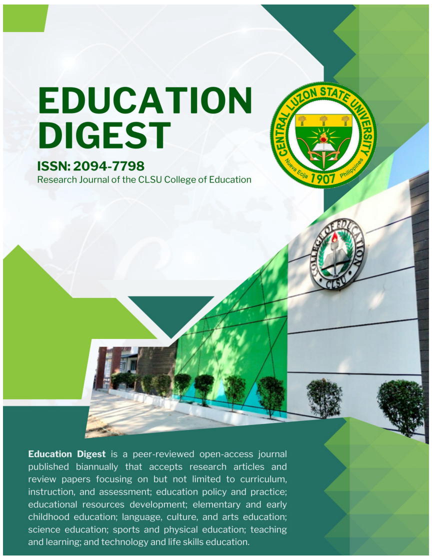

Effectiveness of the IDEAL Model and Polya's Method on Grade 9 Students' Problem-Solving Proficiency and Attitude Toward Right Triangle Problems

Eejay Efraem M. Reyes*, Kyla Kate F. Maron, and Jupeth T. Pentang

Department of Science Education, College of Education,
Central Luzon State University, Science City of Muñoz, Nueva Ecija
*Correspondence: reyes.eejay@clsu2.edu.ph

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Abstract: Problem-solving fosters learners' critical thinking, creativity, and deeper understanding, making them more likely to apply their knowledge in daily life and achieve greater academic success. This study compared the IDEAL Problem-Solving Model and Polya's Problem-Solving Method regarding proficiency and attitudes toward problem-solving involving right triangles. While the IDEAL model emphasized structured analysis of cognitive processes, Polya's method focused on heuristic steps. Specifically, the research examined how learners' problem-solving proficiency and attitudes changed after the intervention. A quasi-experimental design was used to assess the impact of this intervention. The participants were 60 Grade 9 students from San Jose City National High School, selected through purposive sampling. One group was taught using the IDEAL model, while the other learned via Polya's method. Data were collected through a five-problem-solving test and a semantic differential scale, with responses recorded before and after the intervention. The results showed that using the IDEAL model improved students' problem-solving skills and attitudes, leading to increased engagement and understanding. However, overall performance did not reach the desired level, indicating that teaching strategies still need refinement. Ongoing improvements and guidance are necessary to fully develop learners' mathematical skills.

Keywords: classroom-based action research, mathematics learning interventions, problem-solving strategies

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Introduction

The mathematics education research community has increasingly recognized the importance of problem-solving, providing learners with an interactive platform to explore abstract concepts and develop logical reasoning and critical thinking skills. The ability to solve mathematical problems is essential for learners because it serves as the foundation for higher-level mathematics and real-world problems. Problem-solving in mathematics is a crucial part of learning and is often closely linked to fostering curiosity and understanding of the subject. By engaging learners in problem-solving, educators can promote a culture of discovery and progress. Helping learners achieve more in their studies is an effective way to improve their proficiency and learning outcomes (Mbagwu et al., 2020). The teaching approach is problem-based mathematics, which involves presenting students with problems rather than just introducing theorems and results. Students solve these problems by analyzing, thinking, and imagining different scenarios. Unlike traditional education or routine exercises, problem-solving requires learners to assess situations, recognize patterns, and draw conclusions based on mathematical reasoning. The classroom provides a controlled yet flexible environment where learners can face challenges either collaboratively or independently, using strategies to find solutions.

Students who feel in control of their learning outcomes are more likely to employ effective learning strategies (Abdullah, 2016). Conversely, students who mainly focus on solving exercises tend to rely on familiar solutions, which can hinder their ability to approach problems from fundamental principles (Mourtos et al., 2004). This reliance can make it difficult for learners to solve problems in real-world contexts. According to the PISA 2022 results, almost no learners in the Philippines excelled in mathematics (OECD, 2023). Mathematical problem-solving has long been regarded as a vital aspect of mathematics education, both in teaching and learning (Liljedahl et al., 2016). Solving mathematical exercises involves lower-order thinking skills such as remembering, understanding, and applying. Developing strong problem-solving skills offers significant benefits for learners, allowing them to apply mathematical principles in various real-world situations and generate new ideas based on mathematical concepts.

