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From Numbers to Innovation: Understanding Grade 11 Students' Creativity and Attitudes Towards Mathematics

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Abstract

Aim: This study examines the relationship between students' creativity and attitude toward mathematics among Grade 11 students at Kalamansig National High School, in light of the 2022 PISA results, which highlighted a gap in creative thinking and academic performance among Filipino students. In particular, it sought to determine the level of students' creativity in terms of fluency, flexibility, and originality, determine the level of students' attitude towards mathematics relative to affective, behavioral and cognitive component, and establish whether a significant relationship exists between these two variables.

Methodology: The study employed a descriptive-correlational research design with a quantitative approach. A total of 432 Grade 11 students from Kalamansig National High School participated. A Mathematical Creativity Test assessed the students' creativity in Mathematics and an adapted questionnaire was used to determine the level of students' attitude toward mathematics. Descriptive statistics such as mean, weighted mean were used to summarize the data. Pearson's Product-Moment Correlation was utilized to examine the relationship between students' creativity and their attitudes toward mathematics.

Results: The results revealed that students generally exhibited low levels of creativity. Despite this, their attitudes toward mathematics were notably positive, characterized by high levels of motivation, confidence, and classroom engagement. Statistical analysis showed a weak positive correlation ($r = 0.121$, $p = 0.012$) between creativity and attitude toward mathematics. While this suggests a slight relationship, the effect size indicates that creativity alone may not substantially influence students' attitudes in a practical sense.

Conclusion: There is a statistically significant, though weak, relationship between students' creativity and attitude toward mathematics.

Keywords: students' creativity, attitude, mathematics, grade 11 students

INTRODUCTION

Over time, various factors such as teaching methods, school environment, and emotional engagement have been identified as key components influencing students' attitudes and performance in mathematics (Boaler, 2016). These factors are especially pertinent for high school students, whose cognitive and emotional development is still in a crucial stage. Emerging research demonstrates that mathematical creativity, when combined with positive dispositional attitudes toward the subject, serves as a critical foundation for deeper student engagement and improved academic outcomes in mathematics (Schoevers et al., 2020; Simonton, 2018). Studies have found that fostering mathematical creativity through open-ended problem-solving enhances students' conceptual understanding and promotes positive attitudes toward the subject (Kandemir & Gür, 2022). Additionally, students' attitudes toward mathematics have been shown to directly influence their achievement levels and persistence in mathematical studies (Recber et al., 2018). Understanding these relationships is vital for educators and policymakers aiming to enhance learning experiences and foster a positive learning environment. Recent studies have further emphasized the role of digital technologies in transforming mathematics education, showing how interactive learning platforms can increase student engagement and conceptual understanding (Bakker et al., 2021). As mathematics education evolves, growth

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mindset interventions have shown promising results in helping students overcome perceived limitations and develop resilience when confronting mathematical challenges (Yeager et al., 2019).

In line with recent educational research, Haavold and Birkeland (2021) emphasize the importance of educational interventions that nurture mathematical creativity, such as hands-on problem-solving tasks, collaborative exploration, and open-ended challenges. These activities, designed to stimulate creative thinking, can significantly impact students' engagement with mathematics by shifting the focus from rote memorization to problem-solving and critical thinking. The integration of creativity-enhancing interventions can provide students with a platform to engage with mathematical concepts in a more dynamic and meaningful way, fostering deeper understanding and a positive attitude toward the subject (Sriraman et al., 2023). As Tabach and Friedlander (2022) demonstrate, when teachers implement strategies that encourage divergent thinking in mathematics classrooms, students develop more flexible approaches to mathematical problems and show increased persistence when facing challenges.

In addition to creativity, students' attitudes toward mathematics play a crucial role in their academic performance. Boaler (2016) highlights that students who feel comfortable with mathematical concepts are more likely to approach challenges with creativity and persistence. This sense of comfort is particularly important in fostering a mindset conducive to risk-taking, a key aspect of both creative thinking and mathematical problem-solving. When students feel confident and supported in their learning environment, they are more likely to experiment with different approaches and solutions, thereby enhancing their problem-solving skills and creativity.

Furthermore, recent research by Patall et al. (2019) demonstrates that behavioral engagement, such as active participation in classroom activities, is directly linked to improved academic outcomes in mathematics. Krause and Watt (2021) expand on this finding, showing that in mathematics specifically, behavioral engagement can take the form of students seeking help when needed, participating in group discussions, and engaging with mathematical problems outside of class. These behaviors are essential for cultivating a deep, lasting understanding of mathematical concepts. An extensive longitudinal study by Li et al. (2022) confirms that students who actively engage in their learning process are significantly more likely to develop the skills necessary for creative problem-solving and demonstrate higher levels of mathematical achievement, particularly when this engagement is sustained over time.

