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Statistical analysis of assessing mathematical preparedness of future teachers in Palestine

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ABSTRACT

There are several advantages to the so-called enlightenment in general and mathematical enlightenment in particular. In this study, we developed a specialized test for measuring the level of mathematical enlightenment and evaluated its important components. A cross-sectional descriptive study design was utilized for a sample of students from five different universities in Palestine; the test was applied to a sample of 551 students. Six components of mathematical enlightenment were identified, and all participants were able to score above the set benchmark. A Pearson correlation test, an independent samples test, analysis of variance (ANOVA), and bivariate analysis were performed to examine the associations between research variables. The rest of the students in the sample, 348 in total, or 63%, achieved above 70 in the enlightenment measurement patterns. The overall mean performance of the sample was calculated at 72.4%, surpassing the target level of 70, indicating that the students, in general, showed an adequate level of enlightenment in mathematics. It was also found that female students shown higher mathematical enlightenment than male students.

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1. INTRODUCTION

Throughout our lives, scientific and technological advances demand that we possess both relevant information and the skills to adapt. Enlightenment, once defined simply as literacy and numeracy, has evolved to mean the broader development of understanding across personal, intellectual, and societal dimensions. Reason played a central role in catalyzing scientific, industrial, and social revolutions [1], [2]. Enlightenment can be general or field-specific, such as in mathematics or technology, where individuals demonstrate expertise through specialized knowledge and skills [3]. Specific enlightenment involves understanding specialization goals, distinguishing core concepts, using effective learning strategies, and recognizing social and technical applications, as emphasized by the Egyptian Association [3]. Scheiner *et al*. [4] describe scientific enlightenment as involving interdisciplinary knowledge and daily life attitudes [4], while Osborne and Allchin [5] and Odden *et al*. [6] highlight core components like ethics, the nature of science, and science-society interaction. Mathematical enlightenment is a lifelong, dynamic process supporting ambition, growth, and decision-making [7], [8]. Mathematics, deeply intertwined with fields like medicine and commerce, develops critical thinking and problem-solving skills [9], [10]. As such,

mathematics education aims to foster enlightenment by equipping students to analyze, deduce, and innovate in ways that benefit both themselves and their communities [11], [12].

The National Council of Teachers of Mathematics (NCTM) [13] offers a future vision for mathematical illumination that's technologically embedded and emphasizes the principle that basic knowledge enables students to apply mathematics in ordinary situations [13]. This necessitates that there be an analysis of the current state of math education and preparation for future needs. A mathematically enlightened teacher, who's learned about underlying ideas, principles, and thinking strategies, is pivotal in cultivating student comprehension. Without this type of teacher competence, mathematical enlightenment cannot be effectively passed on [10], [14], [15]. Mulu *et al*. [16] add that pre-service teachers must be competent in both mathematical content and good thinking skills to become mathematically enlightened. Likewise, Yildiz *et al*. [17] stress that mathematical literacy, as the opposite of illiteracy, involves building blocks and the ability to use them in various contexts.

Çelik and Özdemir [15] define the core dimensions of mathematical enlightenment as mathematical thinking methods, foundational concepts, and an understanding of the nature and historical development of mathematics. National and international frameworks, such as the Ohio Department of Education's assessment, evaluate high school students' enlightenment across areas like algebra, data analysis, and geometry [15]. For adult learners, Fatmanissa *et al*. [18] identify key dimensions such as mathematical communication, evaluation, and problem-solving confidence. Ultimately, mathematical enlightenment is driven by a curriculum rooted in sound principles and practices. When students engage with mathematical thinking—such as deduction, explanation, and measurement—they gain tools to enhance their lives and contribute meaningfully to their communities [19], [20].

