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RESEARCH ARTICLE

CREATIVE THINKING AND PROBLEM-SOLVING: CAN PRESERVICE TEACHERS THINK CREATIVELY AND SOLVE STATISTICS PROBLEMS?

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Abstract

Math prospective teachers must be able to think creatively and solve problems. The study looked into preservice teachers' creative thinking and problem-solving abilities in statistics. The investigation was guided by a correlational design in a public university in the Philippines. Stratified random sampling was used to select the 103 study participants from two teacher education programs. Through google forms, data were collected using Torrance et al. (2008)'s tests of creative thinking and researcher-made statistics problem test. The findings revealed that preservice teachers have commendable creative thinking, particularly fluency, flexibility, and elaboration skills. Still, they lack problem-solving skills in statistics, specifically with central tendency, dispersion, and position measures. The correlational analysis revealed no link between creative thinking and problem-solving. Still, creative thinking and problem-solving courses are recommended to help preservice teachers develop their fundamental skills as mathematics educators.

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INTRODUCTION

Creative Thinking

Creative thinking skills are the ability to gain new knowledge from different ideas. It is a particular aspect that is important to generate new knowledge and encompasses the different development aspects (Fatmawati et al., 2019). It is far beyond just thinking, more complex, and has various aspects. Creative thinking is the full range of cognitive processes people use depending on a particular object, issue, setting, or conduct toward an event and the issue with the individual's capacity (Birgili, 2015). This skill helps to develop a particular characteristic that would improve insights about the different discoveries encountered, new knowledge that is learned, and new principle that is developed wherein they try to use imaginations to think deeper, the intelligence to think beyond a particular theory and the different insights and ideas about a problem. Developing creative thinking is a prerequisite for an individual's success in the modern world (Borodina et al., 2019). Preservice teachers' creative thinking skills are required to develop innovative problem-solving strategies.

Creative Thinking and Problem-Solving

Thinking creatively is crucial for finding solutions to problems (Amin et al., 2019). It will give every individual the idea to solve mathematical problems using this skill to build an abstract idea representing the given problem. Creative thinking skills include problem-solving that develops, implements, and leads to new ideas, encourages curiosity, improves flexibility, and increases one's ability to identify connections between the different concepts and ideas in solving the problem (Yayuk, 2020). Many researchers have learned the importance of creative thinking skills in problem-solving. Problem-solving enhances thinking abilities. Hidayat et al. (2018) demonstrate that teaching students to improve their creative thinking and problem-solving skills can address the lack of abilities of students. This skill serves as a fundamental tool for preservice teachers to solve challenging and complex problems, formulate solutions to a problem, and utilize different tools in solving problems especially involving statistics (Mariano-Dolesh et al., 2022; Pentang, 2019).

Preservice Teacher' Creative Thinking Skills

Creative thinking skills allow preservice teachers to propose a solution and utilize different tools in solving real-life problems. It is necessary for everyday problem-solving, including mathematical problems (Ardana et al., 2019). Creative thinking skills in problem-solving will allow preservice teachers to formulate mathematical objectives and find their innate relationship to solve problems according to the appropriateness of integrating different tools in solving problems, specifically statistical tools that are widely used in solving real-life problems in statistics. Husamah and Khoiriyah (2018) emphasize that when a person's creative thinking ability develops, it will generate many ideas, make many connections, have many perspectives on something, create and do imagination, and care about the results. Preservice teachers need creative thinking to solve problems in new and innovative ways (Hermita et al., 2021), involving them in creative activities in educational situations that require fulfilling their creativity. Creative preservice teachers use their imagination to generate novel ways of organizing learning experiences and ideas, consider alternative materials and media of expression, and evolve creative strategies (Topno, 2020).

Fostering creative thinking is the key to educational success, particularly in mathematics. Accordingly, this skill is necessary for preservice teachers who will be mentors and mathematics models for the future generation. However, no research determined preservice teachers' creative thinking skills in solving real-life problems in statistics. Thus, this

study explored the preservice teachers' creative thinking skills and their problem-solving performance in statistics and determined if there is a significant relationship between them. Additionally, this study seeks to determine if demographic profile variables correlate with the preservice teachers' creative thinking skills and problem-solving performance.

Research Questions

Generally, this study aims to determine the math self-concept, self-efficacy, and attitude of the preservice teachers and its implications for mathematics achievement. Specifically, the study was able to:

1. What is the preservice teachers' level of creative thinking skills and problem-solving performance in statistics?
2. Is there a significant relationship between the preservice teachers' demographic profile with their creative thinking skills and problem-solving performance in statistics?
3. Is there a significant relationship between preservice teachers' creative thinking skills with their problem-solving performance in statistics?