In addition to engagement and creativity, students' mindsets—specifically, the growth mindset—are a key factor in their attitudes toward mathematics. Yeager et al. (2019) and Sanchez and Sarmiento (2020) argue that students who believe their abilities can improve with effort and practice are more likely to persist through challenges and succeed in their academic endeavors. Kim et al. (2022) further support this, suggesting that students with high achievement goals, such as a desire to develop their skills, engage in behaviors that enhance their learning, such as seeking help and practicing independently. This proactive approach to learning, rooted in a growth mindset, fosters resilience and perseverance, both of which are essential for success in mathematics.

Students who embrace a growth mindset are more likely to approach mathematics with an open, optimistic attitude, which in turn influences their engagement with the subject. Boaler (2016) suggests that when students understand the value of mathematics as a tool for critical thinking and problem-solving, they are more likely to engage with the subject at a deeper level. This deeper engagement enhances their cognitive abilities and fosters a positive, lasting relationship with mathematics. In this context, fostering a growth mindset in students can lead to improved academic performance and greater creativity in their approach to mathematical problems.

International research, such as the Programme for International Student Assessment (PISA) report (2012), underscores the importance of mathematics in developing cognitive skills such as logical reasoning and analytical thinking. These skills are essential not only for academic success but also for personal and professional development. Mathematics, when approached with creativity and positive emotional engagement, can serve as a powerful tool for cultivating the critical thinking skills necessary for success in both academic and real-world contexts.

The aim of this study is to explore the relationship between creativity and attitudes toward mathematics among Grade 11 students at Kalamansig National High School. By examining how students' creative abilities influence their perceptions and engagement with mathematics, this research seeks to provide insights into how educators can enhance teaching practices to foster both creativity and positive attitudes toward the subject. The study also aims to contribute to the growing body of literature on the importance of creativity in mathematics education, offering practical recommendations for fostering a learning environment that supports both creative thinking and academic success.

Ultimately, the findings of this study may have significant implications for mathematics instruction. By identifying the factors that contribute to students' creative engagement and positive attitudes toward mathematics, educators can design interventions that not only improve students' mathematical skills but also encourage them to approach the subject with curiosity, confidence, and persistence. This, in turn, can lead to better academic outcomes and a more positive relationship with mathematics as a critical tool for solving problems and thinking critically.

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Objectives

This study aimed to find out the relationship between students' creativity and their attitude towards mathematics among the Grade 11 students of Kalamansig National High School.

In particular, this study addressed the following questions:

1. What is the level of students' creativity in terms of fluency, flexibility and originality?
2. What is the level of students' attitude towards mathematics relative to affective, behavioral and cognitive component?
3. Is there a significant relationship between the student's creativity and attitudes toward mathematics?

Hypothesis

Given the stated research problems, the following hypotheses were tested at 0.05 level of significance:

H_0: There is no significant relationship between the students' creativity and attitude towards mathematics.

H_a: There is a significant relationship between the students' creativity and attitude towards mathematics.

METHODS

Research Design

The research design used in this study was descriptive-correlational research design to examine and describe the relationship between the students' creativity and attitude towards mathematics in Grade 11 students of Kalamansig National High School, Kalamansig, Sultan Kudarat.

Population and Sampling

This study involved all Grade 11 students enrolled at Kalamansig National High School during the 2024–2025 school year, totaling 432 students across twelve sections from various academic strands, including HUMSS, STEM, ABM, and TVL. A census sampling technique was used to include the entire population, ensuring comprehensive representation and minimizing sampling bias for more accurate and reliable findings.

Instrument

The study employed two adapted questionnaires to collect data. Part I assessed students' creativity using a tool from from Roble, et al. (2018), measuring fluency, flexibility, and originality through 6 items. Part II measured students' attitudes toward mathematics using a questionnaire adapted from Barago (2015), covering affective, behavioral, and cognitive components with 21 items rated on a five-point scale.

Data Collection

The data were collected at Kalamansig National High School after securing formal approval from the school principal and class advisers. The researchers scheduled the distribution of the questionnaires and personally administered them with the assistance of the class advisers. The data collection process took place during regular class hours in a controlled and familiar environment to ensure participant comfort and minimize disruptions. Before the distribution of questionnaires, clear instructions and the purpose of the study were thoroughly explained to the respondents to ensure understanding. After the participants completed the questionnaires, the researchers collected them immediately. The data were then organized and tallied for analysis.

