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The Effectiveness of the Mathematical Practices in Improving the Problem-Solving Skills of the Grade 9 Learners in Goa District, Division of Camarines Sur

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ABSTRACT

This study examined the mathematical practices employed by teachers and their effectiveness in improving the problem-solving skills of Grade 9 learners in the Goa District, Division of Camarines Sur, during School Year 2024–2025. Anchored on contemporary perspectives in mathematics education and learning recovery initiatives, the study focused on five core mathematical practices—anticipating, monitoring, selecting, sequencing, and connecting—and their influence on learners' problem-solving skills in terms of critical thinking, decision making, reasoning, analytical thinking, and creativity. The study responds to persistent concerns on learners' low performance in mathematics and science, as reflected in national and international assessments, and emphasizes the role of classroom practices in strengthening higher-order thinking skills. A descriptive–evaluative–correlational research design was utilized. Data were collected from thirty-one (31) Grade 9 mathematics teachers in the Goa District using a researcher-developed questionnaire supplemented by interviews. Weighted mean was employed to determine the extent of implementation of mathematical practices and their effectiveness in improving learners' problem-solving skills, while Kendall's Coefficient of Concordance (W) and the corresponding chi-square test were used to determine the level of agreement in rank orders among respondents, with the level of significance set at 0.05. Results revealed that all five mathematical practices were rated "Very Much Employed," indicating a high level of instructional implementation across schools. Among these, anticipating and selecting practices obtained the highest ratings, highlighting teachers' emphasis on predicting learner responses and choosing tasks that promote conceptual understanding and multiple solution strategies. Moreover, the mathematical practices were found to be highly effective in improving learners' problem-solving skills, particularly in critical thinking and reasoning, while decision making, analytical thinking, and creativity were rated as much effective. Tests of agreement showed significant concordance in selected domains, suggesting shared perceptions among teachers regarding effective practices, although variability existed across school types. The study concludes that intentional and well-structured mathematical practices significantly contribute to the development of learners' problem-solving skills at the secondary level. The findings provide empirical support for strengthening inquiry-based, learner-centered mathematics instruction and serve as a basis for formulating policy recommendations aimed at enhancing teacher training, curriculum implementation, and instructional support systems to improve mathematics learning outcomes.

1. Introduction

Problem-solving is a central goal of mathematics education, as it equips learners with the ability to analyze situations, apply logical reasoning, and generate solutions to both academic and real-world challenges. In mathematics, problem-solving is not limited to performing computations but involves a complex cognitive process that includes understanding the problem, identifying relevant information, translating situations into mathematical representations, and applying appropriate strategies to reach justified conclusions. These competencies are essential in developing higher-order thinking skills, particularly at the secondary level where mathematical concepts become increasingly abstract and demand deeper reasoning and analytical capacity.

In recent years, concerns have been raised regarding the declining problem-solving skills of learners, particularly in the context of rapid digital advancement and increased exposure to non-academic online activities. While technology offers opportunities for innovative learning, excessive and unguided use has been associated with reduced engagement in sustained reading, reasoning, and reflective problem-solving tasks. These challenges are reflected in the consistently low performance of Filipino learners in international assessments such as the Trends in International Mathematics and Science Study (TIMSS), which highlight persistent gaps in mathematical reasoning and application skills. Such outcomes underscore the urgent need to strengthen instructional practices that explicitly develop learners' problem-solving competencies in mathematics classrooms.

The Philippine education system has responded to these challenges through policy reforms and learning recovery initiatives that emphasize foundational and higher-order skills. Legislative frameworks such as the Enhanced Basic Education Act of 2013 (Republic Act No. 10533) and ongoing national programs like the National Learning Recovery Program underscore the importance of equipping learners with critical thinking, decision making, and problem-solving abilities. These reforms place teachers at the center of instructional transformation, recognizing that the quality of classroom practices directly influences learners' cognitive development and academic achievement. In mathematics education, this has led to increased attention to mathematical practices that guide how teachers design tasks, facilitate discussions, and support learners' reasoning processes.