LITERATURE REVIEW

Creative Thinking Skills of Preservice Teachers

One of the essential qualities in the twenty-first century is the ability to think creatively. It enables us to be adaptable and deal with the opportunities and challenges in our complex and rapidly changing world (Corebima et al., 2019). Enhancing the creative thinking skills of prospective teachers prepares them for the classroom. It will help them be innovative when developing learning activities for class and be adaptive to children's needs to understand abstract mathematical topics (Hermita et al., 2021).

The formation of preservice teachers' creative thinking skills may differ in different ways regarding the foundation of their professional education, including their participation in the development of creative thinking, which has a vital role in their responsibility as a teacher (Kagema, 2018). In a higher context, the development of creative thinking skills for future educators has a significant contribution to the effectiveness of their creative ability and their attainment of a higher level of creativity, especially in their professional careers. Looking into the state of modern education, determining the actual level of the formation of creative thinking to all future educators, and recognizing different factors affecting its effectiveness are all included in the process of forming student's creative thinking in the environment of higher education (Dagdilelis, 2018).

Bozhkova et al. (2019) emphasize that developing creative thinking for all future educators is a comprehensive approach with a specific objective, set principles, and different components. In the high-level context of education, the development of creative thinking for all future educators has a relevant role in fulfilling their creative abilities and attaining a high level of inventiveness in their future professional endeavors (Borodina et al., 2019). In addition, Dagdilelis (2018) revealed that organizing a meaningful process of creating student's creative thinking in the higher context of education's learning environment entails searching for the state of modern education, defining the actual levels of the formation of future teacher's creativity and trying to identify the conditions and different factors affecting its effectivity.

Creative thinking skills are determined by four important factors: fluency, flexibility, originality, and elaboration (Bakar et al., 2015; Surya & Syahputra, 2017; Torrance et al., 2008). The capability to express oneself is known as fluency. Flexibility is the capability of an

individual to create various ideas from a different view. Originality is the capability of an individual to suggest a unique idea that differs from what we see in the books or from any suggestions of different individuals. Elaboration is the capability of an individual to present the different factors influencing them and to suggest any ideas. Bakır and Öztekin (2014) found no significant differences in the creative thinking level of preservice teachers in terms of their sex, educational attainment, school, and parent condition.

With limited literature on preservice teachers' creative thinking skills, this study must be considered to learn about their level of creative thinking skills and whether there is a significant relationship between their creative thinking skills with their demographic profiles and problem-solving performance.

Problem-Solving Performance of Preservice Teachers

Problem-solving skills allow every individual to know first what the problem is, then its reason will allow individuals to solve the problem accordingly without having difficulty is considered the intellectual process. It has been considered a higher-order cognitive process involving different regulations and control of their daily activities through different skills. The various step in problem-solving involves understanding and knowing the problem, developing various strategies for solving the problems, looking for solutions, and redefining the given problems to know the solution (Habeahan & Saragih, 2014). Preservice teachers require problem-solving skills (Pentang et al., 2022). Preservice teachers who could not solve the problem correctly lacked understanding and had misconceptions about the problem (Bacsal et al., 2022, Ibañez & Pentang, 2021; Mariano-Dolesh et al., 2022; Pentang, 2019), while some have negative dispositions or no interest in it (Bacsal et al., 2022; Ibañez and Pentang, 2021; Mariano-Dolesh et al., 2022).

Nowadays, teachers' problem-solving skills are essential in teaching mathematics, for it dramatically influences the student's performance in problem-solving (Pentang, 2019). Teachers' problem-solving skills play an essential role in mathematics and are prominent in the mathematics education of K-12 students (Cai & Lester, 2010). Additionally, Pentang (2019) revealed that preservice teachers exhibited low problem-solving performance due to poor math content knowledge and problem-solving skills. Aside from that, Yew and Zamri (2016) found that preservice teachers used several strategies, the most common being drawing an illustration, followed by having a trial-and-error strategy and identifying patterns, and using an equation or listing.