Modern education views technology as a crucial component of the teaching process. For a mathematics teacher to effectively enlighten their students, they must have a profound comprehension and understanding of mathematics, including its philosophy, fundamental principles, and teaching methods. Additionally, they should be familiar with various mathematical concepts and applications including algebra, logic, geometry, probability, and statistics. Researchers, who are drawing from their experiences in teaching courses related to mathematics like teaching methods and practical teaching, have observed that pre-service teachers often make significant errors and lack fundamental mathematical knowledge essential for grasping the structure of mathematics. This lack of foundational understanding among pre-service teachers indicates a shortfall in the mathematical enlightenment necessary for a solid foundation in pure, applied, and educational mathematics.

This study will examine the concept of mathematical enlightenment for mathematical students in Palestine. Gaining a thorough grasp of this idea will help us evaluate the situation more accurately and create a plan for raising the level of knowledge of the next math teachers. The principal aim of the study is to evaluate teachers' prior mathematical knowledge before they started teaching. Concerning the primary matter, the key questions are: i) what are the dimensions of enlightenment in mathematical? ii) how knowledgeable in mathematics are pre-service teachers currently? iii) are there differences in the level of mathematical enlightenment between universities or between genders? and iv) is there a relationship between the degree of mathematical enlightenment and the cumulative college average (GPA)?

Mathematics is an important subject, and teaching is an important process. The duty of math teachers to promote pupils' mathematical enlightenment is the subject of this study. It highlights the need for math teachers to have a solid grasp of the subject's foundations, as stated by [13]. The study is noteworthy in addition because it attempts to evaluate prospective math teachers' level of mathematical enlightenment prior to their start of teaching. The mathematics curriculum at each university in Palestine is revised every four years to address the need for updated knowledge and diverse mathematical skills for students. Depending on the attitudes and values outlined in the Standard Document for Curriculum and Assessment, the Palestinian Ministry of Higher Education (MOE) aims to develop students who can think mathematically, understand mathematical concepts, and apply their knowledge and skills responsibly in everyday life. As such, it is imperative that mathematics be taught in a way that strengthens students' capacity to solve real-world issues.

This study seeks to evaluate the level and dimensions of mathematical enlightenment among mathematics teachers before they begin teaching. It also aims to identify any differences in responses based on university and gender. The findings will be communicated to decision-makers to inform necessary decisions and actions to enhance the mathematics education process. This study presents a novel contribution by being the first in Palestine to develop and apply a comprehensive, empirically validated framework for assessing mathematical enlightenment among pre-service teachers. Unlike previous research, which often isolates content knowledge or attitudes, this work introduces and statistically analyzes six core dimensions: mathematical knowledge, mathematical thinking, scientific research in mathematics, problem-solving, attitudes toward mathematics and its teaching, and understanding the nature and history of mathematics. Importantly, this research aligns with recent policy changes by the Palestinian Ministry of Higher Education (MOHE), which

now requires candidates to pass a national qualification exam prior to employment as teachers. Therefore, this study not only fills a critical research gap but also serves a practical function by informing the preparation of teacher candidates for national standards. With a large sample (n=551) and a high-reliability instrument (Cronbach's alpha=0.83), the study offers the first data-driven insights into readiness levels across universities and genders, providing actionable evidence for policy and curriculum reform.

Many scholars have studied pre-service teachers of mathematics in the context of scientific and mathematical enlightenment. García-Carmona [1] reported a notable relationship between science teachers' enlightenment and their students' scientific understanding, as 65.5% of 1,025 students showed signs of enlightenment. Jarrah [21] evaluated an education diploma cohort at Najran University and reported satisfactory levels of scientific enlightenment, especially among science majors. There were no differences between male and female students. Kalender *et al*. [22] mentioned that overall understanding of physics was in the lower range of 75% with females outperforming males. Prayitno *et al*. [23] demonstrated using qualitative techniques that 12th graders had high levels of achievement in mathematical thinking due to engaging in graph theory activities. Yildiz *et al*. [17] noted that greater mathematical reasoning among pre-service teachers was associated with more positive attitudes towards mathematics courses. Kartal [24] reported that pre-service teachers of science and mathematics with greater self-perception of teaching efficacy had more positive attitudes toward teaching. Finally, Tinh *et al*. [25] examined teacher preparation in Vietnam and found that pre-service teachers had a sound grasp of mathematics, but their knowledge of teaching AI strategies was insufficient, highlighting the need for better pedagogy in teacher education programs.