Treatment of Data

To analyze the data, mean and weighted mean were used to evaluate responses for problems one and two, with results interpreted using a five-point scale. For problem three, Pearson's correlation was employed to assess the relationship between students' creativity and their attitudes toward mathematics, with the null hypothesis tested at a 0.05 level of significance.

Ethical Considerations

The researchers adhered strictly to ethical standards throughout the study. Prior to data collection, informed consent was obtained from all participants. They were made aware of their right to decline participation at any time without any negative consequences. The confidentiality and anonymity of all responses were guaranteed—no identifying information was collected, and data were stored securely and used solely for research purposes. Participants

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were also assured that the results of the study would be reported in aggregate form to protect individual identities. The researchers demonstrated respect for the autonomy, dignity, and well-being of all participants and ensured that the study posed no harm. These measures were implemented to maintain the ethical integrity of the research and to uphold the rights and privacy of all involved.

RESULTS and DISCUSSION

This section contains the presentation, analyses, and interpretation of the data resulting from the study conducted. Tabular information is presented in this section to show and exhibit significant points that are useful in pursuing the main concern of this study.

The Level of Students' Creativity in Mathematics

The table below presents the level of students' creativity in Mathematics in terms of fluency, flexibility and originality.

Table 1. The Level of Students' Creativity in Mathematics

Creativity	n	Mean Scores	SD	Interpretation
Fluency	432	11.10	2.94	Low Level of Fluency
Flexibility	432	11.00	2.98	Low Level of Flexibility
Originality	432	11.10	2.86	Low Level of Originality
Average	432	11.07	2.93	Low Level of Creativity

Mean Score Range	***Interpretation***
18.00 – 24.00	*Very High Level of Creativity*
15.00 – 17.99	*High Level of Creativity*
12.00 – 14.99	*Moderate Level of Creativity*
9.00 – 11.99	*Low Level of Creativity*
6.00-8.99	*Very Low Level of Creativity*

The data in the table reveal the creativity levels of the students in terms of fluency, flexibility, and originality. The fluency score has a mean of 11.10 with a standard deviation of 2.94, indicating a low level of creativity. This suggests that the students are capable of generating ideas, but their output is somewhat limited and could benefit from further development. Similarly, for flexibility, the mean score is 11.00 with a standard deviation of 2.98, which also falls within the low level range. This indicates that while students are somewhat adaptable in their thinking, they may struggle to shift perspectives or approach problems from different angles. The originality score, with a mean of 11.10 and a standard deviation of 2.86, suggests that students are moderately original but still have room to generate more groundbreaking and innovative ideas. Overall, the total mean score of 11.07 (with a standard deviation of 2.93) further confirms that the creativity of these students is in the low to moderate range, with potential for growth in all areas—fluency, flexibility, and originality. These results indicate that while students have a basic foundation in creative thinking, they could greatly benefit from interventions and activities designed to enhance their creativity.

The Level of Students' Attitude Towards Mathematics

The table below presents the level of students' attitude in Mathematics relative to affective, behavioural and cognitive component.

Table 2. The Level of Students' Attitude in Mathematics

Component	n	Weighted Mean	SD	Interpretation
Affective	432	4.08	0.28	High Level
Behavioural	432	4.19	0.30	High Level

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Cognitive	432	4.13	0.24	High Level

Legend: 4.21-5.00 Very High, 3.41-4.20 High, 2.61-3.40 Average, 1.81-2.60 Low, 1.00-1.80 Very Low

Table 2 presents the level of students' attitudes toward mathematics based on three components: affective, behavioral, and cognitive. The findings reveal that all components fall within the "High Level" category, based on the provided interpretation scale. The affective component recorded a weighted mean of 4.08 with a standard deviation of 0.28, indicating that students generally have positive emotional responses toward mathematics, such as enjoyment, interest, and confidence. The behavioral component showed the highest weighted mean of 4.19 (SD = 0.30), suggesting that students are actively engaged in mathematical tasks and consistently participate in learning activities related to the subject. Meanwhile, the cognitive component had a weighted mean of 4.13 and a standard deviation of 0.24, reflecting students' recognition of the importance and usefulness of mathematics in real-life situations and future goals. Overall, these results suggest that Grade 11 students at Kalamansig National High School maintain a highly positive attitude toward mathematics across emotional, behavioral, and cognitive dimensions.

