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PROFICIENCY OF PRE-SERVICE TEACHERS IN MATHEMATICS IN THE MODERN WORLD: BASIS FOR LEARNING RESOURCE PACKAGE

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Abstract— Mathematics in the Modern World (MMW) teaches us to analyze data, identify patterns, and develop solutions, which is essential in today's data-driven world. This descriptive-comparative study assessed the proficiency level of second-year pre-service teachers in MMW as a basis for a learning resource package (LRP). The researchers made Mathematics in the Modern Proficiency Test (MMWP Test) was administered among 152 respondents from the Bachelor of Secondary Education (BSEd) program at Cagayan State University – Andrews Campus. The results revealed that most respondents are female, took the Humanities and Social Sciences (HUMSS) strand in senior high school (SHS), and are English majors. In terms of proficiency level in MMW, the respondents were nearly proficient, indicating that they were approaching mastery in using basic and procedural skills to solve problems. Particularly, the respondents were nearly proficient level in three areas of MMW namely, Nature of Mathematics, Mathematics as a Tool, and Geometric Design, and were low proficient level in one area – Mathematics of Finance. On comparison of the respondents' proficiency level in MMW when grouped according to profile variables, the results showed that a significant difference exists in terms of SHS strand and field of specialization. The study recommends the adoption of the LRP that was developed to help the BSEd pre-service teachers improve their proficiency level in MMW.

Keywords— mathematics in the modern world, mathematics proficiency, pre-service teacher, learning resource package

I. INTRODUCTION

In the dynamic realm of education reform, the Philippines has embarked on a transformative journey to enhance the preparedness of its students for the complexities of the modern era. The Commission on Higher Education (CHED) Memorandum (CMO) No. 20, series of 2013, proposed a New General Education Curriculum (GEC) for college, which includes Mathematics in the Modern World (MMW).

MMW holds significance within the new general education curriculum in the Philippines, emphasizing the connection of mathematics with natural patterns, logical thinking, and its application in the modern world. This course aims to equip students with skills to manage finances, appreciate geometric shapes and designs, and decode information. The implementation of a revised set of general education subjects at the higher education level and the relocation of all general education subjects to senior high school, as mandated by RA 10533 (K–12 Law), prompted its introduction. The core curriculum of MMW includes several essential areas of mathematical investigation, such as the essence of mathematics, the language of mathematics, problem-solving skills, and data management techniques.

The Commission Memorandum Order (CMO) No. 75, Series of 2017, emphasized the importance of subject mastery in teacher education, mandating educators, including pre-service teachers, to possess a deep understanding and expertise in their teaching subjects. High mathematical proficiency is crucial, enhancing subject comprehension and educators' awareness of student learning needs. Pre-service teachers, as future educators, play a dual role, requiring proficiency in MMW to effectively teach the course and set a standard for subject mastery in teacher education programs.

A study by Remo (2019) revealed several key problems related to the level of proficiency in the course. Problem-solving and reasoning were perceived as the most challenging topics within the MMW curriculum. Another study by Nabayra (2022) focused on identifying the least mastered topics in MMW among freshmen college students, revealing that statistics concepts, problem-solving, and logic were among the least mastered topics and posed significant challenges for students.

This study seeks to address the identified gap by focusing on the proficiency levels of pre-service teachers in MMW and its various areas, encompassing the nature of mathematics, mathematics as a tool, geometric design, and mathematics of finance. This investigation is motivated by findings from Cipriano (2023), which underscore the imperative of bridging the divide between theoretical comprehension and practical application of MMW concepts. Additionally, this study aims to build upon the insights provided by Taguiam (2020), who highlighted persistent proficiency gaps among pre-service teachers enrolled in the Bachelor of Secondary Education program at Cagayan State University, particularly in fundamental areas such as Numbers, Measurements, Algebra, Geometry, and Data and Chance.

II. METHODOLOGY

Research Design

This study employed a descriptive-comparative design. The descriptive design was utilized to characterize the respondents in terms of sex, senior high school strand, and specialization. Simultaneously, the comparative design was applied to identify if a significant difference exists in the respondents' proficiency level when grouped according to sex, senior high school strand, and specialization.

