COMPUTER-BASED GAMIFICATION STRATEGY ON STUDENTS' ACADEMIC PERFORMANCE AND ANXIETY IN MATHEMATICS

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ABSTRACT. *Computer-based gamification strategy is one of the cooperative learning strategies which challenge the students to take responsibility for their own learning through online games.The study determined the mathematics anxiety and students' academic performance among the students exposed to Computer-based Gamification Strategy (CGS) and Non-Computer-based Gamification Strategy (Non-CGS) of Grade 7 students in Mindanao State University Wao Community High school. The purpose of the study was to determine the level of achievement of students when exposed to CGS and those exposed to Non-CGS in terms of their pretest and posttest scores; describe the level of anxiety in mathematics when exposed to CGS and those exposed to Non-CGS; identify the difference between the academic performance of the students when exposed to CGS and those exposed to Non-CGS in terms of their pretest and posttest scores; and lastly, compare the difference of the anxiety of students in mathematics when exposed to CGS and those exposed to Non-CGS. The study was quantitative in nature. It used the quasi-experimental research design conducted at Mindanao State University Wao Community High School. One hundred twenty (120) pupils in Grade 7 participated in the research study as respondents. The students who were exposed to CGS had "very low performance" in the pretest and had "moderate performance" in the post-test, while those who were exposed to Non-CGS also had "very low performance" in the pretest and had "low performance" in the posttest. Moreover, for the level of students' anxiety towards mathematics, they experienced fair anxiety before the after the intervention for both CGS and Non- CGS groups. The mathematics academic performance of the students exposed to CGS was significantly higher than the academic performance of those exposed to Non-CGS. Both groups felt similar level of anxiety of the students in Mathematics*.

Keywords: academic performance, anxiety, mathematics, computer-based gamification.

1. INTRODUCTION

The Philippine government through the Department Education launch the Basic Education Curriculum to answer the need of the Filipino learners to the intense demand to build students' 21st century skills. The optimal time of learning under the Basic Education is considered to be a twelve-year curriculum. It is also the internationally acknowledged benchmark for students and professionals. However, it faces a lot of challenges. There are several aspects that influence Filipino pupils' ability to study mathematics. The amount of money, the learning process, the kind of instructional materials used, the curriculum, the level of administrative support, and the level of teacher training are all essential aspects to consider. These deficiencies are reflected in the poor performance of high school students in the Philippines on a variety of standardized assessments, most notably the National Achievement Test (NAT). According to the data provided by the Department of Education, the national average percentage score (MPS) on the NAT for high schools in the school year 2012-2013 in the Philippines fell short of the target by 51.41 percent, which is equivalent to 23.59 percentage points [1]. Moreover, the Program for International Student Assessment (PISA) in the Philippine National According to a report, as of the year 2018, Filipino students obtained an average score of 353 points in Mathematical Literacy, which was much lower than the average score of 489 points that the Organization for Economic Co-operation and Development (OECD) achieved. In addition, only one in every five Filipino pupils (19.7 percent) achieved the required competency level (Level 2) in Mathematical Literacy.

Filipino student needs attention and immediate intervention by teachers as facilitators of learning [2]. One of the solutions to address the problem is to incorporate approaches and strategies in the classroom. The researcher believes that gamification allows students to collaborate, compete, and actively participate in the learning process [3].

According to the findings of research conducted by Kapp [4], a gamified educational endeavor has to strike a healthy balance between instructional content and enjoyable gameplay in order to be successful, and gamification has been shown to boost student engagement in the learning process. More so, researchers took into consideration a number of other aspects of game design, such as experience points, levels, and in-game incentives. The pupils had a more fun time learning, and their interest in the material was also significantly improved [5].

Filipino student needs attention and immediate intervention by teachers as facilitators of learning. One of the solutions to address the problem is to incorporate approaches and strategies in the classroom. In addition, gamification allows students to collaborate, compete, and actively participate in the learning process [6].

Computer-based gamification learning is one of the instructional strategies, and it provides students with the opportunity to be positively challenged to take responsibility for their learning. This type of learning develops students' active participation in the learning process. The students are allowed to enjoy Mathematics while learning, thinking, and communicating with others participating in class. The teacher guides the student on how to explore by themselves and learn the concepts independently. This avoids passive learning and provides meaningful learning.

One cooperative learning tactic that encourages students to take responsibility for their education is computer-based gamification, which could be done via a game-based learning platform. Moreover, gamification learning is a modest structure that results in an extraordinary change in student positivity, confidence, and learning of Mathematics.

