

Using Gamified Instruction on Students' Self- Efficacy and Performance in Mathematics

Myra Rabutazo Bacsafra

mybacsafra@gmail.com

Laguna State Polytechnic University Sta. Cruz Laguna 4009 PHILIPPINES

Abstract

This study wants to identify the level of implementation of gamified instruction on students' self-efficacy and its performance in Mathematics. Specifically, it seeks to determine the level of using gamified instruction, student's self-efficacy and performance. In addition, the study would like to test the significant differences in students' performance before and after the implementation of gamified instruction. Furthermore, it also aims to test the significant relationship between gamified instruction and students' self-efficacy and performance in mathematics.

The researcher utilizes a self-made questionnaire as an instrument in gathering information. The study includes 40 struggling mathematics students from Grade 7 at San Antonio Integrated National High School in the school year 2023-2024. These students are selected by the researcher to obtain a broader range of responses regarding the implementation of gamified instruction.

Based on the results of the data, the findings are drawn from this study. The students had very high experience on using gamified instruction and self-efficacy upon their experience on the gamified instruction practices. Also, students obtained developing in comprehension and problem-solving but beginning in critical thinking for the before evaluation while the students were classified as developing in problem solving and critical thinking but obtained approaching proficiency in comprehension for their after. Students' performance in mathematics after the usage of gamified instruction showed differences on the results of written test after the integration of gamified instruction as they were able to identify relationships of the given in creating solutions upon exposure on the curriculum delivery with the use of games and applications. Moreover, the usage of gamified instruction in mathematics subject does not predict and improved student's performance as not all the students had equal access in information communication technology resources which were necessary in the implementation of strategy in the subject.

In line with the findings of this study, students' performance in mathematics after the usage of gamified instruction showed significant differences on the results of written test after the integration of gamified instruction. In addition, the gamified instruction was observed to be significant predictor in developing students' self-efficacy in mathematics subject. Moreover, the usage of gamified instruction in mathematics subject does not improved student's performance thus signified acceptance of null hypothesis.

Based on the findings and conclusions made, and the following recommendations are forwarded. The school may devise different practices to address students' critical thinking and problem-solving skills, conduct learning action cell to utilized gamified instruction and consider the flexibility of materials and availability of resources in implementing gamified instruction. Also, the teacher may enhance the culture of integration of gamified instruction in mathematics and utilize gamified instruction to provide practice drills and supplemental activities to students to attain mastery.

Keywords: gamified instruction; self-efficacy; performance in Mathematics

1. Introduction

Technology integration, especially information and communication technology (ICT), is becoming more and more common in modern education. Curriculum delivery is changing, becoming more participatory and engaging, thanks to ICT, which is in line with instructors' pedagogical abilities and subject-matter expertise. ICT is essential to 21st-century education because it gives students access to a wealth of knowledge and techniques that improve their technology proficiency while addressing subject-specific competences. Innovative approaches are being used in many nations to educate pupils, utilizing software and instructional websites to support the process of teaching and learning. Education is constantly evolving due to technological advancements and pedagogical changes. Teachers seek innovative ways to engage students, encourage active learning, and improve understanding. Gamified teaching, rooted in game design, was a viable approach. It incorporates games, challenges, incentives, and interactive feedback to create immersive learning environments. These elements capture students' interest and motivate them, making gamified education a popular choice for boosting learning outcomes in various subjects. This approach goes beyond traditional teaching methods, capturing students' interest and enhancing their overall learning experience.

According to Li et al. (2023) highlight the effectiveness of gamification in enhancing student learning. Factors such as duration, user type, learning environment, design principles, and pedagogical discipline influence its effectiveness. While science disciplines show the strongest effect size, gamification can be tailored to suit mathematics instruction by focusing on mechanics, dynamics, and aesthetics. According to the study of Ghavifekr & Rosdy (2015), ICT integration in education is crucial for modern teaching and learning, enhancing students' learning and classroom management. Teachers have a positive attitude towards ICT integration, believing it helps develop confidence, creativity, and imagination. However, proper implementation and support from school top management are essential for successful ICT integration.

Gamified instruction is a valuable tool in teaching mathematics, as it can help develop students' enthusiasm and competence in the subject. By incorporating game design concepts, teachers can create interactive learning environments that encourage experimentation, discovery, and teamwork. Students' critical thinking, problem-solving, and arithmetic skills all increase with gamified math tasks. Additionally, they increase self-assurance and a feeling of accomplishment, motivating kids to take on challenging assignments. This approach can greatly improve math instruction.

Despite the increasing popularity of gamified instruction, there is a significant research gap regarding its relationships in teaching mathematics. Empirical research on the relationship of gamification on student learning outcomes, engagement levels, and attitudes towards mathematics is lacking, despite theoretical frameworks and anecdotal evidence suggesting potential benefits.