Problem-solving is an essential part of mathematics education, helping learners to apply their knowledge, think critically, and develop practical solutions to complex problems. Despite its significance, there are ongoing concerns about students' proficiency in problem-solving activities across different subjects. These issues stem from the need to ensure that learners have the skills necessary to manage both academic and real-world challenges effectively. The mathematics problem-solving activity involves learners in evaluating how they use mathematical principles in various problem scenarios (Pentang, 2019; Suseelan et al., 2022). Performance in problem-solving reflects a learner's ability to combine knowledge, reason logically, and be creative when facing unfamiliar situations. It serves as an indicator of how well learners can turn theoretical understanding into practical application. This aspect of learning has gained increased attention recently, as educators recognize its importance in promoting lifelong learning and adaptability. Learners develop problem-solving skills by critically analyzing problem statements, assessing information, and applying strategies, which reinforces their understanding through active problem-solving and presenting information (Ayllón et al., 2016). Classroom problem-solving tasks are designed to assess learners' knowledge while encouraging the development of higher-order thinking skills. Students need to go beyond memorization to analyze, evaluate, and generate new ideas.

As a result, problem-solving has become a crucial skill for preparing learners for new and complex situations. As Nguyễn (2021) emphasized, higher-level skills like analytical reasoning, evaluation, and problem-solving are often not prioritized through traditional teaching methods. Several factors affect learners' problem-solving abilities, including cognitive skills, prior knowledge, and education level. Ihechukwu (2020) studied the impact of instructional scaffolding on secondary students and found that this approach has been effective in enhancing learners' performance in mathematics teaching and learning. Teachers play a vital role in creating opportunities for learners to engage in meaningful tasks that broaden their thinking and foster patience. Teachers who encourage learners to take ownership of their learning and develop genuine interest in their work increase motivation and desire to learn (Johnson, 2017). The way classroom tasks are designed significantly influences learners' achievement. Tasks that are too simple may fail to engage students, while overly challenging tasks can cause frustration and disengagement. A practical approach involves balancing activities that are demanding yet appropriate for the learners' current abilities, which is key to fostering growth and confidence in problem-solving. Recent research has highlighted the challenges and advancements in problem-solving education. While much attention is given to problem-solving strategies and performance, it is also vital to consider learners' attitudes toward problem-solving, including working with the right triangle, to understand their experiences and learning progress better.

The attitude of learners impacts their ability to solve problems involving right triangles. They take more risks on complex issues when they have a positive attitude. Attitude also supports their logical and analytical thinking, which are crucial for understanding the concept of trigonometric ratios and applying correct solutions. An encouraging environment fosters engagement, better understanding, and a higher level of applying learned concepts. As Paul (2013) indicated, a positive attitude toward mathematics leads learners to be more committed and active, more willing to put in effort to solve challenging problems, and better at problem-solving. Such positive attitudes increase motivation, decrease math anxiety, encourage more active engagement, and enhance conceptual understanding. As Monje (2005) describes, a well-established relationship exists between learner perceptions, attitudes, and beliefs about work and actual performance. It demonstrates how effective learners can be problem solvers when they trust their abilities. However, many learners struggle with negative attitudes, such as fear of mathematics, lack of self-confidence, and avoidance of complex problems. These attitudes are slightly negatively associated with academic achievement, highlighting the importance of considering other factors, such as teaching methods, home support, and cognitive abilities (Idris et al., 2020). These factors can cause confusion with the correct formula, lead to misunderstandings about angles and sides, and result in a lack of patience during step-by-step problem solving.

Additionally, limited experience with active problem-solving, little real-world application of the right triangle, and low interest contribute to these issues. Erdemir (2009) identified that low learner attitudes are caused by a lack of basic knowledge, lower problem-solving skills, low self-confidence, incorrect use of formulas, and an inability to act as experts in physics tasks, many of which hinder successful learning. This study recommends implementing various active learning strategies, such as heuristic problem-solving, to improve not only students' attitudes but also their academic performance. Such methods provide students with more opportunities to develop critical thinking and practice in real-world problem-solving situations (Wakhata et al., 2022). The IDEAL problem-solving model is an effective way to address problems systematically and transparently. It provides a logical framework that facilitates problem-solving, whether working alone or in a group. The steps involve identifying the problem, setting goals, generating potential solutions, implementing the selected solution, and then analyzing the process and results (Annizar et al., 2020). This organized method encourages learners to think critically, increase their creativity, and continuously evaluate their conclusions, leading to a more effective thought process and better decision-making. It is versatile and helpful in many situations, such as when groups work together to solve problems or individuals make decisions. Another technique used by DepEd is Polya's problem-solving method. George Polya, a Hungarian mathematician, developed this approach. It involves four steps: understanding the problem, devising a plan, executing the plan, and reviewing the results. Polya's method is beneficial for learners because it teaches them how to approach complex problems. Bayocot and Lubina (2019) found that students were significantly better at solving mathematical problems when taught using Polya's approach compared to traditional teaching methods. They also noted that this strategy improved learners' critical thinking skills.