Mathematics anxiety exemplifies the qualities of a sensation of tension, nervousness, and anxiety that interferes with a person's ability to execute mathematics, including the manipulation of numbers and the solution of mathematical set of problems in a wide variety of academic and non-academic contexts. Mathematics Anxiety affects people of all ages and educational levels, from elementary school to college. On the other hand, activity-based learning and online/distance learning can potentially lessen the anxiety associated with the threat of seeming ignorant in front of one's contemporaries. The use of untimed, unassessed examinations with minimal stakes is another tactic that may help alleviate the anxiety associated with mathematics while also boosting confidence. Anxiety over mathematics is alleviated by studying relevant topics; applying mathematics and statistics to real-world situations is particularly effective.

Many studies have been implemented to find out factors associated with students' achievement such as teachers' skills and competencies [9, 10, 11, 12], teachers' awareness, perceptions, and challenges [13, 14, 15, 16, 17], contemporary pedagogies [18, 19, 20, 21, 22, 23] and others [24, 25, 26, 27, 28, 29, 30], however, little has been done on exploring the use of CGS in teaching mathematics.

The overall implementation of Computer-based Gamification Strategy provides numerous opportunities for growth and improvement in undergraduate courses but whether similar results can be obtained when it is applied to secondary school is still unclear. Thus, the present study explored the effects of Computer-based Gamification Strategy in public secondary students.

2. MATERIALS AND METHODS

The study assessed the academic performance and anxiety in Mathematics using Computer-based Gamification Strategy at Mindanao State University Wao Community High School for SY 2021-2022. The quasi-experimental research design was used to examine the students' academic performance and Mathematics Anxiety in the two groups of grade 7 Mathematics class using the Computer-based Gamification Strategy (CGS). The experimental group was subjected to a Computer-based Gamification Strategy (CGS) strategy, while the controlled group experienced a non-Computer based Gamification Strategy (Non-CGS).

A pretest on academic performance and anxiety was administered to the students prior to the introduction of CGS. The CGS was conducted for the fourth grading period of the school year 2021-2022. After a two-month session, the students retook the same test as served as the posttest. The result of these tests had determined the difference in the students' academic performance and anxiety in Mathematics of Mindanao State University Grade 7 students.

There were two (2) instruments used to gather the data, namely, the test questionnaire and the mathematics anxiety questionnaire [7]. The researchers wrote the letter to the Principal requesting permission to conduct the study in Mindanao State University Wao Community High School; the study was participated by the selected Grade 7 students enrolled in Math 7 subject school year 2021-2022. A printed module for the computer-based Gamification was followed. It covers the activities or tasks to carry out the concept of Measures of Central Tendency of Ungrouped Data, Measures of Central Tendency of Grouped Data Solving Problems Involving Measures of Central Tendency of Ungrouped and Grouped Data, Illustrating the Measures of Variability (Range, Average Deviation, Variance, Standard Deviation) of a Statistical Data Measures of Variability (Ungrouped Data), and Solving Problems Involving Measures of Variability of Ungrouped and Grouped Data. The researcher conducted the study from March 2022 to May 2022. A pretest in academic performance and a questionnaire for Mathematics Anxiety were given before the experimental period, while a post-test after Computer-based Gamification and Non- Computer-based Gamification was administered. The researcher explained the research instruments and their purpose to the respondents, then they were introduced to the study itself, which was followed by the administration of the questionnaires. In order to guarantee accurate and trustworthy findings, the researcher provided the respondents with instructions on the proper way to complete the questionnaires and went over each item with them in detail.

The respondents of the study were grouped into two according to their section. Both groups were given the same differentiated mathematics instruction. The first group was given a Computer-based Gamification Strategy (CGS), and the second group was given a non-Computer-based Gamification Strategy (CGS).

The following rating scale was used to better understand the data:

Score	Percentage score	Descriptive rating	Interpretation
0-14	74% and below	Beginning	Very Low
15-17	75% - 79%	Developing	Low
18-20	80 – 84%	Approaching Proficiency	Moderate/Average
21-24	85 – 89%	Proficient	High
25-30	90% and above	Advance	Very High

Rating	Scale	Descriptive Rating	Qualitative Interpretation
5	4.51-5.00	Strongly Agree	Highly Positive
4	3.51-4.50	Agree	Positive
3	2.51-3.50	Undecided	Fair
2	1.51-2.50	Disagree	Negative
1	1.00-1.50	Strongly Disagree	Highly Negative

3. RESULTS AND DISCUSSIONS

This part presents the analysis and interpretation of data gathered from the student's scores relevant for testing the study's hypothesis. The order of presentation follows the arrangement of the problems identified in the study.