1.1 Statement of the Problem

Specifically, it sought answers to the following questions:

1. What is the level of using gamified instruction in terms of:
 - 1.1. Gamified Based Learning;
 - 1.2. Gamified Assessment;
 - 1.3. Response System;
 - 1.4. Use of Digital Resources; and
 - 1.5. Application of Gamified Instruction Techniques?
2. What is the level of students' self-efficacy in mathematics terms of:
 - 2.1. Peer Interaction;

- 2.2. Growth Mindset;
- 2.3. Goal Setting; and
- 2.4. Resilience?
- 3. What is the level of students' performance in mathematics before and after gamified instruction in terms of:
 - 3.1. Comprehension;
 - 3.2. Problem Solving; and
 - 3.3. Critical thinking?
- 4. Is there a significant difference on students' performance in mathematics in terms of before and after gamified instruction?
- 5. Is there a significant relationship between gamified instruction and students' self-efficacy?
- 6. Is there a significant relationship between gamified instruction and students' performance in mathematics?

2. Methodology

The research design used in this study was Descriptive Method of Research in collecting and gathering necessary data.

Pangandaman (2023), Descriptive Method of Research design is to describe and explore relationships between the learner's academic performance, teachers' preparedness, and competence in implementing the modular learning approach. It is appropriate since descriptive means describing a situation or phenomenon, answering research inquiries about what, when, where, and how rather than why, and finding the relationship between them through correlation.

3. Results and Discussion

This chapter deals with the presentation, analysis and interpretation of data gathered to answer the sub problem relative to the main problem of this study. This part discusses the findings of the study based on the research questions.

Level of Gamified Instruction

In this study, the level of gamified instruction refers to gamified based learning, gamified assessment, response system, use of digital resources and application of gamified instruction techniques.

The level of gamified instruction was revealed in the following tables, which shows the statement, mean, standard deviation, remarks and verbal interpretation.

Table 1 illustrates the level of gamified instruction with regards gamified based learning. The students had very high ($M=3.35$, $SD=0.78$) experience on the gamified instruction practices in terms of gamified based learning as there are widely use practice of different application available in the internet and gadget integrated in the discussion of the lessons in mathematics that allowed students to practice computation and calculations and leads to better learning experiences.

Table 1 shows the level of gamified instruction in terms of gamified based learning.

Table 1 Level of Gamified Instruction in terms of Gamified Based Learning

STATEMENT	MEAN	SD	REMARKS
The teacher's used of gamified practices allow learners to...			
...utilized different application to practice computation.	3.60	0.55	Strongly Agree

... integrate games as motivation to learn.	3.28	0.91	Strongly Agree
... tracks progress of learners' accomplishment through leader board.	3.38	0.77	Strongly Agree
... appreciates reward system after finishing the game-based instruction.	3.40	0.87	Strongly Agree
... shows mastery through collaborative game application.	3.10	0.71	Agree
Weighted Mean		3.35	
SD		0.78	
Verbal Interpretation		Very High	

The students were strongly agree ($M=3.60$, $SD=0.55$) that the utilization of gamified instruction in mathematics subjects allowed them to utilized different applications in performing calculations. This denoted that the teacher's initiative in integrating different application available in gadget and online led the student to practice calculations of mathematical problems and process computation that leads to drills and mastery of the concept.

Moreover, the students were agree ($M=3.10$, $SD=0.71$) that the teacher's initiative in utilization of gamified instruction helped learners to show mastery though collaborative activities though game application. This implied that the students developed their mastery on the mathematics concept as they exchange idea and collaborate with their peers with the use of applications and games in the discussion.

Level of Gamified Instruction in terms of Gamified Assessment

Table 2 illustrates the level of gamified instruction with regards gamified assessment. The students had very high ($M=3.27$, $SD=0.72$) experience on the gamified instruction practices in terms of gamified assessment as there were evaluation of students' progress on mathematical skills and problem-solving ability with emphasis in correctness and their speed.

Table 2 shows the level of gamified instruction in terms of gamified assessment.

Table 2 Level of Gamified Instruction in terms of Gamified Assessment

STATEMENT	MEAN	SD	REMARKS
The teacher's used of gamified instruction in teaching mathematics allows learners to...			
... practice computation speed as there is present timer each game.	3.25	0.74	Agree
...tracks individual progression in each game check points.	3.23	0.73	Agree
... appreciate individual progress in the game shown in the progress bar.	3.23	0.80	Agree
... solves real life problems while learning values and skills.	3.38	0.67	Strongly Agree
... assess particular skills in specific game.	3.28	0.68	Strongly Agree
Weighted Mean		3.27	
SD		0.72	
Verbal Interpretation		Very High	

It is evident from the results that the students are strongly agree ($M=3.38$, $SD=0.67$) that upon the teacher's practice of gamified assessment, the students had the chance to solve real life problems while learning values and skills. This implied that the students exposed in evaluation strategies with the use of

games in mathematics develop their ability to understand the problems they encountered in real life and proved possible solutions with consideration to their personal values and set of specific competencies.

