MATHEMATICAL PROFICIENCY AS AN OUTPUT OF ENRICHMENT PROGRAMS AND PEDAGOGICAL PREPAREDNESS

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ABSTRACT

The primary purpose of this study was to examine the intricate relationship between enrichment programs, pedagogical preparedness, and the mathematical proficiency of pre-service teachers. Employing a quantitative research design, the study utilized a descriptive-correlational method to establish the relationship between variables. A comprehensive sampling was used and adapted well-structured survey questionnaires were distributed to gather relevant data from the participants. Correspondingly, the data analysis was performed using statistical tools such as mean and standard deviation, Pearson's correlation coefficient (r), and regression analysis to distill complex data into meaningful insights and answer the research objectives. The findings revealed that the levels of both enrichment programs and pedagogical preparedness among pre-service teachers were very high, indicating that they are always manifested and consistently implemented. Additionally, the level of mathematical proficiency was found to be high, suggesting that the pre-service teachers frequently exhibited strong mathematical skills. There is a confirmation that the levels of enrichment programs and pedagogical preparedness have a significant relationship with mathematical proficiency. Therefore, this connects to the idea that enrichment programs and pedagogical preparedness influence the mathematical proficiency of pre-service teachers. These findings emphasize the importance of integrating comprehensive enrichment programs and adaptive pedagogical strategies into teacher training, enabling pre-service teachers to develop advanced mathematical understanding and effective teaching practices. Continuous professional development tailored for pre-service teachers, complemented by peer mentoring, seminars, and collaborative training within and beyond schools, can further refine teaching skills and enhance mathematical proficiency. By fostering this holistic approach, the study contributes to improving teaching effectiveness and student outcomes, promoting a culture of excellence in mathematics education.

KEYWORDS

Enrichment programs, pedagogical preparedness, mathematical proficiency, pre- service teachers, Davao City, Philippines

1. INTRODUCTION

Mathematical proficiency encompasses a blend of abilities contributing to effective learning and application of mathematics. It is a multifaceted construct involving mathematical knowledge, skills, and dispositions (Fuchs et al., 2021). It includes conceptual understanding –the ability to grasp mathematical concepts, processes, and relationship—and procedural fluency, the ability to execute procedures flexibly and accurately (Al-Mutawah et al., 2019). A comparative study of Kandeel et al. (2018) showed that learners' mathematical proficiency in first world countries are notably high. However, in the Organization for Economic Cooperation and Development's (OECD) latest Programme for International Student Assessment (PISA), the Philippines ranked

77th out of 81 countries in mathematics, reading, and science for 15-year-old students. Filipino learners scored an average of 355 points in mathematics, significantly below the OECD average of 472, with only 16% reaching at least Level 2 proficiency compared to an OECD average of 69%. This indicates a substantial gap in the country's educational system, underscoring the need for interventions (Ines, 2023; 2024).

Studies have inferred various factors influencing mathematical proficiency, such as attitudes and perception of teachers and students (Chand et al., 2021), student demographics and parents' educational attainment (Peteros et al., 2019), teacher qualifications and instructional materials (Varaidzaimakondo & Makondo, 2020), and mentoring strategies (Mijares, 2022). These factors impact mathematics performance, and a lack of appreciation for the relevance of mathematics in different careers can negatively impact students' engagement (Fitzmaurice et al., 2021).

Meanwhile, enrichment programs are proven to aid mathematical performance, especially for learners needing additional support. Mentorship programs, for instance, have been effective in improving the academic performance of underperforming students (Guhan et al., 2020b). Additionally, teachers who use visual representations, such as imagery, also enhanced students' cognitive processes during math learning (Murphy, 2019). As Homedan et al. (2021) reported, supplementary mathematics classes significantly improve students' mathematical performance.

Additionally, pedagogical preparedness including efficient teaching strategies like structured lesson plans, encouragement of classroom discussions, and integration of modern teaching tools, have the potential to enhance students' mathematical competencies (Sarder & Haider, 2023). Moreover, effective classroom management strategies, highlighted by Runyan (2018), also significantly impacts students' mathematical proficiency and help teachers adapt to dynamic school environments (Granziera et al., 2019).