Research Questions

This action research aims to evaluate the effectiveness of the IDEAL problem-solving model and Polya's problem-solving method on the proficiency and attitude of Grade 9 students in solving problems involving right triangles. Specifically, it seeks to answer the following questions:

(1) What are the proficiency levels of the IDEAL Problem-Solving Model group and Polya's Problem-Solving in terms of their pre- and posttest scores in problem-solving involving right triangles?
(2) How do the pretest and posttest scores of the IDEAL Problem-Solving Model group and Polya's Problem-Solving Method group significantly compare?
(3) How do the posttest scores of the IDEAL Problem-Solving Model group significantly compare with those of Polya's Problem-Solving Method group in solving problems involving right triangles?
(4) What are the pre-intervention and post-intervention attitudes of the IDEAL Problem-Solving Model group and Polya's Problem-Solving Method group towards problem-solving involving right triangles, and how do these attitudes compare?
(5) How do pre- and post-intervention attitudes of the IDEAL Problem-Solving Model and Polya's Problem-Solving Method compare towards problem-solving involving right triangles?
(6) How does the post-intervention attitude of the IDEAL Problem-Solving Model group compare with that of Polya's Problem-Solving Model group in problem-solving involving right triangles?
(7) Is there a significant correlation between posttest scores and post-intervention attitude of the IDEAL Problem-Solving Model group and Polya's Problem-Solving Method group?

Methodology

Research Design and Sample

This study employed a quasi-experimental design to investigate the effectiveness of two teaching strategies: the IDEAL Problem-Solving Model and Polya's Problem-Solving Method. Such a design was used to quantify the effect on the proficiency and attitude of Grade 9 learners as they attempted to solve right triangle word problems. Information was collected from intact instructional groups that were already participating in the school program. This allowed us to assess how interventions operated within a natural learning environment. This design enabled the practical comparison of the impacts of two different strategies while still respecting the existing differences between learner groups. This research involved 60 ninth-grade learners from San Jose City National High School, with 30 learners in each group. Participants were selected through purposive sampling, including learners from two different sections based on specific criteria. These criteria included their third-quarter math grades and their perceptions of observable signs of problem-solving skills and attitude. This sampling method was chosen to ensure that the participants were relevant to the study's purpose.

Data Collection and Instruments

Before conducting the formal survey and test, the feasibility and validity of the questionnaire needed to be confirmed. First, the researchers provided learners with an introduction to Polya's method. Then, they handed out a pretest questionnaire. The pretest assessed the learners' problem-solving skills related to right triangles, while the attitude section gauged their initial responses to problem-solving in mathematics. Part of the intervention involved using a lesson plan to ensure a systematic discussion of the IDEAL model. After the intervention, both groups completed a posttest and a post-intervention survey. The posttest included similar questions to the pretest but used the IDEAL model to evaluate any improvement in problem-solving ability. The same semantic differential scale was employed to measure any change in learners' attitudes following the intervention. The instruments used included five problem-solving test questionnaires to measure problem-solving proficiency, and the semantic differential scale was used to measure the participants' attitudes by rating their perspectives before and after the intervention.

