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Demystifying the Relationship Between Confidence and Critical Thinking in Mathematics among Preservice Teachers in West Philippines

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Abstract: Mathematical confidence and critical thinking are essential in preparing preservice teachers. Thus, this study explored the perceived confidence and critical thinking levels in mathematics of elementary and secondary preservice teachers. A descriptive-correlational-comparative research design was employed, with a sample of 107 randomly selected preservice teachers enrolled in the Bachelor in Elementary and Secondary Education programs of a state university in West Philippines. The study used arithmetic mean, standard deviation, Spearman's rank-order correlation, and independent samples t-test to analyze and draw conclusions from the data. The findings revealed that the preservice teachers have high confidence and critical thinking skills. Their program significantly correlates with their perceived critical thinking and confidence level. Besides, the preservice teachers' confidence levels and perceived critical thinking skills significantly correlate. Further analysis found significant confidence and critical thinking differences favoring the secondary over the elementary preservice teachers. These findings provide insights that would benefit mathematics educators in providing priority programs to enhance the preparation of future math teachers.

Keywords: *Educational research, innate characteristics, mathematics education, prospective teachers, thinking skills.*

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Introduction

The study of mathematics is critical in school and society, and it has an outstanding contribution that benefits humans and the world. It is also crucial to students, especially preservice teachers. Studying variables such as confidence and critical thinking among preservice teachers makes sense for them to better understand mathematics. Like understanding the preservice teachers' math anxiety (Ersozlu et al., 2022) and math self-efficacy (Dua et al., 2022; Subekti et al., 2022), demystifying their confidence and critical thinking is vital to their preparation as future math educators. Confidence refers to the state of mind that enables individuals to go outside their boundaries and encourages belief within themselves (Greenacre et al., 2014). That means confidence serves as a foundation for a person to achieve something. As people experience, learn, and undertake action, they gain detailed feedback about their potential and thus develop their beliefs and describe them as self-confident. Confidence and critical thinking in mathematics are essential for preservice teachers. Confidence in math allows preservice teachers to deal with math problems. In contrast, critical thinking in math empowers the confidence of preservice teachers to become participative since it enhances their capability to analyze, interpret, evaluate, examine, infer, and explain math problems.

The mathematical confidence of preservice teachers develops the capability to understand the procedure and context of learning the subject. Also, having confidence is vital in learning mathematical concepts, which is necessary for a mathematical growth mindset and a belief that with hard work and perseverance, regardless of ability, one can succeed in mathematics (Santos et al., 2022). Confidence in math reflects preservice teachers' growth mindset for greater comfort with taking risks and dedication to face stretching goals. Still, it includes the willingness to persevere and a positive

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attitude toward mistakes that are part of acquiring knowledge. Confidence is a positive mental attitude of an individual who has positioned or accustomed himself to analyzing himself and his surroundings to feel comfortable performing activities to achieve the planned goals (Kunhertanti & Santosa, 2018). Indeed, preservice teachers' confidence allows them to stay motivated and passionate about studying mathematics as a subject they will teach in the future. This means that confidence is the one that helps preservice teachers to explore learning that they do not know yet, whether it is difficult or easy. As stated, having a positive ability and confidence is an effective way to understand and learn the overall mathematics content. Confidence is beneficial in preservice teachers' learning because it will serve as a tool for them to discover new knowledge.

Critical thinking is an essential tool in mathematics since it is the most desirable skill involving logical reasoning and wise decision-making. Critical thinking necessitates acquiring, interpreting, analyzing, and evaluating data to reach a trustworthy and valid judgment (Chukwuyenum, 2013). In other words, comprehension of the preservice teacher is a must to understand the mathematics that separates facts and information from opinion, and details are scrutinized with evidence before accepting and sharing ideas to solve daily life problems. Through critical thinking, mathematics is easy to learn and interpret. It shapes individuals to make intelligent decisions in solving complex problems in mathematics. Generally, critical thinking is an efficient skill for the preservice teacher that enhances the ability to understand the arithmetic concept. Critical thinking is a high-ordered thinking skill that looks at the situation with being observant and wise in making a decision. It is about analyzing, interpreting, and evaluating the data to study the reliability and validity of the problem. Critical thinking helps preservice teachers to learn the whole concept of a subject. Critical thinking allows them to surely understand what they are doing in studying math. This ability helps further improve preservice teachers' creative, logical, and analytical thinking skills.