Mathematical practices—particularly anticipating, monitoring, selecting, sequencing, and connecting—have been identified in the literature as essential instructional processes that support meaningful mathematical learning. These practices enable teachers to anticipate learner responses, monitor thinking in real time, select and sequence solution strategies strategically, and help learners connect mathematical ideas across contexts. Empirical studies have shown that when these practices are systematically employed, learners are more likely to develop flexible problem-solving strategies, conceptual understanding, and mathematical reasoning. However, despite their documented importance, there is limited empirical evidence examining the extent to which these practices are employed in public secondary schools and how effective they are in improving learners' problem-solving skills within specific local contexts.

In the Goa District, Division of Camarines Sur, schools have demonstrated commendable achievements in academic and co-curricular domains, yet challenges in mathematics problem-solving remain consistent with national trends. Given the district's role as a key educational center in the region, examining instructional practices in mathematics is both timely and relevant. Thus, this study was conducted to determine the extent of the mathematical practices employed by Grade 9 teachers and to assess their effectiveness in improving learners' problem-solving skills in terms of critical thinking, decision making, reasoning, analytical thinking, and creativity. The findings of this study aim to contribute to evidence-based instructional improvement, inform policy formulation, and support ongoing efforts to strengthen mathematics education and learning recovery initiatives in secondary schools.

2. Methodology

This study employed a descriptive–evaluative–correlational research design to determine the extent of the mathematical practices employed by teachers and their effectiveness in improving the problem-solving skills of Grade 9 learners in the Goa District, Division of Camarines Sur, during School Year 2024–2025. The descriptive component was used to establish the level of implementation of mathematical practices and the degree to which learners' problem-solving skills were developed. The evaluative aspect assessed the effectiveness of these practices in enhancing specific problem-solving dimensions, while the correlational component examined the level of agreement among respondents regarding the rank orders of the practices and their effectiveness, without manipulating any variables in the natural classroom setting.

The respondents of the study were thirty-one (31) Grade 9 mathematics teachers from public secondary schools in the Goa District. Purposive sampling was employed, as only teachers currently handling Grade 9 Mathematics during the specified school year were included to ensure relevance and accuracy of responses. For comparative analysis, respondents were categorized according to school type—big, medium, and small schools—based on enrollment size. The study focused on teachers' instructional practices and their perceived effectiveness in improving learners' problem-solving skills, and did not involve direct testing of learners, consistent with the defined scope and delimitations of the research.

Data were gathered using a researcher-developed questionnaire, supplemented by interviews to enrich the interpretation of quantitative findings. The questionnaire was composed of two major sections: the first measured the extent of the mathematical practices employed by teachers along anticipating, monitoring, selecting, sequencing, and connecting; the second assessed the effectiveness of these practices in improving learners' problem-solving skills in terms of critical thinking, decision making, reasoning, analytical thinking, and creativity. All items were anchored on the Grade 9 Mathematics curriculum and established literature on mathematical practices and problem-solving. The instrument underwent content validation by experts in mathematics education and educational research to ensure clarity, relevance, and alignment with the objectives of the study.

For data analysis, frequency count and percentage were used to describe the distribution of respondents according to school type. Weighted mean and ranking were employed to determine the extent of implementation of mathematical practices and their effectiveness in improving learners' problem-solving skills, based on a five-point Likert scale with corresponding verbal interpretations. To test the significance of agreement on the rank orders among respondents, Kendall's Coefficient of Concordance (W) with the corresponding chi-square (χ^2) test was applied, with the level of significance set at 0.05. The results of these statistical analyses served as the basis for drawing conclusions and formulating policy recommendations aimed at strengthening mathematics instruction and problem-solving development in secondary schools.

3. Results and Discussions

3.1 Extent of the Mathematical Practices Employed by Teachers

The extent of the mathematical practices employed by Grade 9 teachers was examined along anticipating, monitoring, selecting, sequencing, and connecting. Results show consistently high levels of implementation across all five practices.

Table 1: Summary of the Extent of Mathematical Practices Employed by Teachers

Mathematical Practice	Weighted Mean	Verbal Interpretation
Anticipating	4.82	Very Much Employed
Monitoring	4.76	Very Much Employed

Selecting	4.88	Very Much Employed
Sequencing	4.59	Very Much Employed
Connecting	4.66	Very Much Employed

As shown in Table 1, all mathematical practices were rated "Very Much Employed," indicating that teachers consistently integrate these practices in mathematics instruction. Among the five, *selecting* obtained the highest weighted mean, reflecting teachers' strong emphasis on choosing tasks and assessment activities that promote conceptual understanding, reasoning, and multiple solution strategies. This finding suggests that task selection is a central instructional priority in Grade 9 mathematics classrooms.