Moreover, the students are still agree that the teacher integration of gamified assessment both offered the student to track their individual progression in each game check points ($M=3.23$, $SD=0.73$) and appreciate individual progress shown in the progress bar ($M=3.23$, $SD=0.80$). These results implied that the students appreciated their individual development as they viewed their point values earned in every stage of game assessment used by the teachers which help them to monitor their own learning progress in mathematics subject.

Level of Gamified Instruction in terms of Response System

Table 3 illustrates the level of gamified instruction with regards to response system. The students had very high ($M=3.39$, $SD=0.72$) experience on the gamified instruction practices in terms of response system as the students develop their skills to respond on set of activities and games that addressed their critical thinking and information processing with the use of game method which emphasized collaborative activities among peers and feedback from the teachers leading to competency mastery.

Table 3 shows the level of gamified instruction in terms of response system.

Table 3 Level of Gamified Instruction in terms of Response System

STATEMENT	MEAN	SD	REMARKS
The teacher's used of gamified instruction in teaching mathematics allows learners to...			
... practice newly acquired skills through games.	3.43	0.68	Strongly Agree
... rapidly assess performance in terms of collecting data of formative assessment.	3.33	0.69	Strongly Agree
... increase opportunities in receiving feedback from teachers.	3.55	0.64	Strongly Agree
... practice note-taking among learners through provided lectures.	3.40	0.63	Strongly Agree
... perform critical thinking through sharing with peers.	3.25	0.74	Agree
Weighted Mean		3.39	
SD		0.72	
Verbal Interpretation		Very High	

The data shows that the students are strongly agree ($M=3.55$, $SD=0.64$) that teacher's implementation of gamified method in increase the chances of receiving feedback among from the mentors. This implied that the students received the teacher's comment more often about their performance in the class through integration of games in evaluation of their competency which were beneficial in development of performances and competencies attainment.

Moreover, the students are agree ($M=3.25$, $SD=0.74$) that the integration of games in the discussion aid the students to perform critical thinking through sharing with peers as part of their response system. It can be gleaned that the students increase the practice of collaborative activity and sharing of ideas with their peers as they perform instruction through the use of games which contributed to their mastery and learning.

Table 4 shows the level of gamified instruction with regards to use of digital resources.

Table 4 Level of Gamified Instruction in terms of Use of Digital Resources

STATEMENT	MEAN	SD	REMARKS
The teacher's used of gamified instruction in			

teaching mathematics allows learners to...			
... access video instruction to aid learning.	3.28	0.85	Strongly Agree
... read interactive books to better learning experiences.	3.28	0.64	Strongly Agree
... utilized self-faced reading material to understand the lesson.	3.30	0.65	Strongly Agree
... use communication medium to aid questions.	3.28	0.82	Strongly Agree
... download software that aids learning.	3.15	0.62	Agree
Weighted Mean		3.26	
SD		0.72	
Verbal Interpretation		Very High	

Table 4 illustrates the level of gamified instruction with regards to use of digital resources. The students had very high ($M=3.26$, $SD=0.72$) experience on the gamified instruction practices in terms of use of digital resources as the students had the chance to use varied learning materials available online and offline in their devices that aid the development of their understanding on mathematical concepts and attainment of competencies within the lesson of specific topic.

The data showed that the students are strongly agree ($M=3.30$, $SD=0.65$) that the use of gamified instruction in teaching mathematics aid the students to access self-faced reading materials to understand the lesson. This denoted that the students used different self-faced reading materials prepared by the teachers to assist their understanding about the mathematical concept based on their level of cognitive development and attention span.

Furthermore, the students are also agree ($M=3.15$, $SD=0.62$) that the teacher's initiative to use gamified instruction in teaching mathematics allowed them to download software to aid their learning practices. This implied that the teacher's practice of using games in teaching mathematics among the students offered an opportunity to the learners to access different application from the internet for them to use as practice drills and reference in attainment of the competency.

Table 5 shows the level of gamified instruction in terms of application of gamified instruction techniques.

Table 5 Level of Gamified Instruction in terms of Application of Gamified Instruction Techniques

STATEMENT	MEAN	SD	REMARKS
The teacher's used of gamified instruction in teaching mathematics allows learners to...			
... enhance least learned competencies through preferred methodology.	3.28	0.75	Strongly Agree
... practice learned concept through different representation of games.	3.13	0.82	Agree
... track individual progress through game levels.	3.28	0.72	Strongly Agree
... provide enjoyable supplemental activities for difficult math concepts.	3.45	0.68	Strongly Agree
... feel motivated while learning through different game-based application.	3.43	0.71	Strongly Agree
Weighted Mean		3.31	
SD		0.74	
Verbal Interpretation		Very High	

Table 5 illustrates the level of gamified instruction with regards application of gamified instruction techniques. The students had very high ($M=3.31$, $SD=0.74$) experience on the gamified instruction practices in terms of use of application of gamified instruction techniques as the students had the chance develop their understanding upon teachers' consideration of using advance technologies in teaching adjusted to teaching practices and level of students' interest and understanding.