The study underscores the need for ongoing enhancements in teacher education programs to better address the practical demands of teaching. The study seeks to evaluate the mathematical knowledge of pre-service teachers in math with an emphasis on solving problems, instructional trends in the mathematical field. Scientific research in the same area of study, also the nature of mathematics and its growth over time. The study also sought to ascertain whether pre-service students categorized by gender and university had significantly different mathematical thinking styles.

2. METHOD

2.1. Research design

A cross-sectional study was conducted in the West Bank, Palestine. The study utilized a descriptive analytical approach, which is effective for understanding current conditions and planning. This approach helps assess the level of mathematical understanding among mathematics teacher candidates and identifies the various dimensions of mathematical enlightenment. The research is divided into two sections: theoretical and empirical. The theoretical section outlines the dimensions of mathematical enlightenment by reviewing relevant studies. The empirical section involves assessing mathematical enlightenment, using methods suited to the descriptive analytical approach for data collection.

A self-administered test was developed by the researchers to assess pre-service teachers' mathematical knowledge in mathematics in the West Bank, Palestine. After that, the whole test was reviewed and modified by the researchers to ensure its suitability for math students. It was then piloted on a sample of 20 after review by the team and translation by bilingual Arabic and English speakers. For clarity, some of the questions were rewritten.

2.2. The study

The study population was all graduating mathematics department students in Palestinian universities during the first semester of the 2023-2024 academic year. A cover letter explaining the purpose of the study and assuring participants that their privacy and confidentiality of the gathered data would be ensured and protected was included with every exam translated into Arabic. Convenience sampling was used in the research site selection process to guarantee that the eligible research participants were included and could shed light on the subject matter being studied. The individuals were described using descriptive statistics. The math department monitors the distribution and application of research tools by teachers at Palestinian universities, as per the official demand made by the authors. The material is treated as though it were a test in class.

2.3. Statistical analysis

The entire dataset was inputted and analyzed using the SPSS version 26. The collected data were described using descriptive statistics such as frequency and percentages. Regarding continuous variables, the mean and standard deviations were computed. Summary data, such as the proportion of male and female respondents, are provided by descriptive statistics. The pre-teachers' scores on mathematical enlightenment were compared using an appropriate and sufficient one-way analysis of variance (ANOVA) and an independent samples t-test based on their demographic features and characteristics.

3. RESULTS AND DISCUSSION

3.1. Demographics

A random sample of 551 senior students was selected based on their gender and their university, as detailed in Table 1. The majority of respondents were female (n=278), while the male respondents numbered (n=273). Additionally, most students were from Hebron University (n=123), with the fewest from Birzeit University (n=79).

Table1. The frequency table categorizes male and female students by the university

University		Hebron	Polytechnic	Al-Ouds	Birzeit	Al-Najah	Total
Gender	Males	42	61	58	50	62	273
	Females	81	48	49	47	53	278
Total		123	109	107	79	115	551

3.2. Measurement of mathematics enlightenment

Researchers conducted a review of existing studies related to mathematical enlightenment and examined the Palestinian mathematics curriculum for pre-college education, spanning grades one through twelve. They identified and analyzed fundamental mathematical concepts, noting that some concepts appeared in multiple grades. Based on this review, a set of 162 mathematical concepts was compiled and phrased accordingly. These phrases were then evaluated by a panel of mathematics teachers and education supervisors for both linguistic and scientific accuracy, as well as their adequacy in measuring mathematical knowledge, which is the primary and fundamental dimension of mathematical enlightenment. Following the judges' feedback, the study progressed to the development of a mathematical knowledge test. Here are the six measurements of mathematics enlightenment we studied:

a. Mathematical knowledge's test

As part of mathematical enlightenment, a 27-paragraph test was designed to assess pupils' mathematical knowledge. We identified the ideas that were required by examining the curriculum's contents and keeping in mind that some concepts are more general than others. Students are given the general idea in the form of a question.