Anticipating also obtained a high mean, highlighting teachers' proactive efforts to predict learner responses, misconceptions, and solution pathways. However, despite the overall high rating, the indicator on scaffolding instruction through prior knowledge registered the lowest mean within this domain. This implies that while teachers anticipate learner strategies, there is room to strengthen explicit scaffolding practices that connect prior knowledge to new mathematical concepts.

Monitoring was likewise rated very highly, underscoring teachers' reliance on formative assessments, inquiry-based questioning, and error analysis to track learner understanding. Nonetheless, adapting monitoring approaches through differentiated instruction yielded the lowest rating in this domain, suggesting challenges in tailoring monitoring strategies to diverse learner needs, particularly across different school types.

In terms of sequencing, teachers demonstrated consistent practice in organizing lessons logically and progressively. However, indicators related to gradually increasing task complexity and scaffolding problem-solving processes ranked lower, indicating a need for more deliberate structuring of learning progressions. *Connecting*, while still very much employed, showed relatively lower means for integrating real-world contexts and interdisciplinary applications, suggesting that conceptual connections are prioritized more than contextual applications.

3.2 Agreement on the Rank Orders of Mathematical Practices

To determine the consistency of teachers' perceptions regarding the rank orders of mathematical practices, Kendall's Coefficient of Concordance (W) was applied.

Table: 2 Test of Significant Agreement on the Rank Orders of Mathematical Practices

Mathematical Practice	Kendall's W	χ^2 Value	p-value	Decision
Anticipating	0.84	20.16	<0.01	Significant
Monitoring	0.62	11.16	<0.05	Significant
Selecting	0.77	18.48	>0.025	Not Significant
Sequencing	0.78	16.38	<0.05	Significant
Connecting	0.54	9.72	>0.05	Not Significant

The results indicate significant agreement among respondents on anticipating, monitoring, and sequencing practices, suggesting shared instructional priorities across schools. However, no significant agreement was observed for selecting and connecting practices. This implies variability in how teachers prioritize task selection and conceptual connections, which may be influenced by school context, available resources, and instructional autonomy.

3.3 Effectiveness of Mathematical Practices in Improving Problem-Solving Skills

The effectiveness of mathematical practices was assessed in terms of learners' critical thinking, decision making, reasoning, analytical thinking, and creativity.

Table 3: Summary of the Effectiveness of Mathematical Practices in Improving Problem-Solving Skills

Problem-Solving Skill	Verbal Interpretation
Critical Thinking	Very Much Effective
Decision Making	Much Effective
Reasoning	Very Much Effective
Analytical Thinking	Much Effective
Creativity	Much Evident

The results show that mathematical practices were very much effective in enhancing learners' critical thinking and reasoning, indicating that learners are able to analyze information, justify solutions, and evaluate mathematical arguments effectively. These outcomes affirm the role of structured mathematical practices in fostering higher-order reasoning skills.

In contrast, decision making and analytical thinking were rated only much effective, suggesting that while learners demonstrate competence in selecting and evaluating solution strategies, these skills are not yet maximized. This may indicate the need for more explicit instruction in structured problem-solving frameworks and analytical reasoning processes. Creativity received the lowest overall rating, although still within a positive category, implying that innovative and flexible problem-solving approaches are present but less emphasized than logical reasoning skills.

3.4 Agreement on the Rank Orders of Effectiveness of Mathematical Practices

The level of agreement among respondents regarding the effectiveness of mathematical practices in improving problem-solving skills was likewise examined using Kendall's W.

Table 4: Test of Significant Agreement on the Rank Orders of Effectiveness

Problem-Solving Skill	Kendall's W	χ^2 Value	p-value	Decision
Critical Thinking	1.00	24.00	<0.005	Significant
Decision Making	0.99	20.79	<0.005	Significant
Reasoning	0.70	12.60	<0.05	Significant
Analytical Thinking	0.77	—	<0.05	Significant

The very high concordance values indicate strong and consistent agreement among teachers regarding the effectiveness of mathematical practices in improving learners' problem-solving skills. This strengthens the reliability of the findings and suggests that observed outcomes are not isolated perceptions but shared instructional experiences across schools.