ICT can improve student learning by fostering teamwork and motivation. Gamified approaches, especially in male students, practical disciplines, and Spanish-speaking colleges, have shown superior outcomes. Higher education can benefit from gamification by increasing engagement and academic success. Addressing women and international students' interests, enhancing motivating tactics, and increasing immersion and practical activities can improve teaching quality, López-Martínez et al. (2022).

The data implied that the students are strongly agree ($M=3.45$, $SD=0.68$) that upon adjustment of teaching methodologies of the teachers which are based on games, this provides enjoyable supplemental activities for difficult math concept. This shoed that the teachers used game as mode of reference and supplemental exercises to the students for them to had additional reading materials and activities after attending the discussion and practice the competencies of specific lesson.

Moreover, the students are still agree ($M=3.13$, $SD=0.82$) that the adjustment of teaching methodologies among mentors allowed the students to enhance their learned concepts through different representations of games. It can be gleaned that the students had the chance to enjoy computation drills and recall of the concepts with the use of different games that emphasized mathematical topics aligned to their lessons and helped them to attain mastery.

Level of Students' Self- Efficacy

In this study, the level of students' efficacy pertains to peer interaction, growth mindset, goal setting, and resilience.

The level of students' efficacy and were revealed in the following tables, which shows the statement, mean, standard deviation, remarks and verbal interpretation.

Table 6 illustrates the level of students' self-efficacy with regards to peer interaction. The students had very high ($M=3.27$, $SD=0.69$) perception of their own ability upon their experience on the gamified instruction practices in terms of peer interaction as the students would able to expressed their ideas and understanding to their classmates as their clarify concepts and help each other.

Table 6 shows the level of students' self-efficacy in terms of peer interaction.

Table 6 *Level of Students' Self- Efficacy in terms of Peer Interaction*

STATEMENT	MEAN	SD	REMARKS
Using gamified instruction, the learners were able to...			
... communicate ideas within the game.	3.18	0.81	Agree
... share understanding of concept during the discussion.	3.25	0.67	Agree
... ask clarification of game instruction within peer to accomplish level.	3.28	0.68	Strongly Agree
... aid peer who encountered difficulty in different game level.	3.33	0.66	Strongly Agree
... explain generalized experiences within the peer through discussion.	3.33	0.66	Strongly Agree
Weighted Mean		3.27	
SD		0.69	
Verbal Interpretation		Very High	

The data clearly expressed that the students were strongly agree that ($M=3.33$, $SD=0.66$) their experience in gamified instruction develop their own perception of their ability to aid peer who encountered difficulty in different game level and explain generalized experiences within the peer through discussion. This explained that the students perceived their development on their ability to assist their classmate in their learning activities by sharing ideas and explanation as they are exposed in different teaching methods involving game integration in mathematics subject.

Moreso, the students were agree ($M=3.18$, $SD=0.81$) that upon their exposure on different integration of gamified teaching strategies used by the teacher during discussion of mathematical concepts, the learners perceived their development on their ability to communicate ideas within the games. It denoted that the students perceived their ability to communicate ideas about the rules involved in the games and rules of problem solving indicated in the activities enhanced as they were involved in the type of discussion that both emphasized the concept and used of modern way of teaching.

Level of Students' Self- Efficacy in terms of Growth Mindset

Table 7 illustrates the level of students' self-efficacy with regards to growth mindset. The students had very high ($M=3.29$, $SD=0.66$) perception of their own ability to set their development upon practice of concepts, feedback and creating schemes of learning habit.

Adipat et al. (2021) proved that educational games have been successfully integrated into English language instruction, particularly for non-native learners. This method aims to engage students and foster collaborative learning, enhancing social and cognitive abilities. Game-based learning is associated with mental growth and enhancement.

Table 7 shows the level of students' efficacy in terms of growth mindset.

Table 7 Level of Students' Self- Efficacy in terms of Growth Mindset

STATEMENT	MEAN	SD	REMARKS
Using gamified instruction, the learners were able to...			
... challenge own capability to practice learned concept.	3.28	0.64	Strongly Agree
... continuously practice concept through games even after errors.	3.15	0.66	Agree
... seek feedback from peer and teachers.	3.53	0.51	Strongly Agree
... look for positive side of error performed.	3.18	0.81	Agree
... create scheme of performing better after failure.	3.33	0.62	Strongly Agree
Weighted Mean		3.29	
SD		0.66	
Verbal Interpretation		Very High	

The data employed that the learners are strongly agree ($M=3.53$, $SD=0.51$) that upon exposure on the gamified instruction used by the teachers in teaching mathematics concepts, the students developed the initiative to seek feedback from peers and teachers. Meaning, the learners developed the urges to have the comment on their academic performance based on their execution of activities through games from their classmates and teachers to improve their academic achievement as they are exposed in gamified instruction practices.