Despite these efforts, poor performance in mathematics persists, as shown by PISA (2022). Hence, more research is needed to address empirical, methodological, and theoretical gaps that exist in this area. Prior findings need empirical verification, and new methods should be employed to uncover fresh insights. A lack of theoretical frameworks also limits understanding (Müller-Bloch & Kranz, 2014; Miles 2017). Unlike previous studies that focused on one or two variables, this study explores the interplay between enrichment programs, pedagogical preparedness, and mathematical proficiency, offering a unique approach.

This study seeks to investigate how enrichment programs and pedagogical preparedness influence pre-service teachers' mathematical proficiency. Specifically, the objectives are: (1) to describe the level of enrichment programs provided to pre-service teachers; (2) to ascertain their pedagogical preparedness; (3) to assess their mathematical proficiency; (4) to determine the relationship between (4.1) enrichment programs and mathematical proficiency, and (4.2) pedagogical preparedness and mathematical proficiency; and (5) to test the influence of enrichment programs and pedagogical preparedness on mathematical proficiency.

The study hypothesizes that (1) enrichment programs and pedagogical preparedness do not have significant relationship with the mathematical proficiency of pre-service teachers; and (2) enrichment programs and pedagogical preparedness do not influence their mathematical proficiency. It also aims to fill existing gaps and provide insights to improve teacher education programs. The findings could inform strategies to enhance the mathematical proficiency of pre-service teachers, ultimately improving the quality of mathematics education in the Philippines.

2. METHODS

2.1. Research Design

This study employed a quantitative research design, utilizing a descriptive-correlational approach to measure characteristics and investigate relationships between variables like enrichment programs, pedagogical preparedness, and mathematical proficiency. Quantitative research investigates the relationship between variables using statistical methods to evaluate objective theories. Additionally, descriptive research was used to collect and organize data about trends and conditions, while correlational research assessed the degree and direction of relationships between variables (Stangor & Walinga, 2014).

2.2. Sampling Method, Sample Size and Research Respondents

The comprehensive sampling method was employed in this study, ensuring all individuals within the specified population characteristics were included (Gray, 2004). The respondents comprised 153 pre-service teachers enrolled in various educational programs such as Bachelor of Secondary Education, Bachelor of Elementary Education, and Bachelor of Physical Education. These participants were included based on their enrollment in mathematics courses, completion of competency appraisals, and relevant experience in classroom contexts, while those not enrolled or lacking relevant experience were excluded. This sampling method ensured the findings would be generalizability to the broader population of pre-service teachers.

2.3. Research Locale

The study was conducted in a distinguished educational institution in Davao City, Philippines, recognized by the Department of Education (DepEd) and the Commission on Higher Education (CHED). The institution offers various academic programs, including senior high school and baccalaureate degrees. It has a strong reputation for maintaining high educational standards and nurturing students' learning capabilities for over 24 years. This institution was chosen due to its accessibility to the researcher and the relevant characteristics of its pre-service teacher population.

2.4. Research Instruments

Three sets of validated survey questionnaires were adapted and used to gather data. The first instrument adapted from Brodesky et al. (2018) assessed the extent and impact of enrichment programs, while the second tool evaluated pre-service teachers' pedagogical preparedness to deliver effective instruction, crafted by Roble and Bacabac (2016). The third instrument designed by Peteros et al. (2019) measured the respondents' mathematical proficiency.

Each instrument employed a four-point Likert scale to assess the frequency and intensity of the variables, ranging from "Very Low" to "Very High", as detailed in Table 1. The researcher ensured the validity of these instruments through face validity, where experts reviewed the questionnaires for cultural appropriateness and relevance (Taherdoost, 2016). To further ensure accuracy the questionnaires were modified to suit the respondents' cultural context, ensuring integrity of the collected data in reflecting the actual area of investigation.

Table 1 Four-point Likert Scale for Interpretation of Results

Range of Means	Descriptive Equivalent	Interpretation
3.26-4.00	Very High	When the level enrichment programs, pedagogical preparedness, and mathematical proficiency of pre-service teachers are always manifested.
2.51-3.25	High	When the level enrichment programs, pedagogical preparedness, and mathematical proficiency of pre-service teachers are oftentimes manifested.
1.76-2.50	Low	When the level enrichment programs, pedagogical preparedness, and mathematical proficiency of pre-service teachers are rarely manifested.
1.00-1.75	Very Low	When the level enrichment programs, pedagogical preparedness, and mathematical proficiency of pre-service teachers are not manifested at all.