Confidence is enhanced by critical thinking, and it works together to achieve effectiveness in solving and understanding complex mathematical problems. Critical thinking abilities are the intellectual activity of actively and skillfully conceptualizing, applying, analyzing, synthesizing, or evaluating knowledge as a framework. Then confidence is about action and belief in oneself (Insorio & Librada, 2021). Everyone and so critical thinking skills can possess confidence. Critical thinking skills can be enhanced through cognitive development and are commonly influenced by higher-order thinkers. Teachers must be able to give students opportunities to understand the concept and make justification for their mathematics learning, not a learning that merely trains students to apply the formula and mathematical procedures (Kusaeri & Aditomo, 2019).

To sum up, confidence and critical thinking in math must possess by the preservice teachers to influence the attitudes and learning skills of students. A teacher has a strategic role in molding the student's confidence and critical thinking in dealing with math problems. They can help develop a child's behavior by encouraging them to do and learn math by ensuring that they provide the proper procedures to enhance the student's critical thinking skills. Hence, mathematics preservice teachers must be confident and critical thinkers to become efficient math teachers. The study proposed that confidence and critical thinking are vital in preparing preservice teachers as future mathematics educators.

However, despite the increasing number of studies suggesting that confidence and critical thinking are essential skills, studies reported that preservice students still need more confidence and critical thinking skills. In the study of Fikriyati et al. (2021), preservice science teachers' critical thinking dispositions and critical thinking skills are classified as low and underdeveloped. Sintema and Marban (2020) revealed that preservice teachers needed more confidence due to insufficient pedagogical subject knowledge and self-concept. This could be because preservice teachers still need further instruction in the mathematical subject and additional training in mathematical pedagogy (Hine & Thai, 2019). This posed a concern since several studies asserted the significant relationship between self-confidence and critical thinking skills. For instance, Demirdag (2019) focused on university students' critical thinking as a predictor of self-esteem. The study found a significant relationship between certain sub-factors of critical thinking and the students 'self-esteem, such as confidence. Furthermore, Sternberg (1987) demonstrates that university students with higher self-esteem are more motivated to learn, leading to improved critical thinking abilities. This may be because students willing to seek information, assess, and learn are more likely to be ambitious in their attempts to dispel their misconceptions and improve their self-confidence (Eales-Reynolds et al., 2013). Considering the literature stated, little theoretical research has concentrated primarily on preservice teachers, specifically in mathematics classes, while considering the relationship between critical thinking abilities and students' confidence. In addition, there is a disparity between theory and practice as some students reportedly declined to participate in assignments that needed critical thinking even if they essentially believed in their talents and abilities (Crocker & Luhtanen, 2003). In this regard, revisiting and investigating aspiring mathematics teachers' critical thinking and confidence is necessary. This paper provided new information concerning the connection between confidence and critical thinking in mathematics among elementary and mathematics preservice teachers. Mathematical confidence beliefs significantly impact math performance (Peker et al., 2018). If preservice teachers are confident, they are most likely to deal with different problems in mathematics with ease, and thus their students may adopt the same attitude. When prospective teachers are trained and think critically, they can improve students analyzing abilities (Prayogi et al., 2018; Sercenia et al., 2023). Indeed, critical thinking is essential in boosting preservice teachers' confidence in understanding, learning, and applying mathematics, and vice versa.

This paper further explored the relationship between critical thinking and confidence with the program and year level. Critical thinking and confidence are essential for success in academic and professional settings. Still, preservice teachers may not always receive adequate training in these skills during their educational journey. In addition, the approach to teaching critical thinking and confidence may vary depending on the program and year level. As such, it is essential to understand these variables' impact on developing critical thinking and confidence among preservice teachers. However, there is limited research on how the program and year level may influence critical thinking and confidence, which are crucial to academic and professional success. Preservice teachers may develop these skills more fully as they progress through their educational journey. However, how the program and year level may influence this development is unclear. Therefore, this study will better understand how program and year level may impact the development of these essential skills among preservice teachers and inform the development of educational interventions to support their preparation as future teachers.