3.1 Mathematics Performance of the CGS and Non-CGS

The mathematics performance of the students exposed to Computer-based Gamification Strategy (CGS) and non-CGS in terms of pretest is presented in Table 1.

As shown in Table 1, in the pretest, 12 students (20%) of Computer-based Gamification Strategy students had high performance, six students (10 %) had moderate performance, ten students (17 %) had a low performance, and 32 students (53 %) had a very low performance.

Table 1. Student academic performance in mathematics when exposed to CGS and non-CGS in terms of pretest

Range	Group				Qualitative Interpretation
	Computer-based Gamification Strategy		Non-Computer-based Gamification Strategy		
	F	%	F	%	
90% - 100%	0	0%	0	0%	Very High
85% - 89%	12	20%	2	3%	High
80% - 84%	6	10%	7	12%	Moderate
75% - 79%	10	17%	11	18%	Low
65% - 74%	32	53%	40	67%	Very Low
	60	100%	60	100%	
Mean Score/MPS	14.05 74% (Very Low)		12.25 74% (Very Low)		

Legend:

Score	Percentage score	Interpretation
0 – 14	74% and below	Very Low
15-17	75% - 79%	Low
18-20	80 – 84%	Moderate/Average
21-24	85 – 89%	High
25-30	90% and above	Very High

The Computer-based Gamification Strategy group's total mean score in the pretest is 14.05, indicating a very low performance. On the other hand, as shown in Table 1, the mathematics performance of students exposed to Non-Computer-based Gamification Strategy in terms of pretest showed that two students (3 %) of students exposed to Computer-based Gamification Strategy had high performance, seven students (12 %) had moderate performance, 11 students (18 %) had a low performance, and 40 students (67 %) had a very low performance in the pretest. The Computer-based Gamification Strategy group's total mean score in the pretest is 12.250, indicating very low performance.

The result of this study shows that the level of students' academic performance of Grade 7 students not exposed to Computer-based Gamification Strategy and Non-Computer-based Gamification Strategy was very low. These data indicate that the participants already had less prior knowledge of the concepts before the intervention.

It validates the findings that students' mathematics performance during pre-tests was poor since pupils do not yet have a basis for the themes and mathematical ideas [8]. It also validates the findings in [32], who discovered that pupils' level of mathematics performance prior to exposure to Flipped Learning was similarly relatively poor. Furthermore, this research validates the findings in [33]. They discovered that the mathematics performance of children exposed to a Rich Assessment Task Environment and those exposed to a non-rich Assessment Task Environment was relatively poor. According to Braza and Supapao [34], students' progress in Mathematics might be hampered by a lack of knowledge of fundamental ideas and abilities.

Table 2 displays the post-test results of the students' mathematical performance, broken down according to whether they were exposed to the Computer-based Gamification Strategy or the Non-Computer-based Gamification Strategy. As can be seen in Table 2, seven students, or 11.6 percent of the students in the group that used the Computer-based Gamification Strategy, had a very high performance on the post-test; 19 students, or 31.7 percent, had high performance, 19 students, or 31.7 percent, had moderate performance, eight students, or 13.4 percent, had a low performance, and seven students, or 11.6 percent, had very low performance. The aggregate mean score on the post-test for the group using the Computer-based Gamification Strategy was 19.667, which reflects a performance that is considered to be moderate. In terms of the post-test, it also demonstrates how well the students performed in mathematics after being exposed to the Non-Computer-based Gamification Strategy. Low performance is shown by the overall mean score of 15.683 on the post-test for the Non-CGS group.

. Table 2. Student's academic performance in mathematics when exposed CGS and non-CGS in terms of post-test

Range	Group				Qualitative Interpretation
	Computer-based Gamification Strategy		Non-Computer-based Gamification Strategy		
	F	%	F	%	
90% - 100%	7	11.6%	0	0%	Very High
85% - 89%	19	31.7%	14	23.3%	High
80% - 84%	19	31.7%	16	26.7%	Moderate
75% - 79%	8	13.4%	4	6.7%	Low
65% - 74%	7	11.6%	26	43.3%	Very Low
	60	100%	60	100%	
Mean Score/MPS	19.667 83% (Moderate)		15.683 76% (Low)		

Legend:

Score	Percentage score	Interpretation
0 – 14	74% and below	Very Low
15-17	75% - 79%	Low
18-20	80 – 84%	Moderate/Average
21-24	85 – 89%	High
25-30	90% and above	Very High

Table 2 reveals that the students exposed to Computer-based Gamification Strategy had a moderate academic performance level in the posttest. On the other hand, students exposed to Non-Computer-based Gamification Strategy in posttest had the academic performance of a low performance level.