Data Analysis

Descriptive statistics were used to summarize and describe the data collected from both the control and experimental groups. The mean, median, and standard deviation were calculated to represent the central tendency and variability of learners' pretest and posttest scores, as well as their pre-intervention and post-intervention attitude scores. These measures gave a clear overview of learners' performance and attitudes, forming the foundation for further analysis. Inferential statistical methods were used to determine the significance of differences and relationships within the data. All analyses were carried out using Jamovi software (version 2.5.3). Before choosing the appropriate tests, assumption checks were performed. The Shapiro–Wilk test evaluated the normality of distributions, where a p-value greater than .05 indicated normality, and $p \leq .05$ signaled a violation. Levene's test assessed the equality of variances across groups. Based on these results, either parametric or nonparametric tests were selected. The student's t-test was applied to data that met the assumptions of normality and equal variance. For data that did not meet these assumptions, the Wilcoxon signed-rank test was used for paired samples, and the Mann–Whitney U test for independent samples. To examine the relationship between posttest scores and post-intervention attitude scores, Pearson's correlation coefficient (r) was calculated. A significance level of .05 was used for all statistical tests.

Ethical Consideration

The current study was conducted in accordance with the ethical guidelines for educational research. Before data collection began, the researchers first obtained the necessary permissions. A letter was sent to the SDS of the San Jose City Division Office to request permission to conduct action research at a selected school. After receiving approval, a letter was also sent to the principal to ask permission to access the school and to recommend participants. Once administrative approval was secured, informed consent forms were distributed to the parents or guardians of the students. The cognitively mature minors were explained the study in an age-appropriate manner, and they provided written or signed consent. Participation was voluntary, and students had the right to withdraw at any time without any negative impact on their standing in the study. Confidentiality of the participants was maintained. No personal information was collected, and the data were securely stored for research purposes only. The instructional intervention in the experimental group was safe, as it aligned with the current curriculum. The control group received standard instructions to ensure equal treatment. The research adhered to the principles of the university and the Department of Education, emphasizing participant safety and fairness.

Results and Discussion

Test Scores of the IDEAL and Polya's Group

The pre- and posttest scores show that Polya's Group had a mean pretest score of 13.0 (SD = 2.27), which slightly decreased to 12.7 (SD = 3.23) in the posttest (Table 1). Similarly, the IDEAL Group started with a comparable pretest mean of 13.0 (SD = 3.20) but showed significant improvement in the posttest, with a mean of 16.1 (SD = 3.75). Despite this improvement, it is essential to note that neither group reached the researcher's target proficiency mean of 19.0 or higher in the post-assessment. These results suggest that, while both groups began at similar levels, only the IDEAL group showed notable improvement after the intervention. This finding aligns with Susanti et al. (2024), who observed significant gains in problem-solving skills among learners using the IDEAL model. The structured stages of the IDEAL model may have helped learners adopt more systematic and reflective approaches to problem-solving, especially with problems involving right triangles. This aligns with Güner and Erbay's (2021) findings, which suggest that structured problem-solving procedures improve metacognitive awareness in learners. However, the posttest mean still falls short of the target of 19.0. This suggests that instructional improvements may be necessary to achieve the desired level of problem-solving proficiency. Allensworth et al. (2021) also noted in Bleiberg's study that instructional enhancements are required to achieve desired competence levels. This emphasizes the importance of establishing instructional benchmarks, completing current interventions, and regularly assessing whether standards are being met. Although the IDEAL model shows considerable promise, the gap between actual and target average scores suggests that additional support, longer interventions, or alternative approaches may be necessary for a larger percentage of learners to achieve advanced skills.

Table 1: Descriptive Analysis of the Pretest and Posttest Scores of the IDEAL Group and Polya's Group.

Group	n	Assessment			
		Pretest		Posttest	
		Mean	SD	Mean	SD
IDEAL Group	30	13.0	3.20	16.1	3.75
Polya's Group	30	13.0	2.27	12.7	3.23

Comparison of Pre- and Posttest Scores of the IDEAL and Polya's Groups

Polya's group showed no statistically significant difference between pretest and posttest scores (p = .510). In contrast, the IDEAL Group demonstrated a considerable improvement from pretest to posttest (t = 5.466, p < .001) (Table 2). These findings suggest that the mean scores for the IDEAL problem-solving model were significantly higher, while Polya's problem-solving method did not produce the same effect. Luthfia (2023) notes that the IDEAL model provides systematic scaffolding to encourage learners' involvement and reflective thinking. Well-structured stages of the IDEAL model may have provided more supportive frameworks for learners to approach problem-solving tasks seriously.