Research Questions

This study aimed to determine the perceived confidence and critical thinking in mathematics among elementary and secondary preservice teachers and the relationship between these variables. In particular, these questions were answered:

(1) What are the elementary and secondary preservice teachers' perceived confidence and critical thinking level in mathematics?

(2) Is there a significant relationship between the year level and the program with their perceived confidence and critical thinking level in mathematics of the elementary and secondary preservice teachers?

(3) Is there a significant relationship between the elementary and secondary preservice teachers' perceived confidence and critical thinking level in mathematics?

(4) Is there a significant difference between the elementary and secondary preservice teachers' perceived confidence and critical thinking level in mathematics?

Literature Review

Mathematical Confidence of Elementary and Secondary Preservice Teacher

Research has emphasized the preparation of preservice teachers and building confidence by preparing those preservice teachers in both content and pedagogy (Li & Kulm, 2008). Confidence has been variously outlined as a size attitude, a final result of ideals approximately one's self-efficacy in a specific situation, and as inherent within the technique of studying and connected to become aware of formation (Beswick et al., 2011). Similarly, self-confidence and great part models among classmates in educators are definitive for students' states of mind towards the subject (Laranang & Bondoc, 2020).

Gresham (2018) emphasized that preservice teachers show a low level of confidence that pushes them to not take advanced courses by avoiding hindering their students. Many college students own low self-confidence in mastering arithmetic, which, in turn, can also additionally cause them to surrender pursuing more mathematics knowledge (Ku et al., 2014). On the other hand, Parsons et al. (2009) researched engineering students' confidence in their abilities which matters in mathematics, revealing that most students felt pretty confident during their first year in developing their confidence in mathematics.

Another study investigated preservice teachers' mathematical confidence. The results suggest that these future teachers need a solid and deep understanding of mathematical knowledge to teach to build confidence in instructing in the classroom, which demonstrates that it is possible and vital to conceptualize the teacher's notion of knowledge in mathematics education in such a way that it includes teacher perceptions (Li & Kulm, 2008). In addition, Mariano-Dolesh et al. (2022) suggested that future teachers with firmer beliefs were more confident about their ability to teach mathematics effectively.

Çiftçi and Yildiz (2019) revealed no significant relationship between confidence and year level. In addition, Ganley and Lubienski (2016) found that early interventions that pay particular attention to girls' mathematical confidence in outcomes and attitudes may be more effective as they progress through their academic and professional lives. One way to boost self-confidence is to set up after-school programs and math clubs for girls, emphasizing viscous partial thinking and non-normative solutions (Heaverlo et al., 2013). The studies above provide insights into building confidence, but some missing points must be addressed. More research is necessary to understand the factors contributing to low confidence levels among preservice teachers, which include program and year levels.

Critical Thinking Skills towards the Mathematics of Elementary and Preservice Teachers

One of the essential aspects of success is critical thinking. It is a manner of approaching problem-solving, reaching conclusions, evaluating probabilities, and making judgments. Critical thinkers use these skills appropriately,

unprompted, and often consciously in various situations (Celik & Ozdemir, 2020). Aside from this, Critical thinking ability is also one of the vital thinking skills that students must master that make life less complicated (Basri et al., 2018). Most perspectives of the preservice instruction were not related to educational convictions around critical thinking mien, perceived readiness, or inclination for constructivist instruction, whereas a few were as it was weakly associated with belief approximately instructing essential aptitudes of thinking (Kusaeri & Aditomo, 2019).

Critical thinking should be high in arranging for instructors to perform successfully and be successful in classroom education activities. In this setting, teachers got to make instructing situations that can move forward the critical thinking abilities of learners (Yüksel et al., 2013). Regarding the importance of students' critical thinking skills, teachers should guide students to have critical thinking skills (Basri et al., 2018). Teaching potential teachers how to think critically has recently received some attention. Before introducing a cognitive talent to their pupils, teachers must teach it to prospective teachers (Prayogi et al., 2018). Furthermore, to strengthen mathematical thinking techniques, it is crucial to ascertain whether preservice teachers have a propensity for critical thought, which can be done by teaching them critical thinking abilities (Jacobs et al., 2010).

