Mathematical Creativity and Mathematical Ability Among College Students

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Abstract

This study investigated the intricate relationship between mathematical creativity and ability among college students, with a focus on uncovering their interplay and implications for educational practices. Employing a causal-comparative quantitative descriptive methodology, adapted questionnaires were utilized to collect data from 162 college students enrolled in mathematics-related courses during their third and fourth years. The comprehensive data analysis unveiled significant insights. While college students demonstrated a notable level of mathematical creativity, reflected in an average score of 3.49 with a large standard deviation of 0.764, their level of mathematical ability appeared comparatively lower, with an average score of 9.86 and a low standard deviation of 2.788. Surpassing the conventional significance threshold, the computed p-value of 0.895 led to the non-rejection of the null hypothesis, indicating no significant correlation between mathematical creativity and ability among the student cohort. In light of these findings, recommendations are proposed to enhance both mathematical creativity and ability within educational settings. Overall, recommendations in this study aim to enrich students' learning experiences and enhance their mathematical abilities.

Keywords: Mathematical Creativity, Mathematical Ability, Causal-comparative, College Students, Philippines

1. Introduction

Mathematical ability is the ability to pick up and master new mathematical ideas and techniques. It is also the capability to gather, organize, and retain mathematical knowledge (Koshy et al. 2009; Karsenty, 2020). Nieves and Jimenez (2020) defined mathematical ability as the ability of the student characterize, embody, generalize, employ logical reasoning in steps, shorten or limit argument or reasoning, identify the opposite of logical thinking, be flexible in their use of mathematical tools, conceive space, and develop a mathematical mind before puberty.

Recently, it has become recognized that mathematical creativity is a crucial talent that all students should have (Mann, 2005). In fact, it is believed that essential skills for success in mathematics include the capacity to creatively apply knowledge to specific situations (Tromp & Sternberg, 2022), provide novel solutions using traditional mathematical algorithms (Shriki, 2010), and discover numerous and noticeably different solutions to mathematical problems (Sriraman, 2022). It is possible to improve one's thought processes for solving mathematical issues. According to Mann (2005), mathematical creativity is an essential aspect in the

development of mathematical talent. Hong and Milgram (2010) talked about how a student's status within the educational system may affect how they see their capacity for and ability to think creatively. According to Kozlowski (2019), teacher practice may have an impact on students' levels of mathematical creativity.

Having high learning ability is a crucial skill that equips students with the ability to continuously acquire knowledge throughout their lives (Alicante-Marte et al., 2024). However, numerous students are said to struggle with mathematics, especially when it comes to problem-solving (Heong, 2005). Also, understanding and applying the concept of mathematics in a practical setting is challenging for students (Jazuli, 2007). Hence, it is crucial to instill innovation and creativity to students (Daffon, 2024).

The research by Mann (2005) and Leiken (2007), which found that mathematical creativity is a requirement for the growth of mathematical ability, serves as the foundation for this. The results of this study support those of Bahar and Maker (2011) and Sak and Maker (2006) investigations, which hypothesized that mathematical creativity would be a predictor of mathematical ability. The pursuit of "mathematics for all" necessitates innovation. In 2019, Kastberg. As stated by Leikin (2007), originality in mathematics is the potential to hold outstanding, novel, and distinctive thoughts. Mathematical fluency is the capacity to come up with a lot of various notions. In mathematics, flexibility is the variety of approaches that can be used to solve an issue. On the other hand, there is no discernible link between mathematical creativity and ability (Christophera & Osakwe, 2020).

1.1. Research Objectives

The study's objective was to identify the areas of mathematical creativity that significantly affect mathematical ability. It was designed specifically to address the following objectives:

1.To evaluate the mathematical creativity on the following scales:
   1.1 fluency;
   1.2 flexibility; and
   1.3 originality
2. To determine one's level of mathematical ability.
3. To ascertain if there is significant association between mathematical creativity and ability

1.2 Hypothesis

The null hypothesis of this study was tested at 0.05 level of significance stating that there is no significant association between mathematical creativity and ability among college students.