Locale of the Study

The study was conducted at the College of Teacher Education, Cagayan State University — Andrews Campus, located at Caritan Highway, Tuguegarao City, Cagayan. The College of Teacher Education offers six programs: Bachelor of Early Childhood Education (BECEd), Bachelor of Elementary Education (BEEd), Bachelor of Secondary Education (BSEd), Bachelor of Technology and Livelihood Education (BTLEd), Bachelor of Technical-Vocational Teacher Education (BTVTEd), and Bachelor of Culture and Arts Education (BCAEd). The college is accredited by the Accrediting Agency of Chartered Colleges and Universities in the Philippines (AACCUP), while the BSEd remains one of the only four programs in the University certified by ASEAN University Network-Quality Assurance (AUN-QA).

Respondents and Sampling Procedure

The respondents of the study were 152 second-year pre-service teachers currently enrolled in the Bachelor of Secondary Education program for the school year 2023-2024. The sampling procedure employed a random sampling technique to identify the respondents per major. Through the utilization of the Raosoft sample size calculator, from the total population of 250, a sample size of 152 was computed and broken down as follows: 46 from English, 23 from Filipino, 21 from Mathematics, 18 from Science, and 44 from Social Studies.

Research Instrument

The research instruments employed in this study included the identification of the student's profile and the Mathematics in the Modern World Proficiency Test. This multiple-choice test was developed to assess the level of proficiency of Pre-service teachers in Mathematics in the Modern World. The development of the instrument underwent four stages: crafting of test items, conducting content validation from experts, revising the test based on expert feedback, and finalizing and packaging the test.

During the crafting of test items, the competencies outlined in the CHED curriculum for Mathematics in the Modern World were aligned. Test objectives were then formulated based on these competencies. A Table of Specifications (TOS) was created to guide the construction of the test. The initial draft consisted of 80 multiple choice items, with 23 items for Nature of Mathematics, 17 items for Mathematics as a Tool, 20 items for Geometric Design, and 20 items for Mathematics of Finance.

Conducting content validation was done by three mathematics experts (college professors teaching Mathematics in the Modern World). They validated the tool by rating the relevance of the items of the test on a scale of 1 to 4, 1 as least relevant and 4 as very relevant. The results of the content validity index and suggestions of the experts were used to refine the items. The computed S-CVI (content validity of the overall scale) is 1, which is an acceptable content validity index. This value is based on the guidelines presented in the article by Yusoff (2019). Moreover, 10 items were improved as suggested by the content validators.

The test was then improved based on the results of the content validation. The findings from the content validity index and the insights or recommendations provided by the experts played a crucial role in refining the test items. This led to the development of the final iteration of the Mathematics in the Modern World Proficiency Test, which was subsequently prepared for its initial trial administration. Finally, the test underwent proofreading, layouting, and designing by experts before being reproduced.

Data Gathering Procedure

Before conducting the study, the researchers sought approval from the dean of the College of Teacher Education dean to conduct a study on pre-service teachers in the Bachelor of Secondary Education program. This step was taken to secure cooperation from the respondents and ensure a seamless data collection process. Upon receiving approval, the researchers sent the letter to the class mayors a day before the administration of the questionnaire. On January 12, 2024, at 4:30 in the afternoon, the researcher reminded the respondents to take the exam in Google Forms at exactly 5:00 PM, and it would close at exactly 6:00 PM, which was the scheduled date and time of the exam. An attached consent form was included in the Google Forms to ensure that the respondents were given the opportunity to answer the MMWP test of their own free will. A concise explanation was provided to help the respondents understand the purpose of the study, and any queries or concerns were promptly addressed. The researchers ensured that all the respondents answered the questionnaire, and the respondents' responses were kept confidential. After gathering all the data from the respondents, the researchers collaborated to analyze the findings.

Data Analysis

The data gathered was analyzed through descriptive and inferential statistics. Frequency and percent are used to analyze the profiles of the respondents. Moreover, Mean Percentage Score (MPS) was used to determine the level of proficiency in Mathematics in the Modern World. The researchers utilized five descriptive equivalents to represent learners' proficiency levels. These levels are described below. On the other hand, Independent Samples T-Test was employed to compare the students' proficiency level. Meanwhile, One-way Analysis of Variance (ANOVA) was used to compare respondents' proficiency level when grouped according to their SHS strand and field of specialization.