Aktaş and Ünlü (2013) found that the critical thinking aptitudes of educator candidates of basic arithmetic were medium but needed to be higher. Critical thinking skills ought to be connected and created within the education and learning process to teach studies that think quality in the future (Firdaus et al., 2015). Additionally, Deringöl (2017) concluded that preservice rudimentary school instructors and mathematics instructors had high levels of critical thinking. The ability of preservice teachers to think critically in identifying assumption sub-skill is the lowest. In contrast, Afriansyah et al. (2021) revealed that the critical thinking skills of preservice teachers in mathematics are low, which implies that a teacher needs to have a good foundation in MCTS. Typically, critical thinking dispositions are anticipated to expand gradually as preservice teachers proceed with their studies (Akgun & Duruk, 2016). Moreover, another study found that preservice teachers studying in different departments have low critical thinking skills (Incikabi et al., 2013).

The studies emphasized the significance of critical thinking abilities. However, several research gaps must be filled. While some research indicates that preservice teachers have strong critical thinking skills, others imply they are lacking. More research is deemed to understand better the complex relationship between critical thinking skills and program and year level.

Mathematical Confidence and Critical Thinking in Mathematics

Students with mathematical critical thinking and confidence possess the basic skills needed to solve math problems in everyday life (Norton, 2019). To acquire the fundamentals of mathematics, creating a learning environment that supports the development of students' mathematical critical thinking skills and confidence is necessary. Engaging in critical thinking activities can develop more confidence (Foster, 2019). Teachers can create situations in which students must go through the problem-solving process in various situations and situations to use their skills effectively. Students can develop and improve basic math skills and often practice math critical thinking skills and confidence (Su et al., 2016). Enhancing students' confidence and critical thinking skills is essential when mathematics literacy develops properly (Pratama, 2020). Still, Hoffman and Elwin (2004) revealed a negative relationship between these variables. The findings above shed light on the relevance of students acquiring critical thinking skills and confidence in mathematics. However, there is one gap in the context of preservice teachers. Preservice teachers are likely to have a critical influence in developing pupils' attitudes and ideas about mathematics. Accordingly, it is critical to investigate how preservice teachers' critical thinking skills and confidence affect their teaching efficacy and students' learning results.

Methodology

Research Design

This study utilized a quantitative research design employing descriptive-correlational-comparative approaches to describe the preservice teacher's perceived confidence and critical thinking in mathematics. It also determined if significant correlations and differences exist between variables without allowing the researchers to manipulate or control them. This method is appropriate for the study since the perceived confidence and critical thinking level in mathematics of elementary and secondary preservice teachers were described. The correlational phase determined the relationship between the preservice teachers' program and year level with their perceived confidence and critical thinking level towards mathematics. Meanwhile, comparisons were conducted to determine differences in the perceived confidence and critical thinking level toward mathematics when grouped according to program and year level.

Sample

The total respondents of this study were 107 second- to third-year BEED generalist and BSED-mathematics preservice teachers of Western Philippines University - Puerto Princesa Campus. They represented 85 percent of the population and were chosen to ensure the reliability of the gathered data. Since collecting data from every single person in a particular community is impossible and uneconomical, a sample of the population must be chosen and representative of the wider group (Bowling, 2014). The study used stratified random sampling to determine respondents randomly and have the

same probability of being chosen for this research, providing greater precision. Stratified random sampling is appropriate in this study since the sample can be divided into mutually exclusive and exhaustive subgroups for the construct of the study. Furthermore, using stratification may result in a lesser estimation error than a simple random sample of the same size, and it tends to be more representative of a population because it warrants that elements from each stratum are represented in the sample, ensuring sample reliability (Daniel, 2012). This group of respondents was randomly chosen because they are credible data sources and will soon be mathematics teachers. The majority of the respondents were from BEED (66.4%), and only 33.6% were from BSED. There were more third-year students (51.4%) than second-year students (44.9%). The first-year students were omitted since they served as samples during the pilot testing of the instrument, while there were only three fourth-year students during the study.