Furthermore, the learners were agree ($M=3.15$, $SD=0.66$) that upon exposure on the gamified instruction utilized by the teacher in teaching mathematics, the learners continuously practice concepts

through games even after errors. This implied that the learners perceived the development of their initiative to practice concepts and had the persistent attitude to attain competencies in mathematics even they encountered difficulty as they are exposed in gamified teaching approach integrated by the teachers in the subject.

Table 8 shows the level of students' efficacy in terms of goal setting.

Table 8 *Level of Students' Self- Efficacy in terms of Goal Setting*

STATEMENT	MEAN	SD	REMARKS
Using gamified instruction, the learners were able to...			
... set measurable targets.	3.33	0.57	Strongly Agree
... proposed challenging paths that stimulate learning and excitement among.	3.23	0.73	Agree
... committed to attain personal goals for growth in the subject.	3.35	0.80	Strongly Agree
... create limitation for entertainment while learning.	3.35	0.62	Strongly Agree
... visualize the end score to meet mastery.	3.35	0.62	Strongly Agree
Weighted Mean		3.32	
SD		0.67	
Verbal Interpretation		Very High	

Table 8 illustrates the level of students' self-efficacy with regards to goal setting. The students had very high ($M=3.32$, $SD=0.67$) perception of their own ability to set learning goal in mathematics subject as they had the chance craft their own target in the subject and visualize their activities that will contribute to attainment of their set standards.

The data clarified that the learners were strongly agree that upon exposure on gamified instructions in mathematics subject, ($M=3.35$, $SD=0.80$) the learners were able to be committed to attain personal goals for growth in the subject and ($M=3.35$, $SD=0.62$) create limitation for entertainment while learning. This implied that the learners perform their best to maintain their interest and engagement in different activities provided by the teacher with the integration of gamified instruction to develop their personal goal of developing their cognitive capacity and attainment of competencies in the subject.

Moreso, the students were still agree ($M = 3.23$, $SD = 0.73$) that upon their exposure in gamified instruction in mathematics subject, they had the opportunity to proposed challenging paths that stimulate learning and excitement among. This implied that the learners had the freedom to choose learning activities that stimulate challenge and excitement on the subject that maintained their interest as they are exposed in gamified teaching strategies.

Table 9 shows the level of students' efficacy in terms of resilience.

Table 9 *Level of Students' Self- Efficacy in terms of Resilience*

STATEMENT	MEAN	SD	REMARKS
Using gamified instruction, the learners were able to...			
... be aware of the effect of practice to learning.	3.28	0.72	Strongly Agree
... controls own behavior while learning.	3.30	0.82	Strongly Agree
... show confidence in own capability to finish task.	3.40	0.90	Strongly Agree
... contribute own experiences by explaining.	3.38	0.70	Strongly Agree

... cope with different challenges encountered in learning process.	3.25	0.67	Agree
Weighted Mean		3.32	
SD		0.76	
Verbal Interpretation		Very High	

Table 9 illustrates the level of students' self-efficacy with regards to resilience. The students had very high ($M=3.32$, $SD=0.76$) perception of their own ability to maintain resilient as they had the chance control their learning habits and practice of concepts even after long drills of trial and error to process achievement of competencies in the subject.

The data entailed that the learners were strongly agree ($M=3.40$, $SD=0.90$) that upon their expose on the gamified instruction performed by the teacher in teaching mathematics, the students were able to develop confidence in their own capacity to finish task. This implied that the students develop their strong belief on their own ability to accomplished assigned task and different academic responsibilities in mathematics as they had the experiences in learning with the use of gamified instruction practices of the teachers.

Moreover, the students were agree ($M=3.25$, $SD=0.67$) that upon experienced of gamified instruction in mathematics subject, they develop to cope with different challenges encountered in learning process. This implied that the learning environment is not always smooth, and encountering challenges is inevitable. However, students could develop resilience by coping with these difficulties. This resilience can be a valuable asset not only in academic pursuits but also in various aspects of life.

Level of Students' Performance

In this study, the level of students' performance pertains to comprehension, problem solving and critical thinking.

The level of students' performance in mathematics was revealed in the following tables, which shows the frequency, mean, percentage, remarks and verbal interpretation.

Table 10 shows the level of students' performance in mathematics in terms of comprehension. The data indicated that the students were developing during the pre-test ($f=5.10$) which implied that the learners never meet the score higher than satisfactory level in terms of items with emphasis on comprehension ability while the students obtained approaching proficiency ($f=8.30$) in their post-test as there were number of learners attained scores from satisfactory standards or higher.