MPS	Descriptor	Interpretation
90 – 100	Highly Proficient	The students demonstrate a high level of proficiency in solving problems. They can analyze and evaluate data to create or formulate ideas. They can effectively use and relate information in various contexts.
75 – 89	Proficient	The students exhibit proficiency in problem-solving. They can analyze and evaluate data to apply ideas. They demonstrate the ability to effectively use information in different contexts.
50 – 74	Nearly Proficient	The students possess a level of proficiency that is approaching mastery in using basic and procedural skills to solve problems. They can comprehend ideas through the analysis and evaluation of data. They can understand information within a given context.
25 – 49	Low Proficient	The students demonstrate a lower level of proficiency in using procedural skills and identifying strategies for solving problems. They can differentiate and organize the given information to some extent.
0 – 24	Not Proficient	The students have not yet reached a proficient level in problem-solving. They can use basic skills to solve simple problems but may struggle to classify and identify the source of the given information accurately.

III. RESULTS AND DISCUSSION

Profile of the Respondents

Table 1.1 presents the profile of the respondents in terms of sex. As shown, the majority of the respondents are female. Out of the 152 respondents, 113 are female pre-service teachers and this consists of 74. 34% of the total respondents. On the other hand, there were 39 male pre-service teachers which is 25.66% of the total respondents.

TABLE 1.1 PROFILE OF THE RESPONDENTS ACCORDING TO SEX

Sex	Frequency	Percent
Female	113	74.34
Male	39	25.66
Total	152	100.00

Table 1.2 shows the profile of the respondents according to the Senior High School strand. As shown, the majority of the respondents took the Humanities and Social Sciences (HUMSS) strand. This is followed by Science, Technology, Engineering, and Mathematics (STEM), General Academic Strand (GAS), Accounting Business and Management (ABM), and Technical-Vocational-Livelihood (TVL) respectively.

TABLE 1.2 PROFILE OF THE RESPONDENTS ACCORDING TO SENIOR HIGH SCHOOL STRAND

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Senior High School Strand	Frequency	Percent
Humanities and Social Sciences (HUMSS)	99	65.13
Science, Technology, Engineering and Mathematics (STEM)	28	18.42
General Academic Strand (GAS)	13	8.55
Accountancy, Business Management (ABM)	7	4.61
Technical Vocational Livelihood (TVL) Total	5	3.29
	152	100.00

Table 1.3 shows the respondents' profile according to the field of specialization. As shown, the majority of the respondents were enrolled in a Bachelor of Secondary Education major in English. This is followed by Social Studies, Filipino, Mathematics, and Science, in that order.

TABLE 1.3 PROFILE OF THE RESPONDENTS ACCORDING TO FIELD OF SPECIALIZATION

Field of Specialization	Frequency	Percent
English	46	30.00
Social Studies	44	29.00
Filipino	23	15.00
Mathematics	21	14.00
Science	18	12.00
Total	152	100.00

Respondent's Proficiency Level in Mathematics in the Modern World

Table 2.1 provides an overview of the proficiency levels of respondents in Mathematics in the Modern World. The data reveals that the respondents' proficiency level in the nature of mathematics has a mean percentage score of 54.39, indicating a nearly proficient level. This suggests that the pre-service teachers possess the necessary basic and procedural skills to solve problems, as well as the ability to analyze and evaluate data to comprehend ideas. Moreover, they have demonstrated competence in understanding information within a given context.

The findings from Labo (2023) study support these results, as the participants demonstrated an average level of proficiency in utilizing various types of reasoning, which falls under the topic of Nature of Mathematics, with an average score of 3.89. This indicates that while they displayed competence in reasoning skills, it was not at a high level. Additionally, the study highlighted that the respondents exhibited skill in effectively organizing problem-solving methods, with an average score of 3.86.

Furthermore, Dela Cruz & Lapinid (2014) found that students encountered the greatest difficulty in translating worded problems into mathematical symbols during problem-solving. This difficulty arose from issues such as carelessness, lack of comprehension, interchanging values, and unfamiliar words used in the problem. Their research sheds light on the challenge's students face in this particular aspect of mathematics.

Additionally, in the area of mathematics as a tool, the respondents' proficiency level has a mean percentage score of 56.45, indicating a nearly proficient level. In this level, students are able to use basic and procedural skills to solve problems, analyze and evaluate data to comprehend ideas, and understand information in a given context.