Data Collection

Before the administration of the questionnaire, approved request letters and informed consent were secured from the authorities and respondents. Ethical measures were considered to ensure the respondents would benefit and not be harmed. The study details were discussed with the respondents before they consented to participate. Then the respondents were selected, the BEEd and BSEd-Mathematics preservice teachers, from the second to the third year for this research paper. Afterward, permission was asked from the respondents to answer the questionnaire through online survey administration software or Google Forms. The link was sent to the selected students, and they were given enough time to finish the online survey. The collected data from the respondents were tallied, summarized, and presented through tables.

Data Analysis

The data gathered were screened first to ensure validity before applying any statistical treatment. In analyzing the gathered data, various descriptive and inferential statistics were utilized using Jamovi software. In the descriptive part of the study, arithmetic mean and standard deviation were reported across the perceived confidence and critical thinking level in math. For the inferential part, Spearman's rho was computed to determine relationships among variables. Independent samples t-test was also computed to determine the significant differences between variables.

Instruments

This study utilized a researcher-made math confidence survey questionnaire, rated on a 4-point scale (1 - strongly disagree, 2 - mildly disagree, 3 - mildly agree, and 4 - strongly agree) where the general confidence of the respondents is measured. Moreover, the researchers also developed a survey questionnaire to determine their critical thinking using a 3-point scale (2 - always, 1 - sometimes, 0 - never) with an objective degree of the core thinking aptitudes required for intelligent decision-making concerning what to accept or do. The researchers developed the instrument and designed and constructed each item concerning the mathematics class. Developing instruments was essential to measure preservice teachers' math confidence and critical thinking. The researchers developed the survey questionnaires to ensure that the questions were tailored to the context of the mathematics class and the study's goals. By having control over the design and content of the questions, the researchers could increase the validity and reliability of the instruments. The instruments allowed for more nuanced data, which helped the researchers better understand math confidence and critical thinking among preservice teachers. The instruments offer greater control, flexibility, and accuracy, allowing the researcher to understand better the phenomena they are studying. The questionnaire was initially subjected to validity and reliability testing to evaluate and ensure the suitability and appropriateness of the items among the preservice teachers. The instruments were given to experts, and the researchers revised and edited each item based on the comments and suggestions. After the validation, confidence and critical thinking yielded ten items totaling 20. The instrument was pilot-tested with 50 non-participants, and the reliability coefficient was estimated using Cronbach's alpha. The pilot sample's Cronbach's alpha coefficient was 0.79, showing acceptable internal consistency and reliability. The final sample had 107 participants, and Cronbach's alpha coefficient was 0.85, indicating that the instrument had acceptable internal consistency and reliability.

Ethical Consideration

The researchers clarified to the respondents the purpose of the study, and they voluntarily participated to be part of the research. Also, the instrument used did not record confidential information that could be traced back to each respondent.

Findings

Elementary and Secondary Preservice Teachers' Confidence in Mathematics

The respondents' perceived mathematical confidence level is presented in Table 1. The preservice teachers achieved a high confidence in mathematics (Mean = 2.86, SD = 0.52). The statement "*I trust my ability to teach mathematics successfully"* got the highest mean (Mean = 3.28, SD = 0.60), followed by the statement "*appropriately apply my knowledge and skills in mathematics*" (Mean = 3.20, SD = 0.62). Meanwhile, "*I can perform excellently in non-routine problems*" (Mean

= 2.59, SD = 0.69) got the lowest mean. This indicates that the respondents have enough confidence to apply their learned knowledge and skills in mathematics to a certain extent.

Table 1. Preservice Teachers' Confidence in Mathematics

Statements	Mean	SD	Category
I can solve current math problems using my prior knowledge.	2.96	0.63	High
I appropriately apply my knowledge and skills in mathematics.	3.20	0.62	High
I trust my ability to teach mathematics successfully.	3.28	0.60	Very High
I can explain math problems to my fellow preservice teachers.	2.70	0.66	High
I effectively understand the right solution to each math problem.	2.88	0.64	High
I understand math concepts and how to apply them.	2.85	0.72	High
I can demonstrate mathematical concepts to non-math majors.	2.76	0.70	High
I can quickly solve mathematical problems on my own.	2.74	0.70	High
I can perform excellently in non-routine problems.	2.59	0.69	High
I am good at analyzing and interpreting mathematics problems.	2.64	0.65	High
Overall Confidence Level	2.86	0.52	High