Relationship between Students' Creativity and Attitudes Towards Mathematics

This final section of this part is the relationship between students' creativity and attitudes towards mathematics among Grade 11 students of Kalamansig National High School

Table 3. Correlation between Students' Creativity and Attitudes Towards Mathematics

Variable 1	***Variable 2***	***Correlation Coefficient***	***Interpretation***	***P-value***	***Decision***
Creativity	*Attitude*	*0.121*	*low positive correlation*	*.012*	*Reject Ho*

A Pearson product-moment correlation was performed to assess the relationship between students' creativity and their attitude toward mathematics among Grade 11 students at Kalamansig National High School. The results revealed a statistically significant, low positive correlation (r = .121, p = .012) between the two variables. This indicates that as students' creativity increases, there is a slight tendency for their attitude toward mathematics to also improve, although the relationship is weak. r (Pearson correlation coefficient): The r value of .121 shows the strength and direction of the linear relationship between creativity and attitude toward mathematics. The positive sign indicates a positive correlation, meaning that higher creativity scores are slightly associated with more positive attitudes toward mathematics. However, the magnitude of .121 reflects a weak or low correlation. The p-value of 0.012 suggests the likelihood of obtaining a correlation coefficient as extreme as 0.121 if there were no actual relationship between the two variables in the population. Since the p-value is lower than the significance level of 0.05, the null hypothesis is rejected, indicating that there is a statistically significant, though weak, relationship between creativity and attitude toward mathematics. The results of the analysis led to the rejection of the null hypothesis (Ho), which stated that there is no significant relationship between students' creativity and their attitude toward mathematics. This conclusion was reached at the 0.05 significance level. While the correlation is statistically significant, it is relatively weak, suggesting that although there is a relationship between creativity and attitude toward mathematics, it is not strong enough to have a substantial practical impact.

Conclusions

This study concludes that grade 11 students at Kalamansig National High School generally exhibit a high level of positive attitude toward mathematics, as shown by high scores across affective, behavioral, and cognitive components. This indicates that students are emotionally invested, behaviorally engaged, and cognitively aware of the importance of mathematics in their academic and personal development.

In contrast, the level of students' creativity in mathematics—in terms of fluency, flexibility, and originality—was found to be low, suggesting that while students may have the foundational ability to think creatively, they currently lack strong creative thinking skills in mathematical contexts. This points to a need for targeted interventions or teaching strategies that foster creative thinking in mathematics education.

Moreover, the correlation analysis revealed a statistically significant but weak positive relationship between students' creativity and their attitudes toward mathematics (r = 0.121, p = 0.012). This suggests that students who

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demonstrate slightly higher creativity also tend to have more positive attitudes toward the subject. However, the weak strength of this correlation implies that creativity alone does not strongly predict students' attitudes.

Overall, while students maintain a positive outlook on mathematics, their creative thinking skills remain underdeveloped. The findings emphasize the importance of integrating creativity-enhancing activities into the mathematics curriculum to strengthen both creative capacity and student engagement with the subject.

Recommendations

Based on the conclusions of the study, several recommendations are proposed to enhance students' creativity and sustain their positive attitude toward mathematics. First, mathematics instruction should integrate creativity-enhancing strategies, such as open-ended problems, real-life applications, brainstorming, group tasks, and project-based learning. These methods can help develop students' fluency, flexibility, and originality in problem-solving. Additionally, professional development and training programs for teachers are essential to equip them with innovative, student-centered approaches that foster both conceptual understanding and creative thinking in the classroom. Creating a supportive and non-threatening learning environment is also crucial. Teachers should encourage students to take intellectual risks and view mistakes as part of the learning process, which can promote both creativity and confidence in mathematics. Schools can further support creative development by offering co-curricular activities such as math clubs, fairs, and competitions, giving students alternative venues to apply creative thinking in engaging and practical ways. To ensure continuous improvement, regular assessment and monitoring of students' creative skills should be implemented. This will help educators adjust their strategies based on students' needs and progress. Moreover, maintaining and enhancing the already positive attitudes of students toward mathematics can be achieved by making lessons more interactive, relevant, and technology-integrated. Finally, further research is recommended to explore additional factors that may influence students' creativity in mathematics, such as teaching styles, learning environments, or access to educational resources. These insights can guide more holistic and effective interventions aimed at cultivating both creativity and sustained interest in mathematics.

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