Table 10 shows the level of students' performance in mathematics in terms of comprehension.

Table 10 *Level of Students' Performance in Mathematics in terms of Comprehension*

Students' Performance						
Before				After		
Score	f	%	Verbal Interpretation	f	%	Verbal Interpretation
13-15	0	0%	Outstanding	3	8%	Outstanding
10-12	0	0%	Very Satisfactory	10	25%	Very Satisfactory
7-9	14	35%	Satisfactory	16	40%	Satisfactory
4-6	15	38%	Fairly Satisfactory	11	28%	Fairly Satisfactory
0-3	11	28%	Did Not Meet Expectation	0	0%	Did Not Meet Expectation

Mean	5.10	Developing	8.30	Approaching Proficiency
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It is evident that most of the respondents obtained fairly satisfactory which represent by fifteen (15) or thirty-eight percent (38%), followed by satisfactory which represent by fourteen (14) or thirty-five percent (35%) during the pre-test on mathematics with emphasis on their comprehension. This implied that the students attained comprehension just with the satisfactory level during their pre-test examination.

Moreover, it is evident that most of the respondents obtained satisfactory which represent by sixteen (16) or fourthly percent (40%) followed by fairly satisfactory which represent by eleven (11) or twenty-eight percent (28%) although there are ten (10) or twenty-five percent (25%) of the student attained the level of very satisfactory. It can be gleaned that the level of the students in terms of comprehension with respect to their performance during post-test is within the satisfactory standard and higher.

Table 11 shows the level of students' performance in terms of problem-solving.

Table 11 *Level of Students' Performance in Mathematics in terms of Problem-Solving*

Students' Performance						
Before				After		
Score	f	%	Verbal Interpretation	f	%	Verbal Interpretation
13-15	0	0%	Outstanding	0	0%	Outstanding
10-12	0	0%	Very Satisfactory	1	3%	Very Satisfactory
7-9	2	5%	Satisfactory	1	38%	Satisfactory
4-6	16	40%	Fairly Satisfactory	5		
0-3	22	55%	Did Not Meet Expectation	2	58%	Fairly Satisfactory
				3		
				1	3%	Did Not Meet Expectation
Mean	3.53		Developing	6.33		Developing

Table 11 shows the level of students' performance in mathematics in terms of problem-solving. The data indicated that the students were both developing their performance in their pre-test ($f=3.53$) and posttest ($f=6.33$) written examination with emphasis on the problem-solving ability of the students. This implied that the level of student's problem-solving ability was lower than satisfactory standard.

It is evident that most of the respondents obtained did not meet the expectation represented by twenty-two (22) or fifty-five percent (55%) followed by satisfactory which represent by sixteen (16) or fourthly percent (40%). It can be gleaned that the level of the students' performance in terms of problem solving was very low and required several developments as they were not able to meet the satisfactory standard which showed lower ability to solve world problems in mathematics.

Moreso, it is evident that most of the respondents fairly satisfactory represented by twenty-three (23) or fifty-eight percent (58%) followed by satisfactory which represent by fifteen (15) or thirty-eight (38%). The result implied that upon exposure on the gamified instruction, the learners attained higher level of problem-solving ability as they attained the standard close to satisfactory.

Table 12 shows the level of students' performance in mathematics in terms of critical thinking.

Table 12 *Level of Students' Performance in Mathematics in terms of Critical Thinking*

Students' Performance

Score	Before			After		
	f	%	Verbal Interpretation	f	%	Verbal Interpretation
13-15	0	0%	Outstanding	0	0%	Outstanding
10-12	0	0%	Very Satisfactory	0	0%	Very Satisfactory
7-9	1	3%	Satisfactory	10	25%	Satisfactory
4-6	18	45%	Fairly Satisfactory	23	58%	Fairly Satisfactory
0-3	21	53%	Did Not Meet Expectation	7	18%	Did Not Meet Expectation
Mean	3.25		Beginning	5.48		Developing

Table 12 shows the level of students' performance in mathematics in terms of critical thinking. The data indicated that the students were beginning during the pre-test ($f=3.25$) which implied that the learners never meet the score higher than satisfactory level in terms of items with emphasis on critical thinking ability while the students obtained developing ($f=5.48$) in their post-test as there were number of learners attained scores close to satisfactory standards.

It is evident that most of the respondents obtained did not meet the expectation represented by twenty-one (21) or fifty-three percent (53%) followed by fairly satisfactory which represent by eighteen (18) or fourthly-five percent (45%). It can be gleaned that the level of the students' performance in terms of critical-thinking was very low and required several development as they were not able to meet the satisfactory standard which showed lower ability to think critically and process complex in mathematical phrases.

