. "Effective teaching strategies" refers to the actual actions teachers take to ensure students understand ideas and solve tasks, such as group work and problem-based lessons (Sukma & Priatna, 2023). "Problem-solving skills" means the steps students take when they face a math question (Polya, 2014). "Challenges in implementation" refers to the barriers teachers encounter when applying these strategies in real classrooms (Valdez & Taganap, 2024).

Moreover, the study aims to improve math classes and build stronger problem solvers among students in Sarrat, Ilocos Norte, by mapping the strategies local teachers currently use. By identifying what works and what slows teachers down, this provides practical and straightforward ways to enhance the teaching of problem-solving in math.

Literature review

Effective teaching strategies are crucial for developing students' problem-solving skills. Recent research emphasizes the importance of varied pedagogical approaches to cater to diverse learning needs and enhance mathematical proficiency.

Teaching problem-solving in mathematics

Good math teaching needs more than one method. Problem-solving should be at the center, and linking lessons to real-life examples keeps students more interested and helps them see why math matters. When

teachers connect ideas to real-world situations, students understand the material better and perceive the subject as more relevant and valuable.

Technology also helps students develop problem-solving skills. Apps, online tools, and simulations offer rapid feedback, enabling students to practice at their own pace (Hwang et al., 2017). These tools also help to present abstract ideas in a clearer form.

Working with classmates is another key support for problem-solving. When students work on a task together, they learn from each other, compare ideas, and refine their thinking (Gillies, 2016). Teachers guide this by giving tasks suited for group work and stepping in when needed.

It is also important to address the main problems that students face, such as weak fundamentals, incorrect ideas about topics, or difficulty in selecting the right strategy. When teachers are familiar with these blocks, they can provide direct support, enabling students to gain confidence (Valdez & Taganap, 2024).

Teaching strategies for enhancing mathematical problem-solving skills

Numerous studies have identified specific strategies that enhance students' problem-solving skills. Sukma and Priatna (2023) found that blended learning—a combination of online and face-to-face instruction—enhances critical thinking in mathematics.

Visual materials and guided discovery also help students improve their ability to solve tasks. Abebe Kokeb, Mulugeta Atnafu, and Adem Mohammed (2025) demonstrated that visual support in lessons facilitated Grade 10 learners' ability to solve plane geometry problems.

Collaborative problem-solving is another growing approach. Arif Hidayatul Khusna, Tatag Yuli Eko Siswono, and Pradnyo Wijayanti (2024) utilized non-routine problems to develop students' critical thinking skills in group settings.

Bautista and Salonga (2019) noted that teachers who use peer learning, contextual examples, and different task levels help close learning gaps. Cruz and Villanueva (2022) demonstrated that digital tools, such as virtual manipulatives and math games, enhance understanding.

In the Philippines, Garcia et al. (2023) found that lessons tied to culture and mother tongue support early math learning. Ong and Escareal (2023) studied the CPA (Concrete–Pictorial–Abstract) approach in Ozamiz City and saw good gains. Dela Cruz and Bautista (2022) employed CPA in teaching fractions in Las Piñas City, whereas Villanueva and Cruz (2022) examined digital tools in schools in Metro Manila.

Hwang, Lai, and Wang (2017) introduced seamless flipped learning using mobile technology to support problem-solving. Al Farra, Kamal, Al Owais, and Belbase (2022) investigated how Grade 5 learners in the UAE approach word problems and the strategies they employ.

Math teaching still faces many issues. Teachers struggle with abstract topics, diverse student ability levels, and finding ways to keep learners engaged in problem-solving (Baroody et al., 2018). Reyes and Mendoza (2020) demonstrated that teachers also face limited time, inadequate materials, and insufficient training in new methods.

Mixed-ability classes make this more complicated. Bautista and Salonga (2019) found that teachers must continually adjust lessons to accommodate students at different grade levels. Aquino, Barong, Sapotalo, and Panerio Jr. (2025) noted that teachers in rural schools face a lack of resources and low basic skills, while urban schools deal with overcrowding.

After the pandemic, Valle (2025) found that teachers struggled with hybrid learning, lesson redesign, and assessment while also learning to use digital tools more effectively.