The IDEAL group's average score increased from 13.0 in the pretest to 16.1 in the posttest, indicating a significant improvement in problem-solving skills. Meanwhile, Polya's group experienced a slight decrease from a pretest average of 13.0 to a posttest average of 12.7, which was not statistically significant. These results suggest that the IDEAL model's step-by-step structure helped learners' cognitive engagement and strategic thinking. This aligns with Güner and Erbay (2021), who emphasize that structured approaches, such as the IDEAL model, promote metacognitive awareness and strategic thinking through guided reflection. The IDEAL framework's systematic approach—Identify, Define, Explore, Act, and Reflect—likely encouraged learners to think more critically and reflectively as they solved problems. However, since Polya's method is open-ended, it may need additional scaffolding to be effective at this level. According to Gray (2018), Polya's method is more open and less supervised, and teachers' scaffolding has been shown to help learners connect their conceptual understanding to each stage of the problem-solving process.

Table 2: Mann-Whitney U Test Results Between the Pre- and Posttest of the IDEAL Group and Polya's Group.

Group	Assessment	Mean	Statistic	p
IDEAL Group	Pretest	13.0	-5.466	.001
	Posttest	16.1		
Polya's Group	Pretest	13.0	248.0	.510
	Posttest	12.7		

Comparison of Post-Intervention Performance of the IDEAL and Poyla's Group

Polya's Group's average on these items was 12.7 (SD = 3.23), while the IDEAL Group achieved an average of 16.1 (SD = 3.75). The findings showed a significant difference between the posttest scores (U = 191, p < .001), with the IDEAL Group scoring higher than Polya's Group (Table 3). This indicates that the IDEAL problem-solving model was effective in improving learners' ability to solve problems involving right triangles. This is consistent with Pratiwi et al. (2021), who state that the IDEAL model effectively improves mathematical problem-solving skills. It highlights the effectiveness of instructional strategies in mathematics teaching. The results encourage educators to explore alternative, research-based models, such as IDEAL, to improve learner achievement and address gaps in mathematical understanding.

Table 3: Mann-Whitney U Test Result Between the Posttest of the IDEAL Group and Polya's Group.

Group	Mean	SD	Statistic	p
IDEAL Group	16.1	3.75	191	.001
Polya's Group	12.7	3.23		

The findings highlight the importance of instructional design in mathematics education. Although both models aim to enhance problem-solving skills, the IDEAL model's more structured and explicit processes may have given learners clearer cognitive strategies and better scaffolding, enabling them to tackle complex mathematical problems with greater confidence and consistency. Tay and Toh (2023) show that explicitly scaffolded stages, particularly in planning, allow students to engage more systematically and develop cognitive skills in mathematical problem-solving. This suggests that the success of a problem-solving method depends not only on its theoretical reliability but also on its practical use and accessibility for learners.

Furthermore, this statistically significant result encourages educators and curriculum developers to reevaluate traditional methods and explore new, research-based strategies such as the IDEAL model. Mathematics teachers who incorporate such organized approaches into their classrooms may be better equipped to address learning gaps and help students develop a deeper conceptual understanding. Although Polya's method continues to promote independent thinking, the findings highlight the IDEAL model's potential as a more accessible and effective tool for improving learner performance in targeted problem-solving situations. While Polya's problem-solving approach can foster independent thinking, Yapatang and Poliim (2022) show that its effectiveness is significantly increased when supplemented with organized support, such as cooperative learning.

Comparison of Pre- and Post-Intervention Attitudes of the IDEAL Group toward Problem-Solving Tasks

The IDEAL group showed significant improvement in several attitude indicators: "Boring–Exciting" ($p = .003$), "Unengaging–Engaging" ($p = .026$), "Intimidating–Encouraging" ($p = .012$), and "Overwhelming–Stimulating" ($p < .001$) (Table 4). Polya's group showed no significant changes in any of the indicators. This suggests that the IDEAL intervention was effective not only in improving learners' ability to solve problems involving right triangles but also in positively influencing their attitudes toward mathematics. A shift from "intimidating" to "encouraging" and from "overwhelming" to "stimulating" indicates reduced anxiety and increased motivation. These findings highlight the vital role of attitude in mathematics learning. Research by Gjicali and Lipnevich (2021) highlights that students' attitudes toward mathematics have a significant impact on their engagement and performance. Problem-solving models, such as the IDEAL, can create a more open and less intimidating learning environment. This highlights the importance of teaching all aspects of a complete human being, encompassing both attitude and cognition. This aligns with Russo and Minas (2020), who found that problem-based assignments enhance curiosity, creativity, and emotional engagement, all of which contribute to a more stimulating and less intimidating workplace.