This finding aligns with the study conducted by Labo (2023), where the respondents demonstrated a preference for using statistical data for important decisions, as evidenced by an average score of 3.72. Furthermore, they exhibited proficiency in utilizing various tools to handle numbers and logic, with an average score of 3.63. The study also highlighted their competence in employing methods such as linear regression and correlation to predict values in specific situations, achieving an average score of 3.53. It revealed that these participants were skilled in applying mathematical concepts and tools in various real-life situations. Additionally, the study revealed their comfort in using codes for data security and privacy.

However, these findings contradict the study conducted by Asoy & Dagohoy (2023), which revealed that the domain of "data management" obtained the lowest mean score, suggesting a comparatively lower level of accomplishment in this area.

Additionally, in the area of mathematics as a tool, the respondents' proficiency level has a mean percentage score of 56.45, indicating a nearly proficient level. At this level, students are able to use basic and procedural skills to solve problems, analyze and evaluate data to comprehend ideas and understand the information in a given context.

Furthermore, the proficiency level in geometric designs, with a mean percentage score of 53.83, indicates a nearly proficient level for the respondents in this area. This suggests that students are capable of using basic and

procedural skills to solve problems, analyze and evaluate data to comprehend ideas and understand information in a given context.

These findings are in line with the supporting studies conducted by Aydın-Güç & Hacısalihoğlu-Karadeniz (2020) and Hardianti et al. (2017). Aydın-Güç & Hacısalihoğlu-Karadeniz (2020) found that students demonstrated good performances in determining whether a pattern is a tessellation, with similar performances across different types of tessellations. On the other hand, Hardianti et al. (2017) emphasized the need to improve students' geometric thinking skills and highlighted the importance of strategies and interventions to enhance their geometric reasoning and problem-solving abilities.

Moreover, Eberle's (2014) research provides valuable insights into children's understanding, strategies, reasoning, and aesthetic criteria for tessellations. The study highlights the variations in children's conceptualizations of tessellations and their struggles in comprehending the infinite space of mathematical tessellations. The role of aesthetics, such as symmetry, is also emphasized, as it influences children's choices and creation of tessellations and drives their exploration of the mathematical structure behind them. Eberle's (2014) research supports the idea that mathematics not only influences students' aesthetic appreciation of tessellations but also drives their study of the mathematical properties inherent in tessellation structures.

Meanwhile, the proficiency level of the respondents in the mathematics of finance has a mean percentage score of 46.08, indicating a low proficient level. This suggests that students are able to use procedural skills and identify strategies for solving problems, as well as differentiate and organize the given information.

These findings align with the study conducted by Yildirim & Vardari (2020), which revealed low financial mathematical literacy levels among university students. The study observed variations in different knowledge areas related to finance and mathematics. For example, Education Faculty students obtained an average score of 44.9% in knowledge questions regarding Retail Banking, while their average math literacy level was 38.1% for questions related to Advanced Mathematics and Finance Calculations.

In contrast, these findings contradict the findings of Labo (2023), where individuals were skilled in applying math concepts and tools in various areas, including finance. This highlights the significance of mathematical proficiency in the field of finance.

Finally, with a mean percentage score of 52.81, the overall proficiency level among the respondents is nearly proficient. This suggests that the pre-service teachers at Cagayan State University- Andrews campus have a nearly proficient level of proficiency in all areas of Mathematics in the Modern World. In addition, this may imply that the pre-service teachers are capable of using basic and procedural skills to solve problems, analyzing and evaluating data to comprehend ideas, and understanding information in a given context.

These findings align with the results of Taja-on (2023) study, which revealed a commendable overall performance of 91.82% in the course Mathematics in the Modern World. This emphasizes the importance of emphasizing high proficiency in this course. A strong level of proficiency is crucial in equipping college students with the necessary mathematical knowledge and skills to navigate and succeed in the modern world.

TABLE 2.1 RESPONDENTS' PROFICIENCY LEVEL IN THE DIFFERENT AREAS OF MATHEMATICS IN THE MODERN WORLD

Area	Mean Percentage Score	Descriptor
Nature of Mathematics	54.39	Nearly Proficient
Mathematics as a Tool	56.45	Nearly Proficient
Geometric Design	53.83	Nearly Proficient
Mathematics of Finance	46.08	Low Proficient
Overall	52.81	Nearly proficient

Comparison of the Respondents' Proficiency Level in Mathematics in the Modern World when grouped according to their Profile Variables

Table 3.1 presents a comparison of the respondents' proficiency levels in Mathematics in the Modern World in terms of sex. As indicated by the p-value of 0.71 for the overall proficiency, the analysis did not reveal a significant difference in proficiency levels between male and female. It is noteworthy that both male and female were observed to be at a nearly proficient level.