Language can also block understanding. Tolibas (2023) found that translating math terms into Winaray was confusing. Baquiller and Abellon Jr. (2021) also noted that some mathematical concepts are complex to convey in local languages.

Teachers also face trouble applying new strategies. Valdez and Taganap (2024) observed that many pre-service teachers struggled with handling misconceptions and conducting error analysis, a crucial aspect of effective teaching.

Gholami (2024) reported that traditional teaching lowers students' skills in higher-order thinking. In a related 2023 study using TIMSS and PISA data, Gholami demonstrated that foundation-level students in Malaysia continue to struggle with problem-solving.

Some studies show promising solutions. Mario de la Puente et al. (2024) showed that teaching chess improves planning and logical thinking. Mendoza and Lapinid (2024) found that Variation Theory helped students improve their ability to solve right triangles.

All these studies highlight the need for diverse strategies, including blended learning, visuals, group work, and technology tools. However, these only work if schools also address root issues, such as teacher training, a lack of materials, and weak motivation. Without addressing these core gaps, even effective strategies cannot reach their full potential in the classroom.

Statement of the problem

This study aimed to investigate the effective teaching strategies employed by teachers and the challenges they face in teaching problem-solving in mathematics. It specifically sought to answer the following problems:

1. What are the teaching strategies used by mathematics teachers to foster problem-solving skills among students?

2. What are the challenges faced by teachers in using these strategies in teaching problem-solving in Mathematics?

Research methodology

This presents the research design, including the sources of data, which comprise the locale of the study, population, sampling, data gathering instrument, and data analysis, along with its ethical standards.

Research design

This study employed a qualitative research design, specifically a narrative inquiry approach, to explore the lived experiences of elementary teachers in teaching mathematics. The goal was to uncover their personal stories, challenges, and the strategies they use to teach math concepts effectively in their classrooms.

Locale of the study

The research was conducted at Sta. Rosa National High School, a public school located in the Schools Division of Ilocos Norte. This school was selected due to its active engagement in teaching innovation and its diverse student population.

Population and sampling

The participants of the study were mathematics teachers at Sta. Rosa National High School. A purposive sampling technique was employed to select ten teachers who have experience in teaching mathematics and have demonstrated involvement in instructional improvement or participated in math-related training.

Data gathering instrument

The primary instrument for data collection was an open-ended questionnaire divided into two main sections: strategies for teaching problem-solving mathematics and challenges of implementing these strategies. Follow-up informal interviews were also conducted to explore their responses in more detail.

Data gathering procedure

Data were collected through open-ended questionnaires distributed to participating teachers. These questionnaires were designed to encourage reflective and narrative responses, allowing teachers to describe their experiences in detail. Some responses were followed up with informal interviews to clarify and expand on the information provided.

Ethical considerations

The study observed ethical research practices. Informed consent was obtained from all participants. Responses were kept confidential and used solely for this study. Participants were informed of their right to withdraw at any time without any consequence.

Results and discussion

This section explains what mathematics teachers at Sta. Rosa National High School shared in their open-ended responses. Their answers highlight the standard strategies and problems they encounter, as well as the methods they employ to teach math problem-solving.

Problem 1: What are the teaching strategies used by mathematics teachers to foster problem-solving competence among students?

Table 1. Teachers' strategies in teaching problem-solving mathematics

Theme 1: Strategies in teaching problem-solving mathematics	
Merged idea	**Participant**
Gamified activities and interactive teaching methods that actively engage students	P1, P9, P7
Technology-integrated	P2, P6
Collaborative learning approaches to solve real-world problems	P3
Relating the lesson to real-life situations is necessary in everyday life.	P4
Polya's four-step problem-solving method	P5
Inquiry-based learning fosters conceptual understanding by guiding students to explore and generalize mathematical ideas. The "I Do, We Do, You Do" model promotes gradual autonomy through demonstration, guided practice, and independent application.	P8 & P10
Theme 2: Evidence of improved problem-solving competence through practice and application	
Merged idea	**Participant**
Enhanced student engagement through gamified and technology-based learning	P1, P6, P4
Development of problem-solving and cognitive skills through active participation	P2, P9
Evident improvement in academic performance and behavior	P10
Guided practice and scaffolding build confidence and mastery	P7
Visualization enhances conceptual understanding	P8
Real-life application promotes meaningful learning	P5 & P3