b. Trends towards mathematics and its teaching

This assessment looks at how students feel about and think about mathematics and the way they are taught it. There are ten questions, each with three answer options: "strongly agree", "agree", and "disagree". A point system is employed where students receive three points for strongly agreeing, two points for agreeing, and one point for disagreeing. This structured pattern allows instructors to assess the attitudes of students towards math learning, instructional approach, and school life, providing them with essential feedback regarding their motivation, self-confidence, and interest in the subject.

c. A test for mathematical thinking

An assessment for mathematical reasoning is created to evaluate students' capability to perform logical analysis, pattern recognition, abstraction, and problem-solving. The test comprises eight paragraphs, each containing a real-life or imaginary mathematical situation followed by a multiple-choice problem. At the end of each paragraph, three answer options are provided that differ in understanding and reasoning capabilities, demonstrating varying levels of achievement based on the framework. This format motivates scholars to assess mathematical statements, draw conclusions, and apply knowledge in a systematic manner. The focus of the examination is not solely on working out problems and quantitative objectives, but also on the extent to which learners deal with abstract mathematical concepts and consider new challenges from divergent perspectives.

d. A test for scientific research in mathematics

In this assessment, students will complete ten paragraphs that require completion of the blanks for major concepts pertaining to scientific inquiry in mathematics. This assessment seeks to identify whether students understand major concepts entailed in hypothesis generation, identification of variables, analysis of data, mathematical reasoning, and drawing conclusions pertaining to mathematical investigations. This examination is administered under controlled conditions, where the students can express a wider range of knowledge and higher-level thinking than is possible in mathematics.

e. A test for solving mathematical problems

This assessment includes ten carefully chosen mathematical problems which measure practical problem-solving covering areas like arithmetic, algebra, logic, geometry, and data interpretation. Each problem offers a distinct challenge which needs a particular set of mathematical steps to be carried out using deductive reasoning and thought. After attempting each problem, the learner checks the given alternatives and marks the right solution which in turn strengthens their comprehension and catalyzes meaningful

interaction with the response options based on the exercise prompt. These problems are designed to be answered correctly based on the learners with basic level knowledge to more advanced levels of critical thinking. The intent of this assessment is to gauge the learner's skill in interpreting set challenges and subsequently choosing the right action pathways to take along with practical execution steps of the results within the predetermined environment.

f. A test for nature of mathematics and the history of its development

This assessment consists of eight fill-in-the-blank paragraphs exploring students understanding the philosophical underpinnings of mathematics and its history. Each paragraph includes an encyclopedic lexicon of basic mathematical concepts, important mathematicians, and milestones in the history of mathematics starting from ancient systems of arithmetic to modern theories. The test prompts students to relate historical milestones with mathematical concepts grooming a perspective of how the discipline has advanced over time and how it, in turn, has impacted human civilization. By filling the blanks from the list provided, students showcase their understanding of mathematics as more than a mere collection of formulas, but rather, as a vibrant, multifaceted domain shaped by the cultural, scientific, and technological achievements of civilization.

In summary, as previously explained, the final version of the exam consists of 73 paragraphs that are divided into six categories of mathematical enlightenment. These categories include mathematical knowledge, mathematical trends and teaching methods, mathematical research, mathematical thinking, problem-solving techniques, and the nature and history of mathematics. To ensure the validity of the study instrument, each of its dimensions was evaluated for reliability. Table 2 displays the Cronbach's alpha reliability measure.

Based on the scoring criteria recommended by mathematics experts and utilized in reference tests, a student is considered enlightened in a particular dimension if they achieve a score of 70% or higher in that area. One point is granted for each accurate response in categories such mathematical knowledge, Mathematical science research, mathematical thinking, solving mathematical problems, and the nature and history of mathematics. In other categories, "I don't know" or erroneous replies result in zero points. However, arithmetic means are used to evaluate the dimension of tendencies towards mathematics and its instruction differently: a mean score falling between 1 and 1.66 is deemed low, between 1.661 and 2.32 is deemed intermediate, and over 2.321 is deemed high. If a participant receives a high mean score in this dimension, they are deemed enlightened.