2.5. Data Collection and Statistical Tools

Data collection began after obtaining approval from relevant authorities and validation of the research instruments. The researcher distributed the survey questionnaires to the respondents, who completed them with an understanding of the study's objectives. After gathering the data, it was analyzed using several statistical tools. Mean and standard deviation were used to describe the levels of enrichment programs, pedagogical preparedness, and mathematical proficiency. Pearson's correlation coefficient (r) determined the relationships between these variables. To examine the predictive influence of enrichment programs and pedagogical preparedness on mathematical proficiency, regression analysis was utilized. This technique measures how changes in independent variables impact the dependent variable while controlling for other factors (Taylor, 2024). Understanding these relationships can lead to better predictions of future behaviors and conditions in the variables (Mertler, 2018). The analysis aims to provide a deeper understanding of the independent variables' influence on mathematical proficiency. These analyses provided insights into the relationships and predictive dynamics among variables, supporting evidence-based recommendations for enhancing pre-service teachers' mathematical proficiency.

3. RESULTS AND DISCUSSIONS

3.1. Level of Enrichment Programs

It could be seen from Table 2 that the overall level of enrichment programs of pre-service teachers attained a mean rating of 3.51 or very high. This implies that the enrichment programs of pre-service teachers are always manifested. The overall computed standard deviation equivalent to 0.476 indicates that the individual responses to the statements of this variable were clustered around the mean.

The consistency in high ratings across items reaffirms findings by Elhoweris et al. (2022) and Procare (2023), indicating that enrichment programs significantly enhance learning, foster positive attitudes, and support professional development. These programs promote inclusivity and cater to diverse needs through mentoring and differentiated instruction (Guhan et al., 2020; Fusch et al., 2021).

Table 2 Level of Enrichment Programs of Pre-service Teachers

Item	Mean	Standard Deviation	Descriptive Equivalent
1. providing designated time for the students to take an intervention, support or enrichment, or extension classes	3.60	.589	Very High
2. using visual representations to model and explore mathematical ideas	3.63	.549	Very High
3. reviewing mathematics content	3.58	.581	Very High
4. reteaching mathematics content	3.53	.597	Very High
5. providing preview of mathematics content that is forthcoming in the students' general mathematics classes	3.49	.630	Very High
6. having small group discussions for students to talk about math ideas and approaches in solving a problem	3.54	.629	Very High
7. providing approaches to understand word problems	3.57	.593	Very High
8. helping students with homework in general mathematics classes	3.39	.737	Very High
9. allowing students to use technology for instruction and support their learning in mathematics	3.57	.615	Very High
10. providing different activities to students based on mathematics learning needs	3.62	.607	Very High
11. using formative assessments to identify students' strengths, gaps, misconceptions, and difficulties	3.57	.547	Very High
12. teaching test-taking strategies for math assessments	3.54	.639	Very High
13. providing community-based project as part of a regular course that enhances math skills practically (data analysis, budget allocation, etc.)	3.46	.649	Very High
14. providing practice and exercises for math assessments	3.50	.680	Very High
15. providing more opportunities for students to explore math ideas such as peer mentoring, inquiry-based learning, and problem-based learning	3.58	.635	Very High
16. providing students with more hands-on and concrete activities	3.54	.678	Very High
17. providing push-in support from special educators or professors to teach general mathematics class	3.48	.679	Very High
18. providing math tutoring to students during school day	3.29	.817	Very High
19. providing designated time for students to work on a computer-based math program for practice or remediation	3.39	.699	Very High
20. providing additional math classes before or after school	3.28	.782	Very High
Overall	**3.51**	**.476**	**Very High**

The highest-rated item, *using visual representations to model and explore mathematical ideas*, (mean = 3.63, SD = 0.549), aligns with Murphy (2019), who emphasizes that visual aids bridge teaching tools and cognitive processing, enhancing students' understanding of complex concepts. Similarly, Gill (2023) and Lerman (2020) highlight how technology-enabled visual learning enhances mathematical exploration.

In contrast, the lowest-rated item, *providing additional math classes before or after school* (mean = 3.28, SD = 0.782), still falls within the "very high" category. This result mirrors the findings of Homedan et al. (2021) that supplementary classes positively impact student performance, as well as the conclusions of Enrique and Cusipag (2020) that these programs address diverse learning needs.

