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Peer Teaching on Gamified Mathematics Activities and Differentiated Instruction: Battling Mathematics Anxiety

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Abstract

Mathematics anxiety is a common challenge among senior high school students, negatively affecting their performance and confidence in learning. Innovative strategies are needed to make mathematics more engaging and less intimidating.

This study aimed to reduce mathematics anxiety and improve academic performance among Grade 11 GAS students at Abra High School through peer teaching integrated with gamified activities and differentiated instruction.

A multimethod quantitative design, specifically experimental, descriptive, comparative, and correlational approaches were all employed. A two-group pretest–posttest design was used, with one section taught using peer teaching with gamified activities and another using differentiated instruction.

The respondents were 111 Grade 11 GAS students from Abra High School, Main Campus, Bangued, Abra (Opal = 54, Quartz = 57) during school year 2024–2025. A total enumeration sampling technique was applied.

Two tools were used: (1) adapted Mathematics Anxiety Rating Scale (MARS) and Mathematics Anxiety Scale (MAS) to measure cognitive, social, and emotional anxiety; and (2) a validated teacher-made pretest and an adapted posttest (Borje, 2023) to assess performance in five Statistics and Probability topics. Anxiety levels were rated using a 5-point Likert scale, while performance was evaluated using the Department of Education's grading system (DepEd Order No. 08, s. 2015).

Data collection began with pretests on anxiety and Mathematics performance. The intervention phase lasted five weeks, integrating peer teaching with gamified activities (e.g., Math Bingo, Relay Race, Number Line Race) and differentiated instruction (content-based and group activities). Posttests were then administered to measure changes in anxiety and performance.

Descriptive statistics (mean) described performance and anxiety levels. Independent t-tests examined pre–post differences, while bivariate analysis tested relationships between Mathematics anxiety and performance.

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Findings showed that prior to the intervention, students exhibited moderate Mathematics anxiety, with high cognitive anxiety and noticeable emotional symptoms. Their performance was satisfactory overall, though some topics, like "The Normal Curve," were more challenging. A weak correlation was found between anxiety levels and pre-test performance.

After the intervention, both instructional strategies significantly improved students' academic performance, with gamified approach showing more consistent results. Anxiety levels also decreased significantly across cognitive, social, and emotional dimensions. Differentiated instruction was slightly more effective in reducing emotional anxiety. Post-intervention, the relationship between anxiety and performance remained weak, suggesting that while reducing anxiety contributes to a better learning environment, performance is also influenced by other factors such as engagement and instructional strategies.

Study concludes peer teaching, when combined with interactive and student-centered strategies like gamification and differentiated instruction, is effective in addressing both emotional and academic challenges in Mathematics learning. Recommendations include implementing these strategy more broadly, training teachers, developing contextualized learning materials, monitoring student progress, and conducting further research.

Altogether, this research underscores the importance of varied, adaptive teaching methods in enhancing students' confidence, well-being, and academic success in Mathematics.

Keywords: *peer teaching, gamified activities, differentiated instruction, Mathematics anxiety*

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I. INTRODUCTION

Mathematics is often perceived as one of the most challenging subjects among senior high school students, with many experiencing Mathematics anxiety that negatively affects their academic performance and self-confidence. This anxiety can manifest in cognitive, emotional, and social dimensions, making it harder for learners to engage fully in the subject. To address this concern, innovative teaching approaches such as peer teaching, gamified activities, and differentiated instruction have been explored to make Mathematics more interactive and less intimidating.

Mathematics anxiety has been widely studied, with Richardson and Suinn's (1972) Mathematics Anxiety Rating Scale (MARS) serving as a foundational tool for measuring cognitive, social, and emotional aspects of anxiety. Research shows that high levels of anxiety are linked to lower mathematics performance and avoidance behaviors (Ashcraft & Moore, 2009).

Peer teaching has been reported to enhance collaboration and improve comprehension through shared responsibility in learning (Topping, 2019). Similarly, gamification in education—through activities such as math relays, bingo, and digital games—has been shown to increase motivation, reduce fear, and make abstract concepts more accessible (Caponetto, Earp, & Ott, 2014). Differentiated instruction, as emphasized by Tomlinson (2017), provides learning opportunities tailored to students' readiness, interests, and profiles, thereby improving outcomes and reducing frustration.