2. Method

1.1 Research Design

In order to make statistical inferences, this study employed a causal-comparative quantitative research methodology, gathering data in numerical form. Tables and graphs based on these types of data can be created. Numerical data are employed in formal, objective, systematic quantitative research to collect data for the study. The objective of descriptive research is to categorize and characterize the phenomenon (Nassaji, 2015). Descriptive research can also refer to an observation that is made while obtaining data (Walliman, 2011). When doing research, a causal-comparative design searches for the connections between independent and dependent variables after a certain event or action has occurred. Researchers want to determine which group of individuals is the independent variable or the dependent variable when comparing two or more groups, had an impact on the outcome. The research design outlined above is suitable for this study because it aims to gather data in numbers, check the null hypothesis that there is no substantial connection among college students' mathematical creativity and ability, and test the null

hypothesis that the different domains of mathematical creativity have no significant impact on mathematical ability

1.2 Research Respondents

Students in their third and fourth years of college who were taking math-related courses, such as those for a bachelor's degree in secondary education with a mathematics emphasis (BSED-MATH), a bachelor's degree in computer engineering (BSCOE), a bachelor's degree in electronics engineering (BSECE), or a bachelor's degree in electrical engineering (BSEE), made up the respondents to this study. The entire population of the said respondents are 271. In addition, the Slovin's formula was used to determine a sample size of 162. Using stratified random sampling, the sample participants were divided into the following groups who are currently enrolled for the S.Y. 2022-2023: 45 for BSEE, 31 for BSED-MATH, 43 for BSCOE, and 43 for BSECE.

Course Program	Population	Sample
BSED-Math	52	31
BSCOE	51	43
BSECE	30	43
BSEE	138	45
Total	**N = 271**	**n = 162**

Fig. 1. Distribution of Respondents

3. Results and Discussions

Level of Mathematical Creativity among College Students

Indicator	Mean	SD	Descriptive Level
Fluency	3.56	0.868	High
Flexibility	3.50	0.795	High
Originality	3.42	0.830	High
Overall	**3.49**	**0.764**	**High**

Table 1. Level of Mathematical Creativity

Table 1 displays the average of college students' level of mathematical creativity, which is 3.49 overall with a large standard deviation of 0.764. This suggests that the mathematical creativity of college students was highly felt.

This result is aligned with the idea of Ligan and Tacadena (2022) that students engage in honing 21st century learning and innovation skills such as critical thinking, problem-solving, and fostering creativity and innovation within their educational environment. Moreover, Mann (2005) and Leiken (2007) highlighted that mathematical creativity is a necessary condition for the growth of mathematical ability. The findings of this investigation are also supported by Sak and Maker (2006) as well as Bahar (2011), who suggested that mathematical creativity may be a predictor of mathematical ability. Moreover, the goal of "mathematics for all" requires creativity, a subject that is frequently overlooked in the teaching of mathematics is creativity. It is a common belief among educators that logic is the most significant component of mathematics, and that creativity has no role in teaching or learning the subject (Kastberg, 2019).

Leikin (2007) asserts that originality in mathematics refers to the potential to hold outstanding, novel, and distinctive thoughts. Mathematical fluency is the ability to come up with a lot of various notions. The variety of approaches utilized to arrive at a solution in mathematics is a measure of its flexibility. In addition, the capacity of a student to characterize, embody, generalize, use subsequent deductive reasoning, syncopate, or limit logic or argument, inverse logical reasoning or find the converse, be flexible in their use of mathematical techniques, conceptualize spatially, and develop a "mathematical mind" before puberty are all indicators of their mathematical ability (Krutetskii, 1976).

Level of Mathematical ability among College Students

Indicator	Mean	SD	Descriptive Level
Score	9.86	2.788	High

Table 2. Level of Mathematical Ability

Table 2 shows college students' degree of mathematical proficiency, with a 9.86 as the average and a standard deviation that is low at 2.788. This translates to less felt of mathematical ability among college students. This implies that our understanding of mathematics aids our capacity to analyze analytically, reason more effectively, and think rationally about a subject. College students also possess the capacity to take into account a complicated attribute education and training, neurological and cognitive development is also necessary.