It is crucial to realize that pre-service teachers need to be enlightened about mathematical concepts, skills, and operations. They also need to be able to apply mathematical thinking and problem-solving strategies and have a good comprehension of the nature of mathematics and its historical development. This type of enlightenment is measured according to the mathematical enlightenment [17]. It is important to remind readers that mathematics consists of various systems built on logical frameworks rooted in presumptions and axioms. It is a scientific discipline that explores intangible ideas such as symbols, numbers, forms, operations, and the logical analysis of form and quantity [17], [25].

Table 2. Cronbach alpha for each part

Dimensions	Number of items	Cronbach's alpha (α)
Mathematical knowledge	27	0.79
Trends towards mathematics and the methods of its teaching	10	0.73
Scientific research in mathematics	10	0.69
Mathematical thinking	8	0.71
Solving mathematical problems	10	0.65
Nature of mathematics and its history	8	0.70
All tools	73	0.83

3.2.1. What are the main dimensions of mathematical enlightenment?

The dimensions of mathematical enlightenment are derived from its definitions. Dimensions that are linked to teachers of mathematics before they have classroom experience are the following:

a. Mathematical knowledge, which encompasses the essential knowledge a mathematics teacher should possess, specifically: understanding fundamental mathematical concepts and performing basic mathematical skills.
b. Methods of mathematical thinking. In order to solve mathematical problems, a math instructor should be able to apply techniques of mathematical thinking, such as logical and deductive reasoning.
c. Solving mathematical problems, that the teachers will face in their daily lives, therefore they should be able to use mathematical ideas and techniques to address issues in real-world scenarios.

d. Scientific research in mathematics. In other words, the teacher needs to be knowledgeable with mathematical scientific research methodologies.
e. Trends towards mathematics teaching methods. This suggests that a math instructor needs to be passionate about the subject and informed about the teaching strategies used in it.
f. Nature of mathematics and its development throughout history. A math instructor needs to understand the essence of the topic, how it has developed historically, and the scientific breakthroughs in mathematics.

3.2.2. What is mathematical enlightenment's level for pre-service teachers?

The results shed light on how well-prepared future educators are regarding their mathematical understanding and abilities. High levels of mathematical enlightenment indicate that pre-service teachers possess a strong grasp of essential mathematical concepts, the ability to think critically and solve problems, and a deep awareness of the nature and history of mathematics. Conversely, lower levels may suggest areas where additional training or emphasis is needed to ensure that these future educators are fully equipped to teach mathematics effectively. Table 3 displays the estimated averages and standard deviations for the aspects of mathematical insight.

The mark (*) means that all the standards and means were standardized to a five-point scale for scaling standards. The mean scores were 3.62 for knowledge in mathematics, 3.52 for trends in mathematics, 3.50 for mathematical research in science, 3.28 for reasoning in math, 3.21 for problem-solving, and 4.18 for the nature of mathematics and its history. The mark (**) is regarding the weighted mean and weighted standard deviation. Table 3 indicates that, despite 348 (63%) of the sample members scoring higher than 70, the sample's mean performance (mean percentage) on the enlightenment measure was (72.4), which is greater than the determining score of 70. This conclusion disagrees with the work of Kartal study [24], which suggested that the degree of mathematical enlightenment was low, but it agrees with some earlier research [25], which revealed an accepted level of scientific enlightenment.