These findings support the study by Alcantara, Obligar, & Pedrosa (2018), which revealed that there was no discernible gender difference in learning strategies concerning mathematics proficiency. Additionally, no significant distinction was observed between male and female respondents in the extent of their mastery of learning competencies related to functions and their graphs.

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TABLE 3.1 COMPARISON OF THE RESPONDENTS' PROFICIENCY LEVEL IN MATHEMATICS IN THE MODERN WORLD WHEN GROUPED ACCORDING TO SEX

Category	Mean	SD	t-value	p-value	Decision
Female	53.17	17.03	-1.27	0.71	Accept
Male	52.00	14.77			Ho

Table 3.2 shows a comparison of the respondents' level of proficiency in Mathematics in the Modern World in terms of strand. The results of the one-way ANOVA have a probability value of 0.00, lower than the level of significance set at 0.01.

The analysis reveals a significant difference in the level of proficiency in Mathematics in the Modern World among the various strands. Based on the mean proficiency levels of the respondents, Accountancy, Business Management (ABM), General Academic Strand (GAS), Science, Technology, Engineering and Mathematics (STEM), Technical Vocational Livelihood (TVL) are at the nearly proficient level, while Humanities and Social Sciences (HUMSS) are at the low proficient level.

Science, Technology, Engineering, and Mathematics (STEM) exhibits the highest proficiency with a mean percentage score of 63.84 indicating a nearly proficient level, followed by the General Academic Strand (GAS) with a 57.31 mean percentage score. In contrast, Humanities and Social Sciences (HUMSS) displayed the lowest proficiency with a mean percentage score of 48.19.

These findings support the results of Magbanua & Bearneza (2023), which revealed a noteworthy disparity in the level of performance in General Mathematics among senior high school students when categorized based on academic tracks. Particularly, students enrolled in the tracks of ABM and STEM demonstrated an 'average' level of performance, whereas those in HUMSS and TVL displayed a 'low' level of performance. Further analysis, employing the Least Significant Difference (LSD) test, was conducted to assess the proficiency levels in Mathematics in the Modern World (MMW) across different Senior High School Strands. The comparisons unveil 40 specific insights into the proficiency levels among the strands. For instance, the proficiency level in ABM (Accountancy, Business, and Management) is significantly higher than in HUMSS (Humanities and Social Sciences). However, this difference is not statistically significant, as indicated by the Sig. value of 0.367. Similarly, when comparing GAS (General Academic Strand) with HUMSS, HUMSS students have a lower proficiency level. In contrast, significant differences are observed between STEM (Science, Technology, Engineering, and Mathematics) and both HUMSS and TVL (Technical- Vocational-Livelihood) strands. Generally, STEM students exhibit significantly higher proficiency levels.

Further findings from the Least Significant Difference (LSD) test offer valuable insights into the relative proficiency levels of different Senior High School Strands in the context of Mathematics in the Modern World. The differences between learning strands can likely be connected to their background in mathematics. Students enrolled in STEM, GAS, and ABM strands have math-related subjects up to their grade 12 level. For instance, students in the STEM strand take Pre-Calculus, Calculus, and Physics I and II; those in the GAS strand take Applied Economics, Organization and Management, General Mathematics, Statistics, and Probability; and students in the ABM strand take Business Mathematics, Accounting, and Finance.

According to Ma & Bradley (2009), secondary school students' mathematics performance significantly influences their college and job performance. An established foundation in mathematics aids in the development of proficiency in mathematics in college. This finding suggests that students who took mathematics-related subjects in high school, specifically those in the STEM, GAS, and ABM strands, are more likely to have better proficiency in Mathematics in the Modern World.