3.2. Level of Pedagogical Preparedness

It could be observed from Table 3 that the overall level of pedagogical preparedness of pre-service teachers obtained a mean rating of 3.61 or qualitatively described as very high. This conveys that the pedagogical preparedness of pre-service teachers is always manifested. The overall equivalent standard deviation of 0.408 signals that the responses of the respondents to all items of this variable are aggregated within the mean.

Table 3 Level of Pedagogical Preparedness of Pre-service Teachers

Item	Mean	Standard Deviation	Descriptive Equivalent
1. defining objectives clearly	3.71	.498	Very High
2. linking mathematical concepts to students' interest and experiences	3.48	.640	Very High
3. using relevant examples	3.70	.514	Very High
4. planning a variety of teaching strategies	3.65	.590	Very High
5. relating mathematical concepts to another knowledge	3.44	.706	Very High
6. giving clear directions before and not during activities	3.65	.601	Very High
7. administering rules consistently and fairly	3.68	.521	Very High
8. placing the lesson appropriately	3.69	.519	Very High
9. creating a friendly and positive classroom climate	3.68	.546	Very High
10. establishing workable routines	3.63	.559	Very High
11. executing smooth transition from one activity to another	3.61	.576	Very High
12. expressing thoughts fluently	3.61	.619	Very High
13. speaking at an appropriate rate	3.61	.541	Very High
14. responding appropriately to both verbal and non-verbal messages	3.61	.502	Very High
15. using acceptable voice expression and pitch projection	3.56	.549	Very High
16. using appropriate vocabulary	3.59	.555	Very High
17. presenting questions in logical sequence	3.54	.607	Very High
18. using questions as diagnostic tools	3.58	.625	Very High
19. asking questions clearly	3.69	.565	Very High
20. restructuring questions if necessary	3.58	.614	Very High
Overall	**3.61**	**.408**	**Very High**

The respondents' very high rating on pedagogical preparedness indicates consistent manifestation, aligning with Liu et al. (2023), who found that pre-service teachers' pedagogical content knowledge significantly enhances student performance. Similarly, Kariuki et al. (2019) also reported that teachers with strong pedagogical preparation, particularly in lesson planning, had students perform better compared to those with weaker preparation. Also, Sarder and Haider (2023) highlighted that effective teaching methods, structured lesson plans, and modern teaching tools improve academic outcomes. Classroom management strategies that foster intrinsic motivation and adapt to dynamic environments also enhance student performance (Runyan, 2018; Granziera et al., 2019).

The highest-rated subcategory, *defining objectives clearly*, supports Arnó-Macià et al. (2020), who emphasized that clear learning objectives address learners' needs and guide course assessments and activities. This clarity helps instructors align teaching techniques with student goals, fostering higher-order thinking and meaningful learning (Marcu, 2022; McCambridge,

2019; Stapleton-Corcoran, 2023). Customizing teaching methods based on well-defined objectives is critical for optimizing students' learning experiences (Ansori, 2019).

The lowest-rated item was *relating mathematical concepts to another knowledge*, though still rated very high. This aligns with Fritz et al. (2019), who noted that mathematics can alienate students due to its perceived difficulty, leading many to avoid STEM fields and limiting career opportunities in science and technology. However, Li and Schoenfeld (2019) stress the importance of moving beyond seeing math as just fixed facts. They advocate for prioritizing conceptual understanding and critical thinking, encouraging practices that integrate mathematics into broader STEM education for deeper comprehension and sense-making.

3.3. Level of Mathematical Proficiency

It could be gleaned from Table 4 that the overall level of mathematical proficiency of pre-service teachers obtained a mean rating of 3.19 or high. This signifies that the mathematical proficiency of preservice teachers is frequently manifested. Meanwhile, the overall computed standard deviation equivalent to 0.586 implies that the individual responses to the statements to this variable are relatively close to the mean.

The high rating of mathematical proficiency in this study reflects the respondents' consistent demonstration of proficiency, which aligns with the findings of Elsayed (2022) that learners in a STEM-based approach exhibit high proficiency across all five components. This is further supported by Appiah et al. (2022), who noted that positive perceptions of mathematics contribute to high performance, and Pitsia (2022), further emphasizes the role of effective classroom environments in fostering proficiency beyond individual traits.

The highest-rated item, *believing mathematics offers unique ways to discover solutions,* aligns with Maaß et al. (2019), who have argued that innovative approaches in math education, such as workshops and multimedia resources, enhance learning. Furtherly, Freiman and Tassell (2018) also support this, highlighting how creative mathematical discussions foster innovation, while Emre-Akdoğan and Yazgan-Sağ (2018) found that initiatives like the mathematical village stimulate creativity in learners and mathematicians alike.