Collectively, these studies suggest that integrating peer teaching, gamified activities, and differentiated instruction may effectively reduce mathematics anxiety while improving student performance. However, limited research has combined these three strategies in the context of senior high school mathematics, which this study seeks to address.

Statement of the Problem

This study aimed to reduce Mathematics anxiety and improve the academic performance of the Grade 11 GAS students of Abra High School, school year 2024-2025, using peer teaching, gamified activities and differentiated instructions.

Specifically, it sought to answer to the following questions:

1. What is the level of Mathematics anxiety of the respondents before the use of peer teaching on gamified activities and differentiated instruction approach in the teaching-learning process along:
    a. Cognitive;
    b. Social;
    c. Emotional?
2. What is the level of Mathematics performance of respondents before the use of peer teaching on gamified activities and differentiated instruction approaches in the teaching-learning process along:
    a. Random Variables;
    b. Mean, Variance, and Standard Deviation of a Random Variable;
    c. The Normal Curve;

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d. Random Sampling; and
e. Sampling Distributions?

3. Is there a significant relationship between Mathematics anxiety of the respondents and their level of Mathematics performance before the use of the peer teaching on gamified activities and differentiated instruction approaches in the teaching-learning process?
4. What is the level of Mathematics performance of the respondents after the use of peer teaching on gamified activities and differentiated instruction approaches in the teaching-learning process along:
    a. Random Variables;
    b. Mean, Variance, and Standard Deviation of a Random Variable;
    c. The Normal Curve;
    d. Random Sampling; and
    e. Sampling Distributions?
5. What is the level of Mathematics anxiety of the respondents after the use of peer teaching on gamified activities and differentiated instruction approach in the teaching-learning process along:
    a. Cognitive;
    b. Social; and
    c. Emotional?
6. Is there a significant difference between the level of Mathematics performance before and after the use of the peer teaching on gamified activities and differentiated instructional approaches in the teaching-learning process?
7. Is there a significant difference between the level of anxiety of the respondent groups after the use of the peer teaching on gamified activities and differentiated instruction approaches in the teaching-learning process?
8. Is there a significant relationship between the Mathematics anxiety of the respondents and their level of Mathematics performance after the use of the peer teaching on gamified activities and differentiated instruction approaches in the teaching-learning process?

Hypotheses

Following hypotheses were drawn to test for significant relationship among the variables:

1. There is a significant relationship between the mathematics anxiety of the respondents and their level of mathematics performance before the use of the peer teaching on gamified activities and differentiated instruction approaches in the teaching-learning process;
2. There is a significant difference between the level of mathematics performance before and after the use of the peer teaching on gamified activities and differentiated instruction approaches in the teaching-learning process;
3. There is a significant difference between the level of anxiety of the respondent groups after the use of the peer teaching on gamified activities and differentiated instruction approaches in the teaching-learning process;
4. There is a significant relationship between the mathematics anxiety of the respondents and their level of mathematics performance after the use of the peer teaching on gamified activities and differentiated instruction approaches in the teaching-learning process.

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II. MATERIALS and METHODS

Parts of the Materials and Methods include research design, participants of the study, instruments, procedure, and data analysis.

Research Design

This study employed a multimethod quantitative design, specifically experimental, descriptive, comparative, and correlational approaches. A two-group pretest–posttest experimental design was used, with one group taught through peer teaching with gamified activities and another through differentiated instruction.

Participants

The respondents were 111 Grade 11 General Academic Strand (GAS) students from Abra High School, Main Campus, Bangued, Abra, during the school year 2024–2025. The Opal section (n = 54) was assigned to gamified activities, while the Quartz section (n = 57) received differentiated instruction. A total enumeration sampling technique was employed.

Instruments

Two instruments were used: (1) an adapted Mathematics Anxiety Rating Scale (MARS) by Richardson & Suinn (1972) and Mathematics Anxiety Scale (MAS) by Betz (1978) to measure cognitive, social, and emotional anxiety, and (2) a validated teacher-made pretest and adapted posttest (Borje, 2023) to measure student performance in five Statistics and Probability topics. Anxiety was rated using a 5-point Likert scale, while performance was assessed using the Department of Education's grading system (DepEd Order No. 08, s. 2015).