Note. *Data were gathered from open-ended questionnaire responses and follow-up informal interviews with ten mathematics teachers from Sta. Rosa National High School*

Theme 1: Strategies in teaching problem-solving mathematics

This theme underscores the multifaceted pedagogical strategies employed by mathematics teachers to cultivate students' problem-solving proficiency. These approaches include gamified and technology-integrated activities, collaborative learning designed to address real-world problems, and contextualized instruction that connects mathematical concepts to everyday life. Additionally, teachers adopt Polya's Four-Step Problem-Solving Method and Inquiry-Based Learning to promote analytical thinking and conceptual understanding. The "I Do, We Do, You Do" instructional model further supports the gradual

development of learner autonomy through demonstration, guided engagement, and independent application.

> *"I use gamified activities and interactive methods that engage students and encourage critical thinking and collaboration in solving mathematical problems." (P1)*

> *"There are a lot of effective strategies that foster problem-solving competence among students, including digital game-based learning, real-world problems, inquiry-based learning, and collaborative learning, such as think-pair-share and cooperative learning." (P3)*

> *"The effective teaching strategies used by mathematics teachers to foster problem-solving competence among students are using real-life contexts, guided practice, and visualization through technology integration." (P4)*

> *"Mathematics teachers often combine several effective teaching strategies to help students develop problem-solving competence. Here are some approaches I am using in my teaching. First is Polya's Four-Step Problem-Solving Approach. Second is the Inquiry-Based Learning. Instead of providing direct formulas, guide students to explore, discover, and generalize concepts (e.g., deriving the volume of a pyramid from that of a prism). Third is the I do, We do, You Do. Teacher demonstrates first (I Do), then students practice with guidance (We Do), and finally, they solve independently (You Do)." (P10)*

Effective teaching strategies are crucial for developing students' problem-solving skills. Recent research emphasizes the importance of varied pedagogical approaches to cater to diverse learning needs and enhance mathematical proficiency. Strategies such as integrating technology, as noted by Cruz and Villanueva (2022), where digital tools like virtual manipulatives and interactive math games have enhanced conceptual understanding among Filipino learners, alongside collaborative learning environments, highlighted by Gillies (2016), play a crucial role in developing problem-solving abilities. Furthermore, the use of real-life contexts, guided practice, and visualization through technology integration, as reported by teachers, aligns with findings that culturally relevant examples and mother-tongue instruction significantly help early-grade learners grasp basic arithmetic concepts (Garcia et al., 2023). These multifaceted approaches, combining digital tools, collaborative work, and contextual relevance, are essential for fostering a deeper understanding and appreciation of mathematics.

Theme 2: Evidence of improved problem-solving competence through practice and application

This theme highlights the substantial impact of various instructional strategies on improving students' problem-solving abilities. Teachers revealed that these approaches transform problem-solving activities into interactive, engaging, and meaningful learning experiences. The use of gamified and technology-based learning enhances student engagement and motivation, while active participation fosters the development of problem-solving and cognitive skills. Furthermore, teachers observed notable improvements in students' academic performance and behavior, reflecting the effectiveness of these

methods. Through guided practice and scaffolding, learners build confidence and mastery in tackling mathematical challenges. Additionally, visualization techniques strengthen conceptual understanding, and the integration of real-life applications promotes meaningful learning by connecting mathematical concepts to authentic experiences.

> *"Evidence shows that students engage more actively and demonstrate improved problem-solving skills when gamified activities are used in lessons." (P1)*
>
> *"In my Math 9 class, real-life application is like creating a kite when learning about the topic of kites, making the lesson more engaging and meaningful for the students. With guided practice, they gain confidence through step-by-step support, while visualization tools like GeoGebra help the learners clearly see and understand abstract concepts." (P5)*
>
> *"Evidence of the effectiveness of these strategies can be seen in students' behavior and work. With Polya's Four Steps, students demonstrate a better understanding as they can restate problems, choose effective strategies, and explain their answers clearly. Through Inquiry-Based Learning, they become more curious and can connect new ideas to what they already know—for example, discovering how the volume of a pyramid relates to that of a prism. In the "I Do, We Do, You Do" model, students gain confidence as they progress from guided to independent problem-solving. Overall, these strategies lead to greater participation, clearer reasoning, and stronger problem-solving skills among students." (P10)*

The accounts of participating teachers align with studies by Hwang et al. (2017) and Gillies (2016), which demonstrate that technology and collaboration enhance visualization and critical thinking. In contrast, Bautista and Salonga (2019) emphasize that contextualized instruction makes learning more meaningful.