This backs up the assertion of Karsenty (2020), a person's ability for math characterized as either the ability to pick up and understand new mathematics concepts and abilities or as the ability to obtain, operate and remember mathematical knowledge. Pragmatic definitions are frequently used to describe this idea, which is used to evaluate learning outcomes or assess learners' potential. The capacity to carry out mathematical operations and address specific mathematical issues. The development of a "mathematical mind" before puberty was considered a measure of a student's mathematical ability (Nieves & Jimenez, 2020).

Correlations between Mathematical Creativity on Mathematical Ability among College Students

Variables	$\bar{x}$	*SD*	r-value	P-value
Mathematical creativity	3.49	0.764	-0.01	0.895
Mathematical ability	9.86	2.788		

*$p<0.05$

Table 3. Correlations between Mathematical Creativity on Mathematical Ability

The results of the computations are shown in Table 3. The results revealed that the p-value of 0.895, which is greater than the 0.05 significance level. This led to the decision of non-rejection of the null hypothesis. This means that there is no significant relationship between mathematical creativity and mathematical ability. The correlation result further implies that there is no relationship between mathematical creativity and mathematical ability among College Students.

This finding is supported by the study of Christophera and Osakwe (2020) “Effect of mathematical creativity on mathematical ability on students in junior secondary school mathematics”, which found no significant correlation between students' mathematical ability and creativity. Because it makes sense to utilize mathematics as a framework for fostering creativity given its nature, mathematical exercises should

demonstrate originality. Thus, one of the main roles of educators in mathematics is to discover and foster mathematical creativity.

4. Conclusion and Recommendation

The analysis of college students' mathematical creativity and ability levels yielded insightful findings. On one hand, the average mathematical creativity scores of 3.49, coupled with a standard deviation of 0.764, suggests a prevalent sense of mathematical creativity among the student population. Conversely, the average mathematical ability score of 9.86, accompanied by a low standard deviation of 2.788, indicates a comparatively lesser degree of mathematical ability perceived among college students.

Upon examining the statistical significance, the computed p-value of 0.895, surpassing the conventional threshold of 0.05, led to the non-rejection of the null hypothesis. This outcome implies that there is no significant relationship between mathematical creativity and mathematical ability among the college students under study.

In general, despite the evident presence of mathematical creativity among college students, the study does not support the existence of a significant correlation between mathematical creativity and mathematical ability within this demographic. These findings underscore the complexity of assessing and understanding the interplay between creativity and proficiency in mathematical domains, prompting further exploration and refinement of educational strategies to effectively cultivate both aspects among students.

In light of these findings, several recommendations emerge. Firstly, there is a call to enhance mathematical creativity and ability to a heightened degree. To achieve this, mathematics departments and educational faculty members should employ pedagogical strategies geared towards fostering mathematical creativity. These strategies may include problem-based learning, open-ended tasks, and opportunities for divergent thinking to strengthen students' mathematical abilities.

Furthermore, educational analysis institutes and institutions can play a pivotal role by organizing conferences, workshops, and professional development programs aimed at educating mathematics teachers about the importance of mathematical creativity and ability. Providing them with practical ideas to integrate into their teaching practices can significantly contribute to nurturing creativity in the classroom. Additionally, stakeholders responsible for formulating educational policies should prioritize and provide systemic support for initiatives aimed at fostering mathematical innovation. This ensures that mathematical creativity receives the attention it deserves within educational frameworks. Lastly, professional teacher organizations should actively advocate for the inclusion of mathematical creativity in teacher preparation programs and continue to offer ongoing support and resources to mathematics educators.

Research has consistently shown that nurturing creativity can enhance students' learning experiences, promote flexible thinking about mathematical concepts, and cultivate innovative problem-solving skills. By recognizing and valuing students' mathematical inventiveness, future researchers are encouraged to delve deeper into this area, offering insights that challenge existing paradigms. In general, the recommendations stemming from this study have the potential to significantly impact mathematics education by involving various institutions and organizations. Through collaborative efforts, the effective implementation of these recommendations can promote mathematical creativity, strengthen students' mathematical ability, and ultimately enrich the learning experiences of future generations.

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