Procedure

The study began with the administration of pretests on mathematics anxiety and performance. The intervention phase lasted for five weeks, with weekly lesson logs integrating peer teaching. The gamified group engaged in activities such as Math Bingo, Relay Race, and Number Line Race, while the differentiated instruction group engaged in content-based and group activities tailored to learning styles and readiness levels. Posttests were administered after the intervention to measure changes in anxiety and performance.

Data Analysis

Descriptive statistics (mean) described performance and anxiety levels. Independent t-tests compared pretest and posttest results, while bivariate correlation analysis determined the relationship between mathematics anxiety and performance.

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III. RESULTS

Pretest Descriptive Statistics

Before the intervention, both groups showed *moderate mathematics anxiety.*

Table 1a. Pre-Intervention Mathematics Anxiety Levels: Cognitive, Social, and Emotional (Gamified Activities Approach)

Subscale	Item No.	Statement	Mean	Descriptive Rating (DR)
Cognitive	1	I feel nervous when asked to solve a math problem in class.	3.61	High Anxiety
	2	My mind goes blank when I try to solve math problems under time pressure.	3.63	High Anxiety
	3	I have trouble understanding math even when I study hard.	3.20	Moderate Anxiety
	4	I get confused understanding math even when I study hard.	3.33	Moderate Anxiety
	5	I worry about making mistakes in math class.	3.57	High Anxiety
		Sub-Mean	**3.47**	**High Anxiety**
Social	1	I feel embarrassed when I ask a question about math in class.	3.20	Moderate Anxiety
	2	I get anxious when my classmates understand math faster than I do.	3.15	Moderate Anxiety
	3	I feel uncomfortable when discussing math problems with my classmates.	2.83	Moderate Anxiety
	4	I avoid participating in math activities because I fear making mistakes.	2.98	Moderate Anxiety
	5	I prefer working on math problems alone rather than in a group.	3.11	Moderate Anxiety
		Sub-Mean	**3.06**	**Moderate Anxiety**
Emotional	1	I feel stressed before taking a math test.	3.22	Moderate Anxiety
	2	My heart races when I have to solve a difficult math problem.	3.76	High Anxiety
	3	I feel discouraged when I get a low score in math.	3.80	High Anxiety
	4	Math makes me feel frustrated and overwhelmed.	3.43	High Anxiety
	5	I sometimes feel like crying because of math.	3.19	Moderate Anxiety
		Sub-Mean	**3.48**	**High Anxiety**
		As a Whole	**3.33**	**Moderate Anxiety**

Norms:

Range	*Descriptive Rating*
1.00 – 1.80	*Very Low Anxiety*
1.81 – 2.60	*Low Anxiety*
2.61 – 3.40	*Moderate Anxiety*
3.41 – 4.20	*High Anxiety*
4.21 – 5.00	*Very High Anxiety*

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Table 1b. Pre-Intervention Mathematics Anxiety Levels: Cognitive, Social, and Emotional (Differentiated Instruction Approach)

Subscale	Item No.	Statement	Mean	Descriptive Rating (DR)
Cognitive	1	I feel nervous when asked to solve a math problem in class.	3.50	High Anxiety
	2	My mind goes blank when I try to solve math problems under time pressure.	3.63	High Anxiety
	3	I have trouble understanding math even when I study hard.	3.32	Moderate Anxiety
	4	I get confused understanding math even when I study hard.	3.32	Moderate Anxiety
	5	I worry about making mistakes in math class.	3.79	High Anxiety
		Sub-Mean	**3.51**	**High Anxiety**
Social	1	I feel embarrassed when I ask a question about math in class.	3.19	Moderate Anxiety
	2	I get anxious when my classmates understand math faster than I do.	3.42	High Anxiety
	3	I feel uncomfortable when discussing math problems with my classmates.	2.96	Moderate Anxiety
	4	I avoid participating in math activities because I fear making mistakes.	2.77	Moderate Anxiety
	5	I prefer working on math problems alone rather than in a group.	3.02	Moderate Anxiety
		Sub-Mean	**3.07**	**Moderate Anxiety**
Emotional	1	I feel stressed before taking a math test.	3.37	Moderate Anxiety
	2	My heart races when I have to solve a difficult math problem.	3.46	High Anxiety
	3	I feel discouraged when I get a low score in math.	3.40	Moderate Anxiety
	4	Math makes me feel frustrated and overwhelmed.	2.96	Moderate Anxiety
	5	I sometimes feel like crying because of math.	2.74	Moderate Anxiety
		Sub-Mean	**3.19**	**Moderate Anxiety**
		As a Whole	**3.26**	**Moderate Anxiety**

Pretest Mathematics performance in both groups was rated *"Fairly Satisfactory"*, with difficulty in the Normal Curve.