The data shown in Table 3 indicates that the members of the study group possess a deeper understanding of the nature and history of mathematics. This can be attributed to the inclusion of a course on the subject in university curricula and teaching methodologies. This course features contributions from Muslim and Arab mathematicians. People are also more enlightened when it comes to mathematics; this is because general concepts and mathematics basics are taught in math courses offered by Palestinian colleges. However, people lack awareness of the various facets of mathematical problem-solving and thought. This refers to a number of issues, including the absence of activities in math curricula and the discussion of issues in which teachers rely solely on the textbooks for information while ignoring other applications and activities that enable students to see the practical applications of mathematics. Moreover, math professors occasionally lack adequate understanding of scientific and technical advancements [16].

Table 3. Means and standard deviations for sample responders

	Items	Mean*	Standard deviation	Percentage %	Rank of dimensions
Mathematical knowledge	27	3.62	0.42	72.4	2
Trends towards mathematics and the methods of its teaching	10	3.52	0.39	70.4	3
Mathematical science research	10	3.50	0.52	70	4
Mathematical thinking	8	3.28	0.45	65.6	5
Solving mathematical problems	10	3.21	0.39	64.2	6
Nature of mathematics and its history	8	4.18	0.40	83.6	1
All tools	73	3.62**	0.31**	72.4**	

3.2.3. Does a pre-service mathematics teacher's degree of mathematical knowledge change depend on their gender and the university they attended?

To investigate the disparities in mathematical enlightenment levels between male and female pre-service teachers in the subject of mathematics, an independent sample t-test is utilized as in Table 4. The Table 4 reveals that the variations in means were statistically significant (p-value<0.05), indicating a meaningful variation in the level of mathematical enlightenment between genders. Specifically, females were found to be more enlightened than males. This difference can be attributed to various factors such as social, financial, and political ones. In Palestinian society, there are numerous social boundaries and restrictions placed on women, limiting their participation in activities such as joining clubs, engaging in public sports, visiting parks, or wandering alone. As a result, females often channel their energy and focus into their studies, viewing education as the primary means to achieve their ambitions.

Table 4. Independent samples t-test for pre-service mathematics teacher's degree of mathematical knowledge grouped by gender variable

Measure of variation		Mean	Standard deviation	Number	t-value	p
Gender	Male teachers	3.01	0.36	273	15.843	0.001
	Female teachers	3.29	0.15	278		

The findings of Shin's study [26], which also showed that gender had a substantial impact on mathematical reasoning skills, are consistent with the results of this study. Interestingly, Wilkerson research revealed that men pre-service teachers outperformed their female counterparts on the mathematical reasoning skill test, despite the fact that our study indicated that females were more mathematically literate. Nonetheless, they observed that these gender disparities tend to disappear as the sample size of pre-service teachers grows [14].

Additionally, given the financial challenges faced by many Palestinian families, females often feel a heightened responsibility to help improve their family's financial situation. The political climate affects also females more acutely than males, particularly those who have faced significant hardships. This context is reflected in the Tawjihi (high school) exam results, where females consistently outperform males in mathematics. Notably, the top ten students in these exams are predominantly female, underscoring their superior level of mathematical enlightenment.

To assess the statistical significance of the mean differences with respect to the variable universities, a one-way ANOVA was performed as in Table 5. The Table 5 shows no statistically significant difference concerning the university variable, with an F test of 2.44 and a p-value of 0.11, which is not significant at an α=0.05. This underwhelming lack of significance can be attributed to a few reasons. Firstly, The Ministry of Higher Education has common policies across all Palestinian universities. Secondly, the relatively smaller size of Palestine means that most families have comparable childrearing conditions. Third is a large proportion of technological equipment and resources is owned by Palestinian universities. The last is that the occ upation ongoing provides common problems for all Palestinian institutions. Aspects playing a role in this lack of heterogeneity may consist of unified regulations by the Ministry of Higher Education, common socio-political factors, and shared technological resources [26], [27].

Table 5. One-way ANOVA of pre-service mathematics teacher's level of mathematical knowledge classified by university variable

Variation sources	Sum of squares	Freedom's degree	Mean squares	F-statistics	p-value
Between groups	32.7	4	8.18	2.44	0.11
Within groups	1828.2	546	3.35		
Total	1860.9	550			

3.2.4. Is there an association between mathematical enlightenment's level of pre-service mathematics teacher's and the cumulative GPA in university?