Teachers' observations reflect these findings. One noted, "Students engage more actively and demonstrate improved problem-solving skills when gamified activities are used in lessons". Another shared that real-life applications and visualization tools, such as GeoGebra, make abstract concepts easier to understand, supporting Ong and Escareal (2023) and Villanueva and Cruz (2022) in their findings on the effectiveness of technology-based approaches. Likewise, Valdez and Taganap (2024) emphasized the importance of guided practice in addressing misconceptions, as reflected in teachers' use of Polya's Steps and Inquiry-Based Learning.

Overall, teacher experiences confirm that varied, technology-integrated, and context-based strategies significantly enhance students' problem-solving competence by fostering engagement, confidence, and deeper understanding.

Problem 2: What are the challenges faced by teachers in using these strategies in teaching problem-solving in Mathematics?

Table 2. Teachers' challenges in teaching problem-solving mathematics

Theme 3: Challenges faced by teachers in using problem-solving strategies	
Merged idea	**Participant**
Time constraints	P1
Limited availability of materials and technology tools	P2, P6
Teachers must balance guidance and independence.	P3, P7
Some students misuse or misapply strategies, showing limited engagement or understanding.	P4, P9
Designing real-life and curriculum-aligned problems	P5, P8
Differences in students' experiences and levels of understanding	P10
Theme 4: Need for professional development and institutional support	
Merged idea	**Participant**
Provision of additional materials and financial support from the Department of Education (DepEd)	P1
Active support from school heads, parents, and the community through proper scheduling, encouragement, and engagement	P2, P9
Extended discussion time and enrichment programs	P3, P7
Encouraging peer discussions and collaborative sharing of experiences	P6
Adequate learning resources and sustained teacher training	P4 & P5
Curriculum flexibility and administrative support	P8 & P10

Note. *Data were gathered from open-ended questionnaire responses and follow-up informal interviews with ten mathematics teachers from Sta. Rosa National High School*

Theme 3: Challenges faced by teachers in using problem-solving strategies

This theme focuses on the common challenges faced by teachers in implementing problem-solving strategies. Teachers emphasized that these approaches are not always efficient due to various challenges, such as time constraints and the limited availability of materials and technological tools. They also face difficulty in balancing guidance and learner independence, as some students misuse or misapply strategies, demonstrating limited engagement or understanding. Additionally, teachers encounter obstacles in designing real-life and curriculum-aligned problems that suit diverse learners. Differences in students' experiences and levels of understanding further complicate the consistent application of problem-solving strategies in the classroom.

> *"Time constraints and limited resources." (P1)*

> *"Students have different experiences and levels of understanding. It is also time-consuming because all of the students will share previous experiences. (P10)*

> *"Creating real-life problems that are meaningful and aligned with the curriculum can be time-consuming, while large class sizes make it hard to provide step-by-step guidance for everyone. Limited access to resources, unstable internet, or lack of training in technology tools like GeoGebra and Desmos also make visualization difficult to implement." (P9)*

"Teachers face challenges such as limited time, different student abilities, and a lack of materials when using these strategies. Some students struggle to articulate their answers, and teachers must strike a balance between providing assistance and allowing students to work independently. Still, teachers adjust their methods to help students improve in problem-solving." (P10)

This supports the findings of Reyes and Mendoza (2020), who identified inadequate materials, time constraints, and insufficient training as key barriers to effective implementation. In contrast, Aquino et al. (2025) and Valle (2025) noted that limited resources and difficulties in integrating technology hinder effective teaching. Valdez and Taganap (2024) further emphasized the struggle teachers face in addressing misconceptions and conducting error analysis. Likewise, Bautista and Salonga (2019) and Gholami (2024) observed that managing diverse classrooms and constrained instructional time often forces teachers to revert to traditional methods. Overall, both teacher accounts and existing studies affirm that, despite the value of problem-solving strategies, their implementation is constrained by systemic issues, such as a lack of resources, time, and professional support.