Another study investigated preservice teachers perceived personal problem-solving abilities with their gender, major, place lived, and locus of control. Many studies in the literature revealed the relations of these variables. However, the impact of these four variables has yet to be reported on perceived personal problem-solving skills (Barham, 2020). In addition, teachers possessing good problem-solving skills can manage students' learning experiences and help improve their achievement (Adeyemo et al., 2017). The problem-solving skills will not improve if there is a relation concerning the teachers' teaching style. Thus, students who do not possess these skills will be unable to solve complex problems, especially in their daily lives (Pentang, 2021). Subsequently, problem-solving strategies significantly influence the academic achievement of preservice teachers (Gurat, 2017). Furthermore, Aldover (2018) revealed that preservice mathematics teachers had adopted a learning style and knew how to regulate and monitor their learning to help cope with the difficulties of solving problems. These could be the reason for raising performance from poor to average.

A limited study about the relationship between creative thinking skills and the problem-solving performance of preservice teachers cannot be found in a single study, making this study a dire need in the research locale. Since preservice teacher training and preparation is vital in today's changing times (Pentang et al., 2022), the variables were explored to develop new ideas to best train and prepare future mathematics educators to address the underperformance and dislike of Filipino learners with mathematics.

METHODOLOGY

Research Design and Participants

The study employed a descriptive-correlational research design. The descriptive phase described the creative thinking skills of preservice teachers and their problem-solving performance in statistics. The correlational phase studied if there was a significant relationship among these variables. Meanwhile, the study participants were the preservice teachers from a public university in Western Philippines across its three campuses that offer teacher education programs (Table 1). The study used stratified random sampling, obtaining a total of 103 participants coming from the Bachelor of Elementary Education (BEEd) and Bachelor of Secondary Education majoring in Mathematics (BSEd Math) programs. The participants were chosen to aid the results of Pentang (2019) in proposing a specialization for the BEEd program and to support the recommendations of Pentang et al. (2022) to conduct curriculum revision to the concerned teacher education institution.

Table 1: Participants of the Study

Demographic Profile	Frequency (n = 103)	Percentage (%)
Sex		
Male	14	13.6
Female	89	86.4
Age		
20 and below	61	59.2
21 and above	42	40.8
Year Level		
Second Year	44	42.7
Third Year	55	53.4
Fourth Year	4	3.9
Program		
BEEd	66	64.1
BSEd Math	37	35.9
Relationship Status		
In a Relationship	29	28.2
Not in a Relationship	74	71.8
Parent's Educational Attainment		
Father		
Elementary Level	43	41.7
High School Level	41	39.8
College Level	19	18.4
Mother		
Elementary Level	30	29.1
High School Level	50	48.5
College Level	23	22.3
Residence		
Northern Palawan	40	38.8
Southern Palawan	31	30.1
Puerto Princesa City	32	31.1

Instrumentation

The study modified Torrance et al.'s Tests of Creative Thinking (2008), which was mainly used to assess creative thinking skills. This test for creativity measures four elements of creative thinking skills, namely fluency, flexibility, originality, and elaboration, which was comprised of self-reported items arranged on a four-point Likert scale ranging from 4-always, 3-often, 2-sometimes, and 1-never. Meanwhile, the problem-solving performance test was administered to the study participants, composed of a 10-item multiple-choice test to measure preservice teachers' performance in solving real-life statistics problems. The problem set comprises statistics – measures of central tendency, dispersion, and position.

Data Collection Procedures and Analysis

The study used Google Forms to collect data, which was run for two months. The data collected were tabulated and screened first to ensure validity. Weighted mean and standard deviation (SD) were used to describe the participant' level of creative thinking skills and problem-solving performance. Spearman's rho (r_s) was used to investigate the significant relationship between the (a) preservice teachers' problem-solving and creative thinking skills and (b) their profiles with their problem-solving and creative thinking skills. The correlational analysis was performed at a .05 level of significance using the jamovi. This statistical treatment was based on Magulod et al. (2021) and Pentang (2021).

Ethical Consideration

This study ensured that all participants voluntarily participated and that their information remained confidential. The researchers ensured that the participants knew the study's purpose, benefits, risks, and funding before they agreed or declined to join. The different responses of the participants to the related questions were credible and served as relevant data in the study.

RESULTS AND DISCUSSION

Preservice Teachers' Creative Thinking Skills

The creative thinking skills observed in the study cover four skills aspects: fluency, flexibility, originality, and elaboration (Table 2). The preservice teachers' creative thinking skills were in the high category (Mean = 2.70, SD = 0.51). This result indicates that the preservice teachers embodied one of the university's core values, creativity. Creative thinking skills may differ regarding the foundation of their professional education. As math learners and future teachers, preservice teachers should think creatively and apply this skill to problem-solving situations. Specifically, the preservice teachers have commendable creative thinking in fluency, flexibility, and elaboration skills but have modest originality.