Table 2a. Mathematics Performance of Respondents Before Gamified Activities Approach

Topic	No. of Items	Average Score	Descriptive Rating (DR)
Random Variables	10	83	S
Mean, Variance, and Standard Deviation of a Random Variable	10	79	FS
The Normal Curve	10	70	DNME
Random Sampling	10	80	S
Sampling Distributions	10	79	FS
Total	**50**	**77**	**FS**

Norms:

Range	*Descriptive Rating*
90 and above	*Outstanding (O)*
85-89	*Very Satisfactory (VS)*
80-84	*Satisfactory (S)*
75-79	*Fairly Satisfactory (FS)*
74 and below	*Did Not Meet Expectations (DNME)*

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Table 2b. Mathematics Performance of Respondents Before Differentiated Instructional Approach

Topic	No. of Items	Mean	Interpretation
Random Variables	10	85	VS
Mean, Variance, and Standard Deviation of a Random Variable	10	77	FS
The Normal Curve	10	72	DNME
Random Sampling	10	82	S
Sampling Distributions	10	75	FS
Total	**50**	**76**	**FS**

Norms:

Range	***Descriptive Rating***
90 and above	*Outstanding (O)*
85-89	*Very Satisfactory (VS)*
80-84	*Satisfactory (S)*
75-79	*Fairly Satisfactory (FS)*
74 and below	*Did Not Meet Expectations (DNME)*

Pretest Correlation Analysis

Correlation analysis showed a weak but significant negative relationship between Mathematics anxiety and performance before the intervention. Students with lower anxiety levels performed slightly better.

Table 3a. Correlation-coefficient showing the Significant Relationship Between Mathematics Anxiety and Performance Before Gamified Activities Approach

Topics	Level of Anxiety			
	Cognitive	**Social**	**Emotional**	**As a whole**
Random Variables	0.008**	0.159	0.275	0.160
Mean, Variance, and Standard Deviation of a Random Variable	0.128	0.037*	0.133	0.076
The Normal Curve	0.049*	0.094	0.238	0.078
Random Sampling	0.117	0.048*	0.160	0.188
Sampling Distributions	0.194	0.316	0.049*	0.105
As A whole	**0.180**	**0.092**	**0.049***	**0.008****

*Legend: *-0.05 level of significance, **-0.01 level of significance*

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Table 3b. Correlation-coefficient showing the Significant Relationship Between Mathematics Anxiety and Performance Before Differentiated Instruction Approach

Topics	Level of Anxiety			
	Cognitive	Social	Emotional	As a whole
Random Variables	0.244	0.107	0.290	0.711
Mean, Variance, and Standard Deviation of a Random Variable	0.195	0.211	0.300	0.240
The Normal Curve	0.001**	0.056	0.050*	0.076
Random Sampling	0.044*	0.115	0.192	0.270
Sampling Distributions	0.194	0.430	0.071	0.218
As A whole	**0.333**	**0.297**	**0.252**	**0.396**

*Legend: *-0.05 level of significance, **-0.01 level of significance*

Posttest Descriptive Statistics

After the five-week intervention, improvements were noted in both groups. Students taught through peer teaching with gamified activities consistently performed at a "Very Satisfactory" level, while those taught with differentiated instruction achieved "Satisfactory" results. Mathematics anxiety decreased across all three domains, with notable reductions in emotional anxiety.