Moreso, it is notable from the results that students obtained fairly satisfactory which represented by twenty-three (23) or fifty-eight percent (58%) followed by satisfactory level with ten (10) or twenty-five percent (25%). This implied that the performance of the students in mathematics with emphasis in critical thinking improved as they exposed in gamified instruction strategy by the teachers.

Significant Difference on Students' Performance in Mathematics in terms of Pre-Test and Post-test

The study would like to determine the significant differences on students' performance in terms of pre-test and post-test. With the utilization of t-test, the mean difference and analysis are presented on the table. To test the significant difference on students' performance in mathematics in terms of pre-test and post-test, data were treated statistically using spreadsheet.

The data presented consist of mathematical skills, assessment, mean, mean difference, critical t-value, computed t-value and remarks.

There is a significant difference in the performance of students in terms of pre-test and post-test with emphasis on student's comprehension skills as shown in the table with a mean difference of 3.200. The table also shows that p-value is less than the level of significant value of 0.05 which indicated that there is significant different on the student's performance between pre-test and post-test with emphasis on student's comprehension skills upon exposure on the gamified instruction in mathematics.

The table 13 shows the significant difference in the performance of students in terms of pre-test and post-test.

Table 13 Significant difference on student's performance in mathematics in terms of pre-test and post-test

Mathematical Skills	Assessment	Mean	Mean Difference	Critical t-value	Computed t-value	Remarks
Comprehension	Pre-test	5.100	3.200	2.02	12.56	Significant
	Posttest	8.300				
Problem Solving	Pre-test	3.525	2.800			

	Posttest	6.335	
Critical Thinking	Pre-test	3.250	2.225
	Posttest	5.475	

Note: * $p < .05$.

Similarly, there is a significant difference in the performance of students in terms of pre-test and post-test with emphasis on student's problem-solving skills as shown in the table with a mean difference of 2.800. The table also shows that p-value is less than the level of significant value of 0.05 which indicated that there is significant different on the student's performance between pre-test and post-test with emphasis on student's problem-solving skills upon exposure on the gamified instruction in mathematics.

Moreover, there is a significant difference in the performance of students in terms of pre-test and post-test with emphasis on student's critical thinking skills as shown in the table with a mean difference of 2.225. The table also shows that p-value is less than the level of significant value of 0.05 which indicated that there is significant different on the student's performance between pre-test and posttest with emphasis on student's critical thinking skills upon exposure on the gamified instruction in mathematics.

In addition, since the computed t-value of 12.56 is greater than the critical t-value of 2.02 at alpha value 0.50, the null hypothesis was rejected. Therefore, it can be concluded that there is a significant difference on students' performance in mathematics in terms of pre-test and post-test.

From this result, it can be inferred that the students' performance in before and after with consideration in cognitive competencies increased as they utilized gamified instruction in teaching-learning process. The student increase their ability to comprehend lesson content, solve problems and think critically in the problems presented in activities though gamified instruction utilization in teaching mathematics.

Significant Relationship between Gamified Instruction and Students' Self-efficacy

The study would like to determine the significant relationship between gamified instruction and student's self-efficacy. With the utilization of Pearson moment correlation, the p-value was presented on the table.

To test the significant relationship between gamified instruction and student's self-efficacy, data were treated statistically using spreadsheet.

The table 14 shows the significant relationship of gamified instruction and students' self-efficacy. It is evident from the data that the level of gamified instruction in terms of gamified based learning, gamified assessment, response system, use of digital resources and application of gamified instruction techniques was observed to have significant relationship the student's development of self-efficacy in terms of peer interaction, growth mindset, goal setting and resilience. Furthermore, the p-values obtained less than the significance alpha 0.05, hence there is significance.

The table shows the significant relationship between gamified instruction and student's self-efficacy.

Table 14 Significant Relationship between Gamified Instruction and Students' Self-efficacy

Gamified Instruction (IV)	Students' Self-efficacy (DV)	r	Interpretation	p	Analysis
Gamified Based Learning	Peer Interaction	0.28945	Low	0.00034	Significant
	Growth Mindset	0.28423	Low	0.00040	Significant
	Goal Setting	0.36455	Low	0.00004	Significant
	Resilience	0.28111	Low	0.00043	Significant

Gamified Assessment	Peer Interaction	0.33495	Low	0.00009	Significant
	Growth Mindset	0.22888	Low	0.00179	Significant
	Goal Setting	0.32344	Low	0.00013	Significant
	Resilience	0.27838	Low	0.00047	Significant
Response System	Peer Interaction	0.53983	Moderate	0.00000	Significant
	Growth Mindset	0.46640	Moderate	0.00000	Significant
	Goal Setting	0.40430	Moderate	0.00001	Significant
	Resilience	0.38791	Low	0.00002	Significant
Use of Digital Resources	Peer Interaction	0.33588	Low	0.00009	Significant
	Growth Mindset	0.43303	Moderate	0.00000	Significant
	Goal Setting	0.31349	Low	0.00017	Significant
	Resilience	0.38845	Low	0.00002	Significant
Application of Gamified Instruction Techniques	Peer Interaction	0.46690	Moderate	0.00000	Significant
	Growth Mindset	0.66667	Moderate	0.00000	Significant
	Goal Setting	0.48928	Moderate	0.00000	Significant
	Resilience	0.42419	Moderate	0.00001	Significant

This implied that the student's development self-efficacy in mathematics class were affected by the teachers' integration of gamified instruction strategies that improves their attention, engagement and motivation to contribute in their own learning and development.