Overall, the findings demonstrate that mathematical practices are extensively employed and are effective in improving Grade 9 learners' problem-solving skills, particularly in critical thinking and reasoning. While teachers show strong consistency in implementing key practices, variability exists in task selection, conceptual connections, differentiated monitoring, and creativity-oriented instruction. These results highlight areas where instructional refinement and targeted professional development may further enhance learners' higher-order mathematical competencies.

4. Conclusions and Implications

4.1 Conclusions

Based on the findings of the study, it is concluded that the mathematical practices employed by Grade 9 mathematics teachers in the Goa District, Division of Camarines Sur are extensively and consistently implemented. All five practices—anticipating, monitoring, selecting, sequencing, and connecting—were rated Very Much Employed, indicating that teachers deliberately integrate these practices in classroom instruction. This suggests a strong alignment between instructional approaches and contemporary standards in mathematics education that emphasize structured problem-solving, reasoning, and conceptual understanding.

The study further concludes that anticipating and selecting practices emerged as the strongest instructional domains, reflecting teachers' ability to predict learner responses and to choose tasks that promote conceptual depth and multiple solution strategies. However, despite the overall high ratings, certain indicators—particularly those related to scaffolding through prior knowledge, differentiated monitoring, and real-world contextualization—consistently ranked lower within their respective domains. This indicates that while teachers are generally effective in planning and task design, there remains a need to strengthen instructional coherence through scaffolding, differentiation, and contextual application.

In terms of outcomes, the mathematical practices were found to be highly effective in improving learners' problem-solving skills, especially in critical thinking and reasoning, which were rated Very Much Effective. These findings indicate that learners are able to analyze problems, justify solutions, and evaluate mathematical arguments with a high degree of competence. Conversely, decision making, analytical thinking, and creativity were rated only Much Effective or Much Evident, suggesting that these higher-order and generative skills are developing but not yet maximized. This pattern implies that instructional practices are more strongly oriented toward logical reasoning than toward flexible, innovative, and creative problem-solving.

Finally, the tests of significant agreement revealed strong concordance among teachers regarding the effectiveness of mathematical practices in improving problem-solving skills, and partial concordance in the extent of practice implementation. This indicates shared instructional perceptions across schools, while also pointing to contextual variations in how certain practices—particularly selecting and connecting—are prioritized and enacted.

4.2 Implications

The findings of this study have important implications for instruction, school leadership, curriculum development, and educational policy. At the instructional level, the results underscore the importance of sustaining strong practices in anticipating, monitoring, and selecting tasks, while placing greater emphasis on scaffolding instruction, differentiated monitoring, and the integration of real-world contexts. Teachers are encouraged to deliberately link prior knowledge to new concepts, design learning sequences that gradually increase cognitive demand, and create opportunities for learners to engage in creative and flexible problem-solving.

For school heads and instructional leaders, the findings imply the need to provide targeted professional development programs that focus on differentiated instruction, scaffolding strategies, and creativity-enhancing mathematical tasks. Instructional supervision and collaborative lesson planning may help reduce variability in practice implementation and promote greater consistency across school types. Ensuring access to instructional resources, including technology-supported tools and contextualized learning materials, may further enhance the effectiveness of mathematical practices.

In terms of curriculum and policy, the study provides empirical support for strengthening learner-centered and inquiry-based approaches in secondary mathematics education. Curriculum writers and policymakers may use the findings as a basis for refining curriculum guides to explicitly emphasize problem-solving processes, real-world applications, and creative mathematical thinking. Embedding these elements into curriculum standards and teacher training frameworks can help address persistent gaps in decision making, analytical thinking, and creativity.

Overall, the study implies that while strong foundations in mathematical practices are already in place, systematic instructional refinement and policy support are necessary to fully develop learners' higher-order problem-solving skills. Strengthening these areas is essential not only for improving mathematics achievement but also for preparing learners to respond effectively to complex academic and real-life challenges.

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