Fluency. The preservice teachers' level of creative thinking skills in terms of fluency is high (Mean = 2.68). The obtained mean can justify that these future teachers could impart the concept of fluency to their students in solving a problem. This outcome signifies preservice teachers' competency to think of more than one answer to a given problem, respond to the question with many alternative solutions, and determine problem-solving steps entirely and correctly. Even so, these findings connote the competency of preservice teachers to produce thoughts or ideas in solving the problems and provide many ways or suggestions in solving the problem, allowing preservice teachers to propose a solution and utilize different tools or strategies to solve the problems. Poor competencies in problem-solving are attributed to the lack of fluency in creative thinking (Pentang, 2019).

Table 2: Preservice Teachers' Creative Thinking Skills

Aspects of Creative Thinking Skills	Mean	SD	Category
Fluency	**2.68**	**0.49**	**High**
I think of more than one solution and one answer.	2.69	0.75	High
I respond to the question with many alternative solutions.	2.58	0.62	Moderate
I was able to determine problem-solving steps entirely and correctly.	2.61	0.61	High
I was able to produce thoughts or ideas for solving problems.	2.84	0.65	High
I was able to provide many ways to solve the problem.	2.68	0.76	High
Flexibility	**2.76**	**0.10**	**High**
I generate ideas for the varied question.	2.68	0.70	High
I see the problem from a different perspective.	2.64	0.73	High
I look for many different alternatives or strategies.	2.88	0.72	High
I can change my approach to solving problems.	2.77	0.76	High
I could think of and solve the problem on my own.	2.81	0.73	High
Originality	**2.55**	**0.59**	**Moderate**
I reveal new, engaging, and unique ideas.	2.54	0.80	Moderate
I think of unusual ways to express the problem.	2.49	0.75	Moderate
I make combinations of different strategies to solve a problem.	2.64	0.70	High
I provide unique ideas that are logical and relevant to a given problem.	2.52	0.70	Moderate
I enrich the idea from the previous problem by solving new problems.	2.56	0.67	Moderate
Elaboration	**2.83**	**0.12**	**High**
I work and develop an idea to solve the problem.	3.00	0.63	High
I was able to add different ideas to a given problem.	2.90	0.73	High
I was able to create something different to solve the problem.	2.70	0.81	High
I developed the idea of a solution with a brief explanation.	2.82	0.72	High
I was able to seek deeper meaning from a solution to a problem.	2.73	0.76	High
Overall Level of Creative Thinking Skills	**2.70**	**0.51**	**High**

Legend: 3.26-4.00 = Very High
2.51-3.25 = High
1.76-2.50 = Moderate
1.00-1.75 = Low

Flexibility. The preservice teacher's level of creative thinking skills in flexibility is high (Mean = 2.76). It only showed that these future teachers know how to create various ideas from different points of view. The result demonstrated the preservice teacher's ability to generate ideas for the varied question and see the problem from a different perspective. These results complemented Fatmawati et al. (2019), stating that creative thinking skills are essential to generate new knowledge and encompass the different development aspects. The outcome also implies preservice teachers' ability to consider various alternatives or strategies, change their approach or thought, and think about and solve a problem independently. Creative thinking skills helps to develop a characteristic on their own that would improve their insights about the different discoveries encountered, new knowledge that is learned, and new principle that is developed wherein they try to use their imaginations to think deeper, the intelligence to think beyond a theory and the different insights and ideas about a problem.

Originality. The preservice teacher's level of creative thinking skills in originality is moderate (Mean = 2.55). The result suggested that preservice teachers have inadequate knowledge to reveal new and unique ideas, thinking of unusual ways to express the problem. The result substantiated Amin et al. (2019), who revealed that creative thinking skills are essential for creating and finding ideas to solve problems. Aside from this, the result showed the undistinguished capability of preservice teachers to make usual combinations of the different strategies to solve the problems, provide several exciting ideas that are logical,

relatively new, and relevant to the given problem, and the ability to enrich ideas from the previous problem in solving new problems.