Table 4a. Mathematics Performance After Peer Teaching on Gamified Activities Approach

Topic	No. of Items	Mean	Descriptive Rating
Random Variables	10	88	VS
Mean, Variance, and Standard Deviation of a Random Variable	10	85	VS
The Normal Curve	10	85	VS
Random Sampling	10	87	VS
Sampling Distributions	10	86	VS
Total	**50**	**85**	**VS**

Norms:

Range	*Descriptive Rating*
90 and above	*Outstanding (O)*
85-89	*Very Satisfactory (VS)*
80-84	*Satisfactory (S)*
75-79	*Fairly Satisfactory (FS)*
74 and below	*Did Not Meet Expectations (DNME)*

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Table 4b. Mathematics Performance After Peer Teaching with Differentiated Instructional Approach

Topic	No. of Items	Mean	Descriptive Rating
Random Variables	10	87	VS
Mean, Variance, and Standard Deviation of a Random Variable	10	84	S
The Normal Curve	10	81	S
Random Sampling	10	83	S
Sampling Distributions	10	80	S
Total	**50**	**83**	**S**

Norms:

Range	***Descriptive Rating***
90 and above	*Outstanding (O)*
85-89	*Very Satisfactory (VS)*
80-84	*Satisfactory (S)*
75-79	*Fairly Satisfactory (FS)*
74 and below	*Did Not Meet Expectations (DNME)*

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Table 5a. Post-Intervention Mathematics Anxiety Levels: Mental, Social, and Emotional (Gamified Activities Approach)

Subscale	Item No.	Statement	Mean	Descriptive Rating (DR)
Cognitive	1	I feel nervous when asked to solve a math problem in class.	2.67	Moderate Anxiety
	2	My mind goes blank when I try to solve math problems under time pressure.	2.48	Low Anxiety
	3	I have trouble understanding math even when I study hard.	2.35	Low Anxiety
	4	I get confused understanding math even when I study hard.	2.37	Low Anxiety
	5	I worry about making mistakes in math class.	2.59	Low Anxiety
		Sub-Mean	**2.49**	**Low Anxiety**
Social	1	I feel embarrassed when I ask a question about math in class.	2.06	Low Anxiety
	2	I get anxious when my classmates understand math faster than I do.	1.98	Low Anxiety
	3	I feel uncomfortable when discussing math problems with my classmates.	1.76	Very Low Anxiety
	4	I avoid participating in math activities because I fear making mistakes.	1.98	Low Anxiety
	5	I prefer working on math problems alone rather than in a group.	1.94	Low Anxiety
		Sub-Mean	**1.94**	**Low Anxiety**
Emotional	1	I feel stressed before taking a math test.	2.17	Low Anxiety
	2	My heart races when I have to solve a difficult math problem.	2.24	Low Anxiety
	3	I feel discouraged when I get a low score in math.	2.35	Low Anxiety
	4	Math makes me feel frustrated and overwhelmed.	2.04	Low Anxiety
	5	I sometimes feel like crying because of math.	2.00	Low Anxiety
		Sub-Mean	**2.16**	**Low Anxiety**
		As a Whole	**2.20**	**Low Anxiety**

Norms:

Range	*Descriptive Rating*
1.00 – 1.80	*Very Low Anxiety*
1.81 – 2.60	*Low Anxiety*
2.61 – 3.40	*Moderate Anxiety*
3.41 – 4.20	*High Anxiety*
4.21 – 5.00	*Very High Anxiety*

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Table 5b. Post-Intervention Mathematics Anxiety Levels: Cognitive, Social, and Emotional (Differentiated Instruction Approach)

Subscale	Item No.	Statement	Mean	Descriptive Rating (DR)
Cognitive	1	I feel nervous when asked to solve a math problem in class.	2.68	Moderate Anxiety
	2	My mind goes blank when I try to solve math problems under time pressure.	2.18	Low Anxiety
	3	I have trouble understanding math even when I study hard.	2.46	Low Anxiety
	4	I get confused understanding math even when I study hard.	2.21	Low Anxiety
	5	I worry about making mistakes in math class.	2.18	Low Anxiety
		Sub-Mean	**2.34**	**Low Anxiety**
Social	1	I feel embarrassed when I ask a question about math in class.	2.46	Low Anxiety
	2	I get anxious when my classmates understand math faster than I do.	2.60	Low Anxiety
	3	I feel uncomfortable when discussing math problems with my classmates.	2.28	Low Anxiety
	4	I avoid participating in math activities because I fear making mistakes.	2.26	Low Anxiety
	5	I prefer working on math problems alone rather than in a group.	2.05	Low Anxiety
		Sub-Mean	**2.33**	**Low Anxiety**
Emotional	1	I feel stressed before taking a math test.	2.18	Low Anxiety
	2	My heart races when I have to solve a difficult math problem.	2.23	Low Anxiety
	3	I feel discouraged when I get a low score in math.	2.28	Low Anxiety
	4	Math makes me feel frustrated and overwhelmed.	1.95	Low Anxiety
	5	I sometimes feel like crying because of math.	1.98	Low Anxiety
		Sub-Mean	**1.98**	**Low Anxiety**
		As a Whole	**2.26**	**Low Anxiety**