The statistical results underscore the importance of incorporating emotional outcomes into mathematics teaching. For example, the median scores for "Overwhelming-Stimulating" in the IDEAL group increased from 4.00 to 5.00, showing the most tremendous improvement with a highly significant p-value of less than .001. This positive change may result from reduced stress or confusion, which are common when facing challenging situations. Similarly, the increase in the "Intimidating-Encouraging" score from a median of 4.00 to 5.00 ($p = .012$) suggests that learners are becoming more confident and open to math learning environments. The Polya group, however, remained unchanged primarily or showed slight improvements in most indicators, without reaching statistical significance, indicating that the intervention did not significantly influence learners' emotional engagement with mathematics. These results imply that emotional development should not be considered secondary to cognitive growth. When students find the learning environment exciting, engaging, and supportive, they are more likely to participate and persist. As a result, the IDEAL approach not only enhances mathematical achievement but also fosters a more emotionally supportive and motivating learning environment. This dual effect strongly supports the integration of holistic and research-based teaching methods into the mathematics curriculum.

Table 4: Pre- and Post-Intervention Attitudes of the IDEAL Group and Polya's Group.

	IDEAL Group				**Polya's Group**			
Indicator	Pre-Intervention Attitude	Post-Intervention Attitude	Stat	p	Pre-Intervention Attitude	Post-Intervention Attitude	Stat	p
Boring-Exciting	4.00	5.00	13.50	.003	3.00	4.00	- 1.29	.206
Frustrating-Challenging	4.50	5.00	36.00	.162	4.00	4.00	- 1.04	.309
Unengaging-Engaging	4.00	4.00	25.50	.026	4.00	4.00	107.5	.221
Intimidating-Encouraging	4.00	5.00	- 2.69	.012	2.50	4.00	122.0	.063
Overwhelming-Stimulating	4.00	5.00	9.00	.001	2.00	3.00	115.0	.199

Comparison of Post-Intervention Attitude of the IDEAL and Polya's Group

All indicators showed significant differences favoring the IDEAL model. The IDEAL group scored much higher on the "Boring-Exciting" scale than Polya's group ($M = 4.47$, $SD = 0.63$; $M = 3.60$, $SD = 1.10$), $p = .002$ (Table 5). Significant results were found across all other indicators, including "Frustrating-Challenging" ($M = 4.47$ vs. 3.90, $p = .029$), "Unengaging-Engaging" ($M = 4.30$ vs. 3.77, $p = .008$), "Intimidating-Encouraging" ($M = 4.53$ vs. 3.70, $p = .001$), and "Overwhelming-Stimulating" (M = 4.67 vs. 3.53, p = .001). These results demonstrate that the IDEAL model promotes a more positive learner attitude than Polya's method, with learners finding the learning process more engaging, less intimidating, and more stimulating under IDEAL. The findings support Sturn and Bohndick (2021), which shows that even with training interventions, positive student attitudes significantly improve problem-solving performance.

This positive effect led to increased participation, persistence, and interest in problem-solving activities, highlighting the connection between cognitive development and emotional changes. The notable improvements in attitude suggest that the IDEAL model not only enhances learners' problem-solving skills but also creates a supportive learning environment that reduces fear and increases motivation. These emotional effects are vital because they encourage children to take on challenges and persevere in the face of difficulties. This finding is consistent with the results of Gjicali and Lipnevich (2021), who discovered that students' intentions, engagement, and performance are all significantly influenced by their positive attitudes toward mathematics. Therefore, effective teaching strategies should address both what learners know and how they feel about the learning process. Models like IDEAL are valuable for fostering comprehensive development in mathematical education.

Table 5: Mann-Whitney U Test Result Between the Post-Intervention Attitude of the IDEAL Group and Polya's Group.