Legend: 3.26-4.00 (very high), 2.51-3.25 (high), 1.76-2.50 (moderate), 1.00-1.75 (low)

Elementary and Secondary Preservice Teachers' Critical Thinking Skills in Mathematics

Table 2 displays that the preservice teachers have a high level of perceived critical thinking skills in mathematics (Mean = 1.41, SD = 0.39). The statements "*I can interpret and analyze real-life mathematical problems*" (Mean = 1.51, SD = 0.50) and "*I can understand why and how the solution works*" (Mean = 1.51, SD = 0.50) got the highest mean. Meanwhile, the statements "*I can decide or judge a specific mathematical problem*" (Mean = 1.33, SD = 0.51) and "*I can develop strategies for expressing mathematical concepts*" (Mean = 1.28, SD = 0.53) got the lowest mean. This finding implies that the respondents can comprehend and critically examine mathematical problems. They also demonstrate the ability to evaluate their mathematical skills and construct new mathematical ideas.

Table 2. Preservice Teachers' Critical Thinking Skills in Mathematics

Statements	Mean	SD	Category
I can create alternative and new ideas over established ones.	1.43	0.53	High
I can logically argue with others about my solution to a problem.	1.41	0.53	High
I can critique the mathematical ideas of others.	1.42	0.52	High
I can interpret and analyze real-life mathematical problems.	1.51	0.50	High
I can see effective ways of building mental discipline	1.46	0.54	High
I can reason out to answer mathematical problems.	1.40	0.51	High
I can find possible solutions and alternatives to problems.	1.36	0.50	High
I can develop strategies for expressing mathematical concepts.	1.28	0.53	Moderate
I can decide or judge a specific mathematical problem.	1.33	0.51	Moderate
I can understand why and how the solution works.	1.51	0.50	High
Overall Level of Perceived Critical Thinking	1.41	0.39	High

Legend: 1.34-2.00 (high), 0.67-1.33 (moderate), 0.00-0.66 (low)

Relationship between the Elementary and Secondary Preservice Teachers' Profile with their Confidence and Critical Thinking

The relationship between the respondents' characteristics and perceived confidence level and critical thinking was determined using Spearman's rho (Table 3). The confidence level (r_s = .383, $p < .01$) and critical thinking skills (r_s = .250, $p < .01$) have a highly significant relationship regarding the program they are enrolled. The table also showed that the confidence level (r_s = -.070, $p > .05$) and level of critical thinking (r_s = -.014, $p > .05$) have no significant relationship with year level. Thus, the program that the preservice teachers enrolled in are one of the factors that may associate with their perceived confidence and critical thinking skills in mathematics. At the same time, their year level does not affect their confidence and critical thinking skills in mathematics.

Table 3. Relationship between the Preservice Teachers' Profile with their Confidence and Critical Thinking

Profile		Perceived Confidence	Perceived Critical Thinking
Program	Spearman's rho	.383	.250
	p-value	.000	.009
Year-level	Spearman's rho	-.070	-.014
	p-value	.474	.885

Relationship between the Perceived Confidence and Critical Thinking in Mathematics of the Elementary and Secondary Preservice Teachers

To determine the relationship between the respondents' confidence level and perceived critical thinking, Spearman's rho was conducted as presented in Table 4. The preservice teachers' confidence and perceived critical thinking skills displayed a highly significant positive relationship (r_s = .552, p < .01). These findings show that the respondents' perceived confidence is associated with the respondents' critical thinking in mathematics.

Table 4. Relationship between the Preservice Teachers' Confidence and Critical Thinking

Variables	Spearman's rho (r_s)	p-value
Perceived Confidence Perceived Critical Thinking	.552	.000

Difference between the Elementary and Secondary Preservice Teachers' Confidence and Critical Thinking Level in Mathematics

Before analysis, the Normality Test (Shapiro-Wilk) and Homogeneity of Variances Test (Levene's) were conducted, and violations of assumptions were not found. Thus, further analysis was possible, and the independent samples t-test was presented in Table 5. The independent samples t-test displayed a statistical difference between elementary and secondary preservice teachers in terms of their perceived confidence, $t_{(105)} = 4.15$, p < .01. This indicates that secondary preservice teachers have higher confidence (Mean = 3.14, SD = 0.466) than elementary preservice teachers (Mean = 2.73, SD = 0.497). Also, the respondent's perceived thinking was significant, $t_{(105)} = -2.69$, p < .01, indicating that the secondary preservice teachers (Mean = 1.56, SD = 0.383) had high critical thinking skills compared to the elementary preservice teachers (Mean = 1.35, SD = 0.378).