Norms:

Range	*Descriptive Rating*
1.00 – 1.80	*Very Low Anxiety*
1.81 – 2.60	*Low Anxiety*
2.61 – 3.40	*Moderate Anxiety*
3.41 – 4.20	*High Anxiety*
4.21 – 5.00	*Very High Anxiety*

Inferential Statistics: Performance

Results of the t-test showed significant differences between pretest and posttest scores in both groups ($p < 0.01$), confirming that the interventions improved student performance. Similarly, t-test results revealed a significant reduction in mathematics anxiety levels after the interventions ($p < 0.01$).

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Table 6a. The t-Test showing Significant Differences in Performance of Respondents Before and After Integrating Peer Teaching on Gamified Activities Approach in the Teaching-learning Process.

Topic	Mean Gain	t-computed value	t-probability value
Random Variables	5.13	3.891**	0.000
Mean, Variance, and Standard Deviation of a Random Variable	5.67	6.240**	3.74E-08
The Normal Curve	14.19	16.647**	5.27E-23
Random Sampling	7.30	3.773**	0.000
Sampling Distributions	6.44	4.598**	1.34E-05
Total	**8.19**	**17.756****	**2.87E-24**

*Legend: *-0.05 level of significance, **-0.01 level of significance*

Table 6b. The t-Test showing Significant Differences in Performance of Respondents Before and After Integrating Peer Teaching on Differentiated Instructional approach in the Teaching-learning Process.

Topic	Mean Gain	t-computed value	t-probability value
Random Variables	2.18	1.722**	0.045
Mean, Variance, and Standard Deviation of a Random Variable	7.70	10.084**	1.69E-14
The Normal Curve	8.40	10.492**	3.90E-15
Random Sampling	4.98	5.589**	3.51E-07
Sampling Distributions	6.37	14.142**	1.97E-20
Total	**7.49**	**16.859****	**6.64E-24**

*Legend: *-0.05 level of significance, **-0.01 level of significance*

Inferential Statistics: Anxiety Levels

Significant differences were also found between pretest and posttest anxiety levels in both groups ($p < 0.01$). This confirms that the interventions helped reduce students' Mathematics anxiety.

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Table 8a. Correlation Between Mathematics Anxiety and Performance After Peer Teaching on Gamified Activities Approach

Topics	Level of Anxiety			
	Cognitive	Social	Emotional	As a whole
Random Variables	0.213	0.001	0.062	0.148
Mean, Variance, and Standard Deviation of a Random Variable	0.150	0.135	0.008	0.160
The Normal Curve	0.106	0.048	0.024	0.081
Random Sampling	0.205	0.035	0.004	0.101
Sampling Distributions	0.118	0.009	0.043	0.080
As a Whole	**0.224**	**0.038**	**0.023**	**0.162**

*Legend: *-0.05 level of significance, **-0.01 level of significance*

Table 8b. Correlation Between Mathematics Anxiety and Performance After Peer Teaching on Differentiated Instruction Approach

Topics	Level of Anxiety			
	Cognitive	Social	Emotional	As a whole
Random Variables	0.050	0.241	0.154	0.235
Mean, Variance, and Standard Deviation of a Random Variable	0.176	0.114	0.165	0.027
The Normal Curve	0.196	0.096	0.236	0.196
Random Sampling	0.292*	0.193	0.153	0.243
Sampling Distributions	0.158	0.200	0.185	0.200
As A Whole	**0.268***	**0.192**	**0.258**	**0.268**

*Legend: *-0.05 level of significance, **-0.01 level of significance*

Posttest Correlation Analysis

Correlation analysis indicated a significant relationship between Mathematics anxiety and performance. Students with lower levels of anxiety tended to perform better, supporting the hypothesis that reducing Mathematics anxiety positively influences academic outcomes.