Theme 4: Need for professional development and institutional support

This theme emphasizes the vital role of continuous professional development and institutional support in enabling teachers to implement problem-solving strategies effectively. Teachers emphasized that innovative approaches such as technology integration and inquiry-based learning require ongoing training, mentoring, and access to adequate resources. They further emphasized the importance of providing additional materials and financial support from the Department of Education (DepEd), as well as active support from school heads, parents, and the community through proper scheduling, encouragement, and engagement. Moreover, extended discussion time and enrichment programs, along with peer discussions and collaborative sharing of experiences, contribute to enhancing instructional practices. Teachers also noted that curriculum flexibility, administrative support, and ongoing training opportunities are essential for fostering effective implementation and continuous improvement of problem-solving instruction.

“Curriculum flexibility and Administrative support. With the right support, teachers can overcome challenges and foster strong problem-solving skills in students.” (P8)

Teachers need access to adequate resources, training, and technology tools to implement problem-solving strategies effectively. They also require more preparation time and flexible curriculum guidelines to integrate real-life contexts and meaningful activities better." (P5)

"Well, the support or intervention that teachers provide is to make the allotted time for discussions longer, as it will not just take an hour to absorb all the contents of the lesson. Moreover, they make a program that all students must participate in twice or thrice a month, where they can learn or understand the mathematical words and techniques that they can use when solving a problem." (P7)

Teachers need support, such as training on effective problem-solving methods, enough learning materials, and smaller class sizes. They also need help from school heads through proper scheduling and encouragement. Extra support for students and involvement from parents or the community can also make problem-solving lessons more successful." (P2)

The literature emphasizes that effective problem-solving instruction relies on sustained professional development and robust institutional support. Reyes and Mendoza (2020) and Valle (2025) found that limited training and digital readiness hinder teachers' use of innovative strategies, while Bautista and Salonga (2019) stressed the need for continuous upskilling to manage diverse classrooms. Gholami (2024) noted that inadequate resources often push teachers to revert to traditional methods. Likewise, Aquino et al. (2025) and Cruz and Villanueva (2022) emphasized that administrative backing and access to technology are essential for implementing modern approaches. Overall, ongoing training and institutional support are essential for enabling teachers to apply problem-solving strategies and enhance student learning effectively.

Conclusion

This study examined how math teachers assist students in developing problem-solving skills, the challenges they encounter when implementing these methods, and the impact of these strategies on classroom teaching. The study also addressed the question: What problem-solving strategies do teachers use in mathematics instruction? What challenges do teachers face in implementing these strategies?

The results showed that teachers employ different strategies to support problem-solving. These include games, tech-based tasks, inquiry work, group work, and Polya's four steps. Teachers also connect lessons to real-life situations, allowing students to see why math matters in their daily lives. These approaches make learning more active and student-centered.

Even with these methods, teachers still encounter issues in applying them consistently. They lack materials, have limited time, and follow a tight curriculum. Many also have little training in newer approaches. Large classes, varying learning levels, and low student motivation also contribute to the challenge. Many teachers want to incorporate technology and inquiry-based tasks, but often lack sufficient support or training.

The study reveals that teachers require consistent training and enhanced school support to apply problem-solving strategies effectively. They need updated tools, practical training, and leadership that allows some flexibility in teaching. When schools provide this support, teachers can better guide students in thinking through problems and building confidence.

Based on the findings, schools and policymakers should invest in long-term training that focuses on problem-solving, technology use, and differentiated instruction. Schools should also provide more materials, smaller class sizes, and a curriculum with more flexibility. Collaboration through mentoring and learning groups can also improve teaching practice. Meeting these needs will help build students' problem-solving skills, critical thinking, and readiness for future learning.

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References

Abebe Kokeb, Mulugeta Atnafu, & Adem Mohammed. (2025). The effects of a visually assisted guided discovery learning strategy on Tenth-Grade Students' problem-solving skills in plane geometry. *Mathematics Teaching Research Journal, 17*(2), 193-225

Al Farra, N. K., Al Owais, N. S., & Belbase, S. (2022). Computational, logical, argumentative, and representational thinking in the United Arab Emirates Schools: Fifth-grade students' skills in mathematical problem solving. *Mathematics Teaching Research Journal, 14*(1), 215–252.