Conversely, the lowest-rated item, *being good at solving any mathematical problems*, though still rated high, reflects challenges similar to those found by Pascual and Pedro (2018), where errors in algebraic processes were common. Moreover, Kandeel (2021) also noted that while Emirati learners scored high in PISA results, they lag behind international peers. Nonetheless, mastery of mathematics through positive learning experiences has been shown to elevate proficiency levels (Cerbito, 2020).

Table 4 Level of Mathematical Proficiency of Pre-service Teachers

	Item	Mean	Standard Deviation	Descriptive Equivalent
1.	learning mathematics quickly	3.04	.785	High
2.	understanding even the most challenging mathematical problems	3.06	.745	High
3.	being good at solving any mathematical problems	3.03	.790	High
4.	possessing fast analytical thinking for mathematical problems	3.12	.725	High
5.	being capable of getting good grades in mathematics	3.07	.695	High
6.	doing extra work to learn mathematics	3.31	.763	Very High
7.	having never felt incapable of learning mathematics	3.20	.753	High
8.	being able to learn mathematics even if the work is hard	3.24	.688	High
9.	being sure to learn well the skills taught in mathematics class	3.29	.695	Very High
10.	believing mathematics offer unique ways to discover innovative solutions and approaches	3.42	.624	Very High
11.	having confidence in the ability to perform mathematical tasks accurately	3.16	.730	High
12.	trying to figure out the reason for having trouble learning mathematics	3.28	.730	Very High
13.	being able to do practically all the work in mathematics class by not giving up	3.25	.739	High
14.	feeling delighted when answering mathematical questions	3.20	.729	High
15.	being comfortable with solving complex problems in mathematics	3.11	.816	High
16.	improving understanding of other subjects through mathematics (science, business, economics, etc.)	3.27	.726	Very High
17.	having high knowledge about mathematical concepts	3.16	.790	High
18.	applying detailed steps to solve mathematical problems	3.28	.765	Very High
19.	believing that mathematics is an easy subject to pass	3.08	.873	High
20.	thinking excelling in mathematics is a valuable achievement	3.30	.779	Very High
	Overall	**3.19**	**.586**	**High**

3.4. Correlation Between Variables

Illustrated in Table 5 is the relationship between variables, it could be examined from the data that the computed r-value and ρ-value for enrichment programs are .517 and .000 respectively, and for pedagogical preparedness' r-value is .508 with ρ-value of .000, are very much lower than the .05 level of significance set in this study, hence, the rejection of the null hypothesis. The r-value of .517 for enrichment programs indicates a moderate positive correlation with mathematical proficiency, suggesting that as participation in enrichment programs increases, mathematical proficiency also improves. The positive direction of this relationship shows that higher engagement in enrichment programs is associated with better mathematical outcomes. Similarly, the r-value of .508 for pedagogical preparedness also reflects a moderate positive correlation with mathematical proficiency. This implies that better pedagogical preparedness

among pre-service teachers is moderately associated with higher levels of mathematical proficiency.

Thus, the findings demonstrate a notable connection between participation in enrichment programs, pedagogical preparedness, and mathematical proficiency. It can be inferred that any increase in the availability of enrichment programs and improvements in pedagogical preparedness will likely lead to an increase in mathematical proficiency. This aligns with Dweck's Growth Mindset Theory (200)), which suggests that viewing challenges as learning opportunities—cultivated through enrichment programs—fosters a positive attitude towards mathematics, improving proficiency. The hands-on engagement provided by these programs allows students to deepen their mathematical understanding by applying concepts in real-life contexts.

Table 5 Correlation Between Variables

Variables	Mathematical Proficiency		
	r-value	ρ-value	Decision on H_0
Enrichment Programs	.517	.000	Rejected
Pedagogical Preparedness	.508	.000	Rejected

The theory aligns with the National Science Foundation's proposed the Science, Technology, Engineering, and Mathematics (STEM) approach (Hallinen, 2024), integrating academic concepts with real-world applications by combining science, technology, engineering, and mathematics. This framework has proven effective in enhancing mathematical proficiency across five key components: conceptual understanding, procedural fluency, strategic ability, flexible thinking, and productive behavior (Elsayed, 2022). By linking skills across disciplines, the approach meets the demands of the 21st-century knowledge economy, fostering innovation and problem-solving.