Elaboration. The preservice teachers' level of creative thinking skills in elaboration is high (Mean = 2.83). This finding demonstrated the preservice teacher's capability to work and develop ideas to solve the problem, add different ideas to a given problem, and explore it. Husamah and Khoiriyah (2018) affirmed that creative thinking ability develops in a person. It will generate many ideas, make many connections, have many perspectives on something, create and do imagination, and care about the results. These findings also revealed preservice teachers' capacity to create something different to solve the problem, develop the idea of a solution with a brief explanation, and seek deeper meaning from a solution to the problem. Similarly, Topno (2020) supported these findings that creative preservice teachers use their imagination to generate many novel ways of organizing learning experiences and ideas, to consider alternative materials and media of expression, to evolve strategies in the creative process, and to maintain the status of a well-aware facilitator who understands and respects learning capacities and capabilities.

Relationship between Demographic Profile and Creative Thinking Skills

The analysis found no significant relationship between the preservice teachers' profiles with their creative thinking skills (Table 3). The table revealed that age (r_s = .086, p > .05), sex (r_s = -.004, p > .05), year (r_s = .031, p > .05), program (r_s = .184, p > .05), relationship status (r_s = -.002, p > .05), educational attainment of parents [father (r_s = .016, p > .05), mother (r_s = -.152, p > .05)] and residence (r_s = .007, p > .05) do not relate with creative thinking skills. This finding is aligned with Bakır and Öztekin (2014), where preservice teachers' creative thinking levels have no significant differences with their sex, educational attainment, school, and their parent's educational level. Regardless of their profile, the preservice teachers' creative thinking skills describe their ability to gain new knowledge from different ideas and the foundation of their ability to think beyond to solve problems.

Table 3: Relationship between Demographic Profile and Creative Thinking Skills

Variable	r_s	*p*-value	Interpretation
Age	.086	.387	The relationship is not significant.
Sex	-.004	.966	The relationship is not significant.
Year	.031	.755	The relationship is not significant.
Program	.184	.063	The relationship is not significant.
Relationship Status	-.002	.983	The relationship is not significant.
Educational Attainment			
Father	.016	.874	The relationship is not significant.
Mother	-.152	.124	
Residence	.007	.947	The relationship is not significant.

Preservice Teachers' Problem-solving Performance in Statistics

Generally, the preservice teachers' performance in statistics is poor (Mean = 0.56, SD = 0.22), which denotes that these future preservice teachers do not have the fundamental competencies in statistics (Table 4). The result suggests the need for preservice teachers' more profound understanding of statistics and the applications of its concept in problem-

solving. This is comparable to Domingo et al. (2021) and Pentang (2019), who revealed flawed probability thinking and lacking statistics competency among Filipino preservice teachers. This concern may be addressed by training the preservice teachers to think critically and creatively while mastering the fundamental concepts in statistics.

The preservice teachers have poor performance in statistics in the three areas considered: measures of central tendency (Mean = 0.78, SD = 0.30), measures of dispersion (Mean = 0.55, SD = 0.19), and measures of position (Mean = 0.37, SD = 0.04). These preservice teachers could not solve a given data set's mean, median, mode, range, variance, standard deviation, percentile, decile, and quartile. They have difficulty recalling and applying the definition and formula of the statistical tools considered. Besides, they might have encountered misconceptions or confusion about the problem. As preservice teachers, they must involve various steps in problem-solving, which involves understanding the problem first, knowing what the problem is, developing various strategies for solving the problem, looking for solutions, and redefining the given problems.

Table 4: Preservice Teachers' Problem-solving Performance in Statistics

Content Area	Mean	SD	Category
Measures of Central Tendency	**0.78**	**0.30**	**Poor**
1. Mean	0.57	0.50	Poor
2. Median	0.90	0.30	Unsatisfactory
3. Mode	0.86	0.34	Unsatisfactory
Measures of Dispersion	**0.55**	**0.29**	**Poor**
1. Range	0.71	0.46	Poor
2. Interquartile Range	0.57	0.50	Poor
3. Standard Deviation	0.28	0.45	Poor
4. Variance	0.62	0.49	Poor
Measures of Position	**0.37**	**0.29**	**Poor**
1. Percentile	0.34	0.48	Poor
2. Decile	0.42	0.50	Poor
3. Quartiles	0.36	0.48	Poor
Overall Performance	**0.56**	**0.22**	**Poor**