Table 5. Difference between the Preservice Teachers' Confidence and Critical Thinking

Group	Mean	SD	t	p-value
Perceived Confidence				
Elementary Preservice Teachers	2.73	0.497	-4.15	.001
Secondary Preservice Teachers	3.14	0.466		
Perceived Critical Thinking				
Elementary Preservice Teachers	1.35	0.378	-2.69	.008
Secondary Preservice Teachers	1.56	0.383		

Discussion

This study aimed to determine elementary and secondary preservice teachers' perceived confidence and critical thinking in mathematics. The preservice teachers demonstrate a high confidence level in mathematics. This indicates that the respondents already have enough confidence to perform mathematics. These results will influence respondents' belief that they can perform mathematics. These also indicate that respondents are confident in using prior knowledge, applying knowledge and skills, trusting their ability to teach mathematics, understanding mathematical solutions, explaining mathematical problems, and understanding, analyzing, and demonstrating mathematical concepts and problems. These findings somehow contradicted Norton (2019), which found that preservice teachers have low confidence and self-efficacy in mathematics.

Findings also show that the respondents have high perceived critical thinking skills. This result suggested that mathematics helps preservice teachers to develop their creativity and generate alternatives to establish new ideas (Bacangallo et al., 2022). It also suggests that mathematics helps develop rational thinking and logical argument, which improve their reasoning to answer mathematical problems. In contrast to As'ari et al. (2017), preservice teachers were found to have low perceived critical thinking levels. One plausible explanation for the study respondents' high level of perceived critical thinking is that the program's curriculum could have taught more about the ability to solve non-routine problems.

In terms of their profile, it was found that the program where they are enrolled has significant relationships with their confidence level and critical thinking skills. This indicates that preservice teachers enrolled in the BSEd program tend to have a higher level of perceived critical thinking than respondents in the BEEd program. Preservice teachers in BEEd tend to possess low confidence and perceived critical thinking skills. The BEEd respondents have to master multiple subject areas (such as math, science, social studies, music, arts, physical education, and English, to name some) throughout the program, which could have hindered them from paying particular attention to math, which resulted to a low level of confidence. Similarly, Niyukuri et al. (2020) found that the learning experience can influence the confidence of elementary and secondary preservice teachers. Besides, Chukwuyenum (2013) suggest that to increase confidence, preservice teachers should perform better and think more clearly so they can learn skills and apply them. However, the

year level has no relationship with their confidence level and critical thinking. This implies that year level has nothing to do with the respondent's perceived confidence and critical thinking. It also means that the preservice teachers show high perceived confidence and critical thinking regardless of the year level.

A significant positive relationship existed between preservice teachers' confidence and perceived critical thinking ability. This study found that respondents' perceived confidence relates to their critical thinking in mathematics. Similar results were attained by Yuliani et al. (2020), indicating that the higher their level of perceived critical thinking, their confidence in math is also higher. Conversely, respondents with a low level of perceived critical thinking also have low confidence in math. Though this correlation analysis will not be able to tell whether their level of perceived critical thinking causes the change in the level of confidence in math or vice versa, the performed analysis gave us a glimpse that perceived critical thinking is a good indicator of the confidence in math an individual might have or vice versa.

There is a significant difference between elementary and secondary preservice teachers regarding their perceived confidence. This indicates that secondary preservice teachers have higher confidence than elementary preservice teachers. The results coincide with Jung et al. (2011), who found that secondary teacher candidates reported higher confidence levels than elementary teacher candidates. Also, Gencer and Cakiroglu (2007) also found that secondary teachers have stronger beliefs in their ability to teach more effectively and enhance students' learning than elementary teachers. In addition, the secondary education program provides students with a solid understanding of their specialized discipline through theoretical and practical components. In contrast, the elementary education program was structured to prepare students to teach all core subjects. Moreover, the respondent's perceived thinking was also significant, indicating that the secondary preservice teachers had higher critical thinking skills than the elementary preservice teachers. This may be because secondary education majors in mathematics take more mathematics courses than elementary education majors. Teachers who took specialized courses had much stronger mathematical content knowledge than those who took more general mathematics courses (Bacangallo et al., 2022; Pentang, 2019).