Indicator	Group	Mean	SD	Statistic	p
Boring-Exciting	IDEAL Group	4.47	0.63	248	.002
	Polya's Group	3.60	1.10		
Frustrating-Challenging	IDEAL Group	4.47	0.73	313	.029
	Polya's Group	3.90	1.06		
Unengaging-Engaging	IDEAL Group	4.30	0.79	281	.008
	Polya's Group	3.77	0.77		
Intimidating-Encouraging	IDEAL Group	4.53	0.73	229	.001
	Polya's Group	3.70	0.99		
Overwhelming-Stimulating	IDEAL Group	4.67	0.55	178	.001
	Polya's Group	3.53	1.07		

Correlation Between Posttest Scores and Post-Intervention Attitudes of the IDEAL Group and Polya's Group

In both the IDEAL group (r = 0.408, p = .025) and Polya's group (r = 0.411, p = .024), the only attitude indicator that significantly correlated with posttest scores was "Intimidating–Encouraging". This implies that learners who felt less intimidated and more encouraged were more likely to perform better (Table 6). This finding highlights the vital role that emotional safety and support play in the classroom: when learners view problem-solving tasks as encouraging rather than threatening, they are more willing to take academic risks and persist through difficulties. According to Wang et al. (2022), math performance and student involvement are highly predicted by their attitudes. Persistence is increased when the threat is reduced. This attitude shift is crucial in mathematical contexts, where self-doubt and anxiety are common barriers to success.

Furthermore, in Polya's group, posttest scores showed stronger and more statistically significant associations with two additional indicators: "boring-exciting" (r = 0.436, p = .016) and "frustrating-challenging" (r = 0.462, p = .010). These findings suggest that learners who found the tasks more exciting and viewed frustration as a challenge rather than a setback performed better. According to Russo and Minas (2020), when given challenging yet well-supported problem-solving assignments, students report higher levels of enjoyment, engagement, and emotional positivity. Interestingly, these connections were less pronounced in the IDEAL group, where the model's structure may have provided more consistent support, reducing performance variability caused by attitude differences. This suggests that, while positive attitudes can significantly impact performance in open-ended or less structured environments, such as Polya's approach, a well-designed instructional framework, like IDEAL, can help standardize outcomes by providing uniform cognitive and emotional scaffolding for all learners.

Table 6: Correlation of Posttest Scores and Post-Intervention Attitude.

Post-Intervention Attitude	**Posttest Scores**			
	IDEAL Group		**Polya's Group**	
	Pearson's r	**p**	**Pearson's r**	**p**
Boring-Exciting	.009	.963	.436	.016
Frustrating-Challenging	.247	.189	.462	.010
Unengaging-Engaging	.302	.105	.313	.093
Intimidating-Encouraging	.408	.025	.411	.024
Overwhelming-Stimulating	.269	.151	-.026	.889

Conclusion and Recommendations

The IDEAL problem-solving model excelled over Polya's method in terms of improving both learner proficiency and attitudes toward solving right triangle problems. While Polya's group made little or no progress, the IDEAL group showed significant improvements in engagement, motivation, and problem-solving skills. A more disciplined and supportive strategy, such as the IDEAL model, can encourage not only cognitive development but also emotional preparation and confidence in the face of mathematical challenges. However, the findings also highlight the fact that current interventions, while helpful, may fall short of targeted proficiency levels. This emphasizes the importance of ongoing instructional modification, as well as the need to recognize the interplay between cognitive skills and emotional elements in acquiring a deeper understanding of mathematical knowledge.

Teachers may be encouraged to use the IDEAL problem-solving model in mathematics lessons about right triangle problems. Its systematized, learner-focused nature challenges students to pay better attention and learn more effectively. However, for target proficiency levels, additional strategies such as allocating more time on task, differentiation, and visualization might be necessary. Finally, additional training for teachers is also recommended concerning the implementation of problem-solving models. Further investigation might compare the long-term effects of these models, examine how their effectiveness changes with different math topics, and explore how learner attitudes can be more fully utilized to enhance performance.

Conflict of Interest

The authors declare that they have no conflict of interest.

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Authorship Details

Reyes (50%): concept and design, data acquisition and analysis, writing the manuscript
Maron (40%): data acquisition, writing the manuscript.
Pentang (10%): review and editing.

Use of AI Declaration

Grammarly was used to correct spelling and grammar errors, which helped make the research more professional and polished. Additionally, QuillBot was used to paraphrase specific sentences to enhance the writing style while preserving the original meaning of the content. All the mentioned AI tools were used solely as technical support, and the ideas, analysis, and interpretation of the research still originated from the researcher.

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