Relationship between Demographic Profile and Problem-Solving Performance

A significant relationship was found between the program where the preservice teachers belong with their problem-solving performance, r_s = .381, p = .001 (Table 5). Preservice teachers enrolled in the BSEd math program tend to perform better problem-solving compared to the BEEd preservice teachers, coinciding with Barham (2020) and Pentang (2019). Like Pentang (2019), this result concerning preservice teachers' problem-solving performance implies that policymakers and curriculum developers of the Bachelor of Elementary Education may implement a specialization program similar to the Bachelor of Secondary Education, like offering fundamental mathematics and problem-solving course. However, age (r_s = -.038, p > .05), sex (r_s = -.063, p > .05), year level (r_s = -.126, p >.05), relationship status (r_s = -.104, p > .05), parents' educational attainment [father (r_s = .131, p > .05), mother (r_s = .068, p > .05)], and residence (r_s = -.074, p > .05) are not significantly related with the preservice teachers' problem-solving performance. This is aligned with Barham (2020), where the preservice teachers' perceived personal problem-solving abilities are not related to their gender and place lived. Similarly, preservice teachers' sex and their parents' educational attainment have no relation with their conceptual understanding of problem-solving in Mariano-Dolesh et al. (2022).

Table 5: Relationship between Demographic Profile and Problem-Solving Performance

Variable	r_s	*p*-value	Interpretation
Age	-.038	.706	The relationship is not significant.
Sex	-.063	.525	The relationship is not significant.
Year Level	-.126	.205	The relationship is not significant.
Program (1 = BEEd, 2 = BSEd Math)	.381	.001	The relationship is highly significant.
Relationship Status	-.104	.298	The relationship is not significant.
Educational Attainment			
Father	.131	.186	The relationship is not significant.
Mother	.068	.497	
Residence	-.074	.458	The relationship is not significant.

Relationship between Creative Thinking Skills and Problem-Solving Performance

Correlational analysis (Table 6) revealed no significant relationship between creative thinking skills and problem-solving performance (r_s = -.007, p = .944). This suggests that preservice teachers' ability to propose a solution to a complex problem and utilize different tools in solving real-life problems is not affected by their ability to think creatively. The preservice teachers' creative thinking, be it fluency, flexibility, or elaboration skill, does not influence their knowledge and understanding of statistics problems. The result is consistent with Ardana et al. (2019), where creative thinking skills are necessary for everyday problem-solving, including mathematical problems. However, it contradicts Amin et al. (2019), asserting that having the ability to think creatively is crucial for coming up with solutions to problems. Follow-up research is suggested to validate this unpredicted result.

Table 6: Relationship between Creative Thinking Skills and Problem-Solving Performance

Variables	r_s	*p*-value	Interpretation
Creative Thinking Skills Problem-Solving Performance	-.007	.944	The relationship is not significant.

CONCLUSION AND RECOMMENDATION

Preservice teachers can express themselves, especially if they can create various ideas from different portions of view. It also implies that they can suggest unique ideas which differ from what we see in the books or from any suggestions of different individuals, which helps them solve statistics problems. It suggested that the teacher education institution and the mathematics teacher educators concerned implement programs and activities to boost the creative thinking skills to solve complex problems.

The preservice teachers performed poorly in the given problem set due to their lack of statistical content knowledge and poor statistical problem-solving performance. Their lack of knowledge and skills in describing a given problem, using statistical tools, interpreting and analyzing their answers, and using different strategies to find a solution could explain their poor problem-solving performance in central tendency, position, and dispersion measures. As a result, offering problem-solving courses to all preservice teachers and having a remedial class for students who struggle with various problems is suggested. Incorporating this course and having a remedial class may improve the performance and confidence of preservice teachers in becoming mathematics educators.

Aside from this, preservice teachers' creative thinking skills have nothing to do with their problem-solving performance. Creative thinking skills are not the basis for the preservice teachers' performance in problem-solving, considering that future teachers have low performance in statistics problems. Thus, the college concerned and other stakeholders are encouraged to support problem-solving courses that enhance students' creativity to solve complex problems. Irrespective of their profile, the preservice teachers encountered difficulties solving statistics problems. Still, other factors must be studied to help enrich their creative thinking and problem-solving skill. The BSEd math and BEEd curriculum planners and policymakers may review and revise the curriculum and incorporate courses that promote creative thinking and problem-solving.

Preservice teachers should engage themselves in activities that promote creative thinking and problem-solving. Mathematics teacher educators may conceptualize innovative tools and instructional strategies to encourage creative thinking and problem-solving among preservice teachers. This study can be extended to all preservice teachers, primarily secondary and active mathematics teachers. Other researchers may replicate this study by exploring more profile variables and investigating the correlation among critical thinking, creative thinking, and problem-solving skills. Having an interview and focused group examination concerning the problem set may also take place to gain a deeper understanding of preservice teachers' creative thinking skills and problem-solving performance and to have accurate and relevant results concerning the relationship of these variables.

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