Conclusion

Mathematical confidence and critical thinking are essential in preparing preservice teachers for effective teaching and learning practices. As this study explores the perceived confidence and critical thinking in mathematics of elementary and secondary preservice teachers, it was revealed that preservice teachers have high confidence and critical thinking in mathematics. Since preservice teachers are future teachers with field experiences, they are expected to demonstrate positive attitudes and beliefs in mathematics, especially in teaching mathematics. Their ability to think critically and make judgments is also necessary since teaching mathematics subjects requires higher-order thinking skills. Meanwhile, a significant positive relationship between the preservice teachers' perceived confidence and critical thinking levels was found in the study. Since confidence impacts students' performance, thus students are most likely able to think critically and understand the logical connection between ideas. Further analysis found that the year level of the respondents has no significant relationship to their confidence level and critical thinking. However, the program they are enrolled in significantly relates to their skills, giving the respondents enrolled in the BSEd program the upper hand. The differences between the elementary and secondary preservice teachers were also conducted to investigate their confidence and critical thinking level in mathematics. The result revealed that secondary preservice teachers had a higher perceived confidence level and critical thinking skills than elementary preservice teachers. This may be because secondary school programs include more mathematics courses than elementary education programs. Specialized courses tend to have more mathematical content knowledge than those general mathematics courses. This study provides baseline information and insights to improve teaching and learning practices. The results found in the study could help teachers and administrators provide necessary action for the success of mathematics education.

Recommendations

Since the confidence level of the preservice teachers is high, it is suggested to perform reinforcement activities that would further strengthen and allow them to share the standard practices that enable them to achieve and maintain their high level. Similarly, the measured level of perceived critical thinking skills is high. This study recommends continuing and further improving the practices in their math curriculum. Incorporating these more investigations of open-ended math problems and other non-routinary activities will help them to become proficient and critical thinkers in different aspects of mathematics.

Since the preservice teachers from the BEEd program tend to have a relatively lower level of confidence and perceived critical thinking skills in math than those in the BSEd program, this study suggests revising the math curriculum of the BEEd students. In line with the results and literature, the curriculum should provide experiences that promote the development of confidence and stimulate the preservice teachers' critical thinking. Since the study has shown a positive relationship between the level of confidence and the level of perceived critical thinking skills in math, it recommends taking the confidence level as an indicator of critical thinking skills and applying it to classroom settings. The teacher-educators can utilize this result by observing whether their students are confident in their answers, then testing whether they have the required level of critical thinking to grasp the concepts.

For future researchers interested in the same study, adding some variables, like their actual performance in mathematics tasks, is recommended. An interview may also occur to gain a deeper understanding of their critical thinking skills and confidence and to have an accurate and relevant result concerning the relationship between confidence and critical thinking skills among elementary and secondary preservice teachers.

Limitations

The study's findings should not be generalized due to the limited scope of the study. The respondents involved in this study may not represent all adult learners as this was also limited to mathematics class. Also, the researchers deliberately chose students from a particular program who may have been overrepresented in this study. Finally, additional variables not included in this study may confuse the associations between various variables using different measures within this study.

Ethics Statements

The respondents provided their consent to participate in this study.

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Conflict of Interest

The authors declare no conflict of interest.

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Authorship Contribution Statement

Pentang: Concept and design, data acquisition and analysis, editing/reviewing the manuscript, supervision. Caubang: Conceptualization, data acquisition and analysis, drafting the manuscript. Tidalgo: Conceptualization, data acquisition and analysis, drafting the manuscript. Morizo: Conceptualization, data acquisition and analysis, drafting the manuscript. Bautista: Data analysis and interpretation, reviewing and editing the manuscript. Viernes: Data interpretation, formatting the manuscript. Bucad: Language editing, reviewing the manuscript. Sercenia: Data interpretation, editing the manuscript.

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