TABLE 3.2 COMPARISON OF THE RESPONDENTS' PROFICIENCY LEVEL IN MATHEMATICS IN THE MODERN WORLD WHEN GROUPED ACCORDING TO SENIOR HIGH SCHOOL STRAND

Category	Mean	SD	F-value	p-value	Decision
Humanities and Social Sciences (HUMSS)	48.19	15.30	5.97	0.00	Reject Ho
Science, Technology, Engineering, and Mathematics (STEM)	63.84	15.15			
General Academic Strand (GAS)	57.31	14.33			
Accountancy, Business, Management (ABM)	53.75	20.01			
Technical Vocational Livelihood (TVL)	50.25	19.15			

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Table 3.3 presents a comparison of respondents' proficiency in mathematics across different fields of specialization. As indicated by the p-value of 0.00, which is lower than the set level of significance at 0.01. This indicates a significant difference in proficiency levels in Mathematics in the Modern World among the various fields of specialization. Notably, the mean percentage score of major in Mathematics is 69.10, indicating nearly proficient, followed by Science with a 62.71 mean percentage score indicating nearly proficient as well. On the other hand, English, Filipino, and Social Studies majors exhibit lower proficiency level with a mean percentage score of 49.41, 47.48, and 45.64 indicating low proficient.

The findings align with Taguiam (2020), which also identified a significant difference in mathematics proficiency levels based on field of specialization. The study highlighted that students specializing in Mathematics and related fields, such as Physics, demonstrated significantly higher proficiency levels compared to those in majors like English and Filipino. In summary, the results suggest a clear disparity in mathematics proficiency across different specializations, with Mathematics and Science majors performing better than those in Social Studies, Filipino, and English majors. This information may be valuable for educational institutions and policymakers to consider when designing curriculum and support systems for students in various fields of study.

TABLE 3.3 COMPARISON OF THE RESPONDENTS' PROFICIENCY LEVEL IN MATHEMATICS IN THE MODERN WORLD WHEN GROUPED ACCORDING TO FIELD OF SPECIALIZATION

Category	Mean	SD	F-value	p-value	Decision
English	49.24	14.60	13.05	0.00	Reject Ho
Filipino	47.39	16.66			
Mathematics	68.93	12.76			
Science	62.71	13.74			
Social Studies	45.45	13.85			

Learning Resource Package

The learning resource package is designed to support learners in acquiring knowledge and skills in a structured and comprehensive manner. It includes assessment tools to measure learners' progress and understanding. Through a variety of resources, it enables learners to explore and deepen their understanding of the subject matter.

The unit description provides an overview of the unit, outlining the main topics and themes to give students a clear understanding of what they will be studying and its relevance. Learning objectives are specific, measurable goals that define what students should know or be able to do by the end of the topic, guiding both instruction and assessment. Examples are included to illustrate concepts using real-world scenarios or sample problems, helping students understand and apply the material. The unit summary recaps the key points covered, offering a concise review that aids in reinforcement and revision. Answer keys provide correct answers to the activities, allowing students to check their work. References list the resources used in creating the unit, ensuring academic integrity, and offering additional materials for further exploration of the subject.

These components together create a comprehensive learning package that supports both teachers and learners. They serve as a testament to the continuous journey of learning and the impact of research on educational experiences. By identifying and addressing students' weaknesses, these packages help build confidence, address knowledge gaps, and achieve academic success.

IV. CONCLUSION

The proficiency level of pre-service teachers in Mathematics in the Modern World generally falls within the nearly proficient range across the four areas. The students possess a level of proficiency that is approaching mastery in using basic and procedural skills to solve problems. They can comprehend ideas through the analysis and evaluation of data and understand information within a given context. Considering their current proficiency level in Mathematics in the Modern World, it is recommended to further refine their proficiency. To achieve this, it is suggested to provide learning resource packages that can enhance their understanding and proficiency in all areas of the subject. These activities will offer additional opportunities for practice and improvement.

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V. RECOMMENDATIONS

1. MMW instructors can enhance pre-service teachers' low or average mastery in different areas of Mathematics in the Modern World by incorporating more learning activities, materials, and teaching methods, including the utilization of a researchers-designed learning resource package.
2. Pre-service teachers should focus on internalizing, reviewing, and practicing areas of low or nearly proficient proficiency in the areas of Mathematics in the Modern World, specifically in Mathematics of finance. This will enable better understanding, application, and manipulation of mathematical concepts, making them more effective teachers in the future.
3. Future researchers are advised to further explore factors influencing students' mathematical proficiency, such as teaching methods, curriculum design, and student motivation. Longitudinal studies could be conducted to assess the effectiveness of interventions aimed at improving mathematical proficiency and to identify additional variables impacting student learning outcomes.

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