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Table 7a. The t-Test showing significant difference between level of anxiety of respondent groups after the use of Peer Teaching on Gamified Activities Approach in the teaching-learning process.

Approach	Mean Gain	t-computed value	t-probability value
Cognitive	0.98	14.198**	5.3E-20
Social	1.11	13.632**	2.9E-19
Emotional	1.32	14.708**	2.37E-20
Total	**1.14**	**18.339****	**1.31E-24**

*Legend: *-0.05 level of significance, **-0.01 level of significance*

Table 7b. The t-Test showing significant difference between level of anxiety of respondent groups after the use of the peer teaching on Differentiated Instruction Approach in the teaching-learning process.

Approach	Mean Gain	t-computed value	t-probability value
Cognitive	1.17	17.574**	9.34E-25
Social	0.74	14.055**	2.58E-20
Emotional	1.06	25.175**	1.61E-32
Total	**0.99**	**26.835****	**5.91E-34**

*Legend: *-0.05 level of significance, **-0.01 level of significance*

Summary of Findings

Gamified peer teaching produced greater improvement in Mathematics performance compared to differentiated instructions. Differentiated instructions showed a stronger effect in reducing emotional anxiety. Both approaches were effective in enhancing performance and lowering anxiety levels, but with varying strengths.

IV. DISCUSSION

Interpretation of Findings

Results of this study revealed both peer teaching with gamified activities and differentiated instruction effectively reduced Mathematics anxiety and improved student performance. The gamified group showed greater improvement in performance, while differentiated instruction demonstrated a stronger impact in reducing emotional anxiety. This suggests that different strategies address unique aspects of learning: gamification enhances engagement and mastery of content, while differentiated instruction provides emotional support by accommodating diverse learner needs.

Comparison to Existing Studies

The findings are consistent with Richardson and Suinn's (1972) claim reducing anxiety has a direct impact on Mathematics performance. They also support the work of Ashcraft and Moore (2009), who found that Mathematics anxiety negatively correlates with achievement. In line with

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Topping (2019), peer teaching was shown to enhance collaboration and comprehension, while gamification aligns with Caponetto et al. (2014), demonstrating that integrating games reduces fear and increases motivation. Differentiated instruction, as emphasized by Tomlinson (2017), was effective in addressing diverse learner needs and lowering emotional barriers to learning.

Implications for Practice and Policy

These findings highlight the importance of integrating student-centered approaches in mathematics instruction. Teachers may incorporate gamified peer teaching strategies to improve mastery of competencies while using differentiated instruction to support students with high anxiety. School administrators and curriculum developers may consider professional development programs that equip teachers with skills in gamification and differentiation. At the policy level, flexible learning designs can be promoted to address both academic and socio-emotional challenges in mathematics learning.

Study Limitations

The study was limited to two sections of Grade 11 GAS students in one public school, which restricts generalizability. Intervention lasted only five weeks, which may not fully capture the long-term effects of gamification and differentiated instruction. Future studies may expand to larger populations, longer implementation periods, or other strands and subjects.

V. CONCLUSION

Last sections of this manuscript are inclusive of summary of outcomes and recommendations for future research or implementation.

Summary of Outcomes

It is concluded both peer teaching with gamified activities and differentiated instructions significantly reduced Mathematics anxiety and improved student performance. Gamification yielded greater gains in performance, while differentiated instructions had a stronger effect in lowering emotional anxiety. A weak but consistent negative correlation between Mathematics anxiety and performance was also confirmed.

Recommendations for Future Research or Implementation

1. Mathematics teachers are encouraged to adopt gamified peer teaching strategies to increase engagement and performance, while applying differentiated instruction to support learners with higher anxiety levels;
2. School leaders may provide training on integrating gamification and differentiation into classroom practice;
3. Future research may involve longitudinal studies across different grade levels and strands to determine long-term effects;
4. Studies may also explore hybrid models that combine gamification and differentiation for maximum effectiveness.

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