Significant Relationship of Gamified Instruction on Students' Performance in Mathematics

The study would like to determine the significant relationship between gamified instruction and students' performance in mathematics. With the utilization of Pearson moment correlation, the p-value was presented on the table.

To test the significant relationship between gamified instruction and students' performance in mathematics, data were treated statistically using spreadsheet.

The table 15 shows the significant relationship of gamified instruction and students' performance in mathematics. It is evident from the data that the level of gamified instruction in terms of gamified based learning, gamified assessment, response system, use of digital resources and application of gamified instruction techniques was observed to have no significant relationship the students' performance in mathematics in terms of comprehension, problem solving and critical thinking. Furthermore, the p-values obtained greater than the significance alpha 0.05, hence there is significance.

From this result, it can be inferred that integration of gamified instruction is dependent on the availability of technology which the students may utilize. Not all the students had the familiarity in the utilization of the game and resources to use. With this, the enhancement of students' cognitive competency may be affected by this. The use of gamified instruction is within the school context where the students may not be guided to utilize as independent activity and practice drill in their homes to supplement learning practices.

Table 15 shows the relationship of gamified instruction and students' performance in mathematics.

Table 15 Significant Relationship of Gamified Instruction on Students' Performance in Mathematics

Gamified Instruction (IV)	Students' Self-efficacy (DV)	r	Interpretation	p	Analysis
Gamified Based Learning	Comprehension	0.019951	Negligible	0.384641	Not Significant
	Problem Solving	0.013439	Negligible	0.476256	Not Significant
	Critical Thinking	0.003996	Negligible	0.698382	Not Significant
Gamified Assessment	Comprehension	0.005614	Negligible	0.645891	Not Significant
	Problem Solving	0.0002940	Negligible	0.916304	Not Significant
	Critical Thinking	.000507	Negligible	0.890306	Not Significant
Response System	Comprehension	0.000710	Negligible	0.870368	Not Significant
	Problem Solving	0.000639	Negligible	0.876932	Not Significant
	Critical Thinking	0.015221	Negligible	0.448185	Not Significant
Use of Digital Resources	Comprehension	0.017740	Negligible	0.412602	Not Significant
	Problem Solving	0.037445	Negligible	0.231546	Not Significant
	Critical Thinking	0.018980	Negligible	0.396579	Not Significant
Application of Gamified Instruction Techniques	Comprehension	0.033227	Negligible	0.260268	Not Significant
	Problem Solving	0.013394	Negligible	0.476989	Not Significant
	Critical Thinking	0.019094	Negligible	0.395155	Not Significant

4. Conclusion and Recommendations

Based on the findings of the study, the following conclusion were drawn:

In line with the findings of this study, students' performance in mathematics after the usage of gamified instruction showed significant differences on the results of written test after the integration of gamified instruction thus denoted rejection of null hypothesis as the students improved their ability to recall mathematical concepts and solve worded problems as they were able to identify relationships of the given in creating solutions upon exposure on the curriculum delivery with the use of games and applications.

In addition, the gamified instruction was observed to be significant predictor in developing students' self-efficacy in mathematics subject implied rejection of null hypothesis as the students develop their ability to communicate with peer, enthusiastically engaged in learning activities to develop their personal goal after series of trial and error. Furthermore, this finding underscores the importance of incorporating innovative

instructional strategies, such as gamified approaches, to foster a conducive learning environment that empowers students to actively engage with mathematical concepts and achieve their educational objectives.

Moreover, the usage of gamified instruction in mathematics subject does not improved student's performance thus signified acceptance of null hypothesis as not all the students had equal access in information communication technology resources which were necessary in the implementation of strategy in the subject.

Based on the findings and conclusions made, the following recommendations were forwarded.

1. The school may devise different practices to address students' critical thinking and problem-solving skills; may conduct learning action cell to utilized gamified instruction in different subject that may lead to enhancement of students' self-efficacy; and consider the flexibility of materials and availability of resources in implementing gamified instruction.

2. The teacher may enhance the culture of integration of gamified instruction in mathematics in all level to improve student's learning experiences; may advise to utilize gamified instruction to provide practice drills and supplemental activities to students to attain mastery.

3. The students may actively involve in gamified instruction activities provided by the teacher to improve their self-efficacy.

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