Arif Hidayatul Khusna, Tatag Yuli Eko Siswono, & Pradnyo Wijayanti. (2024). Mathematical problem design to explore students' critical thinking skills in collaborative problem solving. *Mathematics Teaching Research Journal, 16*(3), 217-240.

Baroody, A. J., Lai, M. L., & Mix, K. S. (2018). The development of number and operation sense in early childhood education. In C. K. Leong & E. L. Grigorenko (Eds.), *Mathematics and learning, pp. 199–216.* Routledge

Bautista, J. M., & Salonga, M. G. (2019). Challenges in mathematics teaching in multi-grade Classrooms: Experiences from Philippine Rural Schools. *Journal of Mathematics Education, 10*(2), 45–60.

Boaler, J. (2016). *Mathematical mindsets: Unleashing students' potential through creative math, inspiring messages, and innovative teaching*. Jossey-Bass.

Dela Cruz, R. T., & Bautista, L. M. (2022). Addressing misconceptions in fractions through CPA-based lesson study. Sabton*: Mathematics Research Journal, 1*(1), 45–56.

Ernest, P. (2010). *The philosophy of mathematics education.* Routledge.

García, L. A., Santos, M. R., & Lazo, M. P. (2023). Mother tongue-based instruction in math: Strategies for early grade learners in the Philippines. *Southeast Asian Journal of Educational Studies, 5*(1), 34–47.

Gholami, H. (2023). Performance of Malaysian foundation level students in mathematical problem solving as well as gender comparison. *Mathematics Teaching Research Journal, 15*(2), 104–120.

Gholami, H. (2024). The situation of mathematical problem solving and higher-order thinking skills in the traditional teaching method and the lesson study program. *Mathematics Teaching Research Journal, 16*(3), 241–264.

Gillies, R. M. (2016). Cooperative learning: Review of research and recommendations for implementation. *Australian Journal of Teacher Education, 41*(3), 39–54.

Hwang, G. J., Lai, C. L., & Wang, S. Y. (2017). Seamless flipped learning: a mobile technology-supported flipped classroom with effective learning strategies. *Journal of Educational Technology & Society, 20*(1), 268–279.

Mendoza, J. B., & Lapinid, M. R. C. (2024). The use of the variation theory of learning in teaching solving right triangles. *Mathematics Teaching-Research Journal, 16*(3), 58–75.

De la Puente, M., de Oro, C., Torres, J., Ripoll, M., & Rico Fontalvo, H. (2024). Investigating the impact of chess integration on graph theory learning and strategic thinking skills among eleventh-grade students in Colombia. *Mathematics Teaching-Research Journal, 16*(6), 214–250.

Organization for Economic Co-operation and Development (OECD). (2019). *PISA 2018 results (Volume I).* OECD Publishing.

Ong, J., & Escareal, M. (2023). Enhancing students' performance in mathematics through the use of a concrete–pictorial–abstract approach. *International Journal of Research and Innovation in Social Science, 7*(7), 1800–1806.

Polya, G. (2014). *How to solve it: A new aspect of mathematical method.* Princeton University Press.

Reyes, M. V., & Mendoza, A. G. (2020). Struggles of elementary teachers in teaching mathematics in rural schools in Luzon. *Journal of Basic Education Research, 5*(2), 93–109.

Sukma, Y. V., & Priatna, N. (2023). The effectiveness of blended learning on students' critical thinking skills in mathematics education: *A Literature Review Jurnal Elemen, 9*(2), 371–382.

Tolibas, M. C. J. (2023). Experiences and challenges of public-school elementary teachers in teaching mathematics using the Waray Language. *International Journal of Academic Pedagogical Research, 7*(9), 16–23.

Valdez, F. A. O., & Taganap, E. C. (2024). Error analysis of pre-service mathematics teachers in solving verbal problems. *Mathematics Teaching Research Journal, 16(4) 6–34.*

Villanueva, R. M., & Cruz, M. T. (2022). Digital integration in elementary mathematics: Effects on conceptual understanding and engagement. *Philippine Journal of Educational Measurement, 8*(2), 55–70.