As indicated in Table 6, we performed an ANOVA of the regression specifically for the group of enlightened pre service teachers (n=348) in this analysis. Table 6 demonstrates a statistically significant relationship, with an F-statistic of 195.02 and a p-value of 0.001, indicating that mathematical enlightenment has a significant effect on the GPA of pre-service teachers at α=0.05.

Table 6. The analysis of linear regression model for the GPA of the group of enlightened pre service teachers

Variation sources	Sum of squares	Freedom's degrees	Mean squares	F-statistic	p-value
Regression	230.12	1	230.12	195.02	0.000
Residuals	410.20	347	1.18		
Total	640.32	348			

Importantly, Table 7 assesses the efficacy of mathematical enlightenment as a predictor of cumulative GPA in university and gives metrics for how well our whole model fits. Table 7 shows that mathematical enlightenment is not the only factor that is impacting the academic performance, since it explains 46.44% of the variance in GPA. This suggests that while mathematical enlightenment is a significant contributor to academic performance prediction, it does not occur in isolation. As has been postulated in previous research, there are several other variables—e.g., social problems, mental health disorders, and students' ability to adapt to life at university—that are likely to contribute equally significant

roles in influencing academic success [28]. These findings highlight the multiplicity of achievement and warn against parsimonious explanations of student performance.

Table 7. The model variation

Model	R	R^2	Adjusted R^2	Standard error of the estimate
1	68.15%	46.44%	37.13%	0.45

4. CONCLUSION

In conclusion, enhancing pre-service teachers' mathematical enlightenment is essential to creating a mathematics education system that is more influential and successful. Teachers need to have a strong foundation in mathematical thinking since they have a big impact on the mathematical abilities and mindset of their students. Improving pre-service teachers' understanding of mathematics can have a number of beneficial effects, such as suitable classroom instructions, higher students engagement, better evaluation and feedback, improved professional growth, and a boost to student accomplishment. To achieve these aims, the development of mathematical thinking abilities, problem-solving strategies, and a deep understanding of mathematical subject matter must become the top priority in teacher preparation programs and professional development. Furthermore, pre-service teachers can benefit greatly from collaboration and mentoring with seasoned math educators, who can provide insightful advice and support as they continue to hone their teaching techniques.

To find out if school mathematics curricula properly educate kids, it is imperative to first reevaluate them. Secondly, it is imperative to establish a technologically advanced educational environment and allot suitable funds for its execution. Third, a course on problem-solving techniques, including mathematical riddles and different forms of thinking, ought to be instituted. Finally, it is critical to highlight the aspects of mathematical illumination as essential credentials for math teachers and as a hiring requirement.

To consider for future research is a longitudinal study to follow the long-term impact of mathematical enlightenment on students' professional and academic trajectories. Exploring the specific form of thinking most strongly correlated with mathematical enlightenment may provide further clarity on precisely how one should tailor educational practice to meet the needs of different student profiles. Furthermore, exploring the effectiveness of various pedagogical approaches and technological tools to enable mathematical enlightenment would be worth studying. Cross-system or cross-cultural comparison may also shed light on how these factors influence mathematical enlightenment. Finally, research on how mathematical enlightenment can be integrated in teacher preparation programs can help develop more productive teachers who can enable this essential capacity in students.

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C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
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Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

No potential conflict of interest was reported by the authors.

INFORMED CONSENT

All study participants provided informed consent. Teachers who participated were fully briefed on the study objectives and informed of their right to discontinue participation at any time.

ETHICAL APPROVAL

The study adhered to all applicable national regulations and institutional policies and received approval from University Hebron Ethics Committee.

DATA AVAILABILITY

The research data supporting this study's findings can be obtained from the corresponding author, [IN], through reasonable request. The dataset is not publicly accessible due to privacy and ethical considerations, as it contains information that could potentially compromise participant confidentiality.

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