Supporting this, Binns-Thompson et al. (2021) found that Mathematics Enrichment Programs significantly improved learners' math proficiency, while Mun and Hertzog (2018) emphasized that programs like the Saturday Enrichment Program led to higher mathematical achievement. Pre-service teachers also benefit from these programs through exposure to advanced topics and innovative teaching strategies (Yeh et al., 2019; Wasserman, 2023).

Moreover, the positive correlation between pedagogical preparedness and mathematical proficiency is consistent with Heinrich and Molenda's ASSURE model (1999): which stands for which stands for (A) Analyze learners, (S) State objectives, (S) Select methods, media and materials, (U) Utilize technology, media, and materials, (R) Require learner participation, and (E) Evaluate and revise; which enhances teaching effectiveness by focusing on appropriate media selection and active learner engagement. This model has been shown to improve mathematical achievement, as demonstrated by Al-Haydary and Majeed (2021), who found it more effective than conventional teaching methods (Krähenmann et al., 2019; Fukaya et al., 2024).

3.5. Influence of Enrichment Programs and Pedagogical Preparedness on the Mathematical Proficiency

Exemplified in Table 6 is the outline of how enrichment programs and pedagogical preparedness impact the mathematical proficiency of pre-service teachers. Enrichment programs demonstrate a substantial effect on the mathematical proficiency of pre-service teachers (β=.403; t-value=

3.769; $\rho < .05$; significant). In the same manner, pedagogical preparedness also significantly influences the mathematical proficiency of pre-service teachers (β=.432; t-value= 3.461; $\rho < .05$; significant). The overall significance of the regression model is indicated by the F-value, while the combined effect of these variables is measured by the coefficient of determination (R^2). In this study, the R^2 value is .313, indicating that 31.3% of the variance in mathematical proficiency can be attributed to enrichment programs and pedagogical preparedness. The remaining 68.7% is influenced by other factors not addressed in this study. This demonstrates that both enrichment programs and pedagogical preparedness are key contributors to mathematical proficiency, with each variable exerting a significant and positive impact, as evidenced by their respective β and t-values.

Based on the results, enrichment programs and pedagogical preparedness positively impact the mathematical proficiency of pre-service teachers. It mirrors the explications of Lynch et al. (2019) that enrichment programs pose a crucial influence in enhancing mathematical proficiency through a one-year enrichment course. The program led to enhancements in students' problem-solving abilities, creativity, and attitudes towards mathematics. Furthermore, Wasserman (2023) indicates that the concept of Pedagogical Mathematical Practices and their integration into mathematics courses for teacher education such as explicit visualization and multiple approaches, can significantly influence pedagogical strategies and, consequently, students' learning outcomes.

Table 6 Influence of Enrichment Programs and Pedagogical Preparedness on the Mathematical Proficiency

Independent Variables	Mathematical Proficiency				
	F-value	R^2	βCoefficient	t-value	ρ -value
Enrichment Programs	35.601	.313	.403	3.769	.000
Pedagogical Preparedness			.432	3.461	.001

3. CONCLUSIONS AND RECOMMENDATIONS

The study concluded that pre-service teachers demonstrated a very high level of engagement in enrichment programs and pedagogical preparedness, with both frequently and consistently manifested. Their mathematical proficiency was rated high, indicating that they often demonstrated competence in the subject. Furthermore, there was a significant relationship between enrichment programs, pedagogical preparedness, and mathematical proficiency, supporting the hypothesis that these factors play a crucial role in shaping the mathematical proficiency of pre-service teachers. This finding reinforces the notion that enrichment programs and pedagogical preparedness directly influence pre-service teachers' mathematical proficiency.

Based on these findings, it is essential that teacher education programs continue to integrate comprehensive enrichment programs and provide adaptive pedagogical strategies. Continuous professional development tailored specifically for pre-service teachers is recommended to meet evolving educational needs and further enhance their mathematical proficiency. Additionally, engaging in advanced training through peer mentoring and seminars, along with a holistic integration of enrichment and pedagogical preparedness, can improve both teaching effectiveness and proficiency. Collaborative efforts between departments and future research using qualitative or experimental methods in various locales will provide deeper insights and broader perspectives on pre-service teacher development.

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