These findings support the assertion that variable degrees of learning are recorded when various styles or teaching methods are used [35]. However, in this situation, the introduction of the computer-based Gamification Strategy resulted in a dramatic shift in the students' performance from the pre-test to the post-test. Gamification is a pleasant educational strategy that enables repetition in a pleasurable atmosphere for pupils [36].

These findings are comparable to other studies [8, 37]. They discovered that students' mathematics performance in the posttest following exposure to the Gradual Release of Responsibility Instructional Model (GRIM) was moderate. Furthermore, according to research, students who encountered technology integration in their training had higher results after the intervention than students who solely received conventional instruction [38]. Researchers took a variety of game design variables such as experience points, levels, and in-game incentives. Students' learning experiences were more pleasurable, and their engagement was increased [39]. This research also contradicts the findings of Bersano [40], who found that most of students' mathematics performance exposed to educational game-based Instruction was relatively poor.

3.2 Student's Anxiety in Mathematics of CGS before and after Intervention

Table 3 shows the student's anxiety in mathematics of computer-based gamification strategy before intervention. Among the 20 items, students in the Computer-based Gamification Strategy group rated "fair." The table also shows that prior to intervention, five items with higher means in the Computer-based Gamification Strategy group are "I feel that I am not doing well on my Mathematics lesson." (3.47), "I have difficulty in understanding problem in Mathematics," (3.53), "Parents monitoring for homework." (3.65), "I worry for my poor performance" (3.75) and "I worry that I will fail my parent's expectation." (3.98). Also reflected in table 3 are five items with lower means in the Computer-based Gamification Strategy group. They are "I get suffocation and short breath feeling every math class)" (2.13), "I get sweating and nausea when taking a math test." (2.33), "I feel uncomfortable during Mathematics class" (2.60), "I am unable to think during math class." (2.80) and "I get physically agitated during Mathematics class." (2.88).

Table 3. Student's Anxiety in mathematics of computer-based gamification strategy before and after intervention

Anxiety in Mathematics Indicators	Computer-based Gamification Strategy			
	Before		After	
	Mean	QI	Mean	QI
I feel stressed when listening to the strict teacher	3.40	F	2.32	N
I get suffocation and short breath feeling every math class	2.13	N	2.38	N
I feel uncomfortable during Mathematics class.	2.60	F	2.43	N
I have a problem of recalling Mathematics at home	3.30	F	2.45	N
I get sweating and nausea when taking a math test.	2.33	N	2.43	N
I feel nervous and unease during Mathematics class	3.27	F	2.87	F
I worry while learning Mathematics.	3.23	F	2.72	F
Rediculation by peer group for poor performance.	3.33	F	2.77	F
I get physically agitated during Mathematics class.	2.88	F	2.78	F
I am unable to think during math class.	2.80	F	2.80	F
I lose concentration on taking Mathematics test.	3.00	F	2.83	F
I get nervous during math class.	3.12	F	2.95	F
I feel that Mathematics unusual hard subject.	3.40	F	3.08	F
I am afraid of being asked.	3.40	F	3.23	F
I have difficulty in understanding problem in Mathematics.	3.53	P	3.30	F
Parents monitoring for homework.	3.65	P	3.35	F
I am afraid of asking questions during class discussion.	3.40	F	3.42	F
I feel that I am not doing well on my Mathematics lesson.	3.47	F	3.43	F
I worry for my poor performance	3.75	P	3.75	P
I worry that I will fail my parent's expectation.	3.98	P	3.82	P
Overall Mean	3.20	F	2.96	F

Legend: (*) means scoring is reversed

Rating	Scale	Descriptive Rating	Qualitative (QI) Interpretation
5	4.51-5.00	Strong agree	Highly Positive (HP)
4	3.51-4.50	Agree	Positive (P)
3	2.51-3.50	Undecided	Fair (F)
2	1.51-2.50	Disagree	Negative (N)
1	1.00-1.50	Strongly disagree	Highly Negative (HN)

The overall mean score of Student's Anxiety before intervention in Mathematics is 3.20 for the Computer-based Gamification Strategy group. This shows that students have fair anxiety in mathematics.

Students' anxiety in Mathematics is high when their parents monitor their homework. They are more anxious about the subject when they worry about their poor performance. The student's anxiety in Mathematics of computer-based gamification strategy before and after the intervention is fair, which means that even if there is intervention, the level of anxiety is the same. It lends credence to the findings of Alzahrani and Stojanovski [41]. They supported that students with lower self-esteem and less overall enthusiasm to learn mathematics may also experience greater levels of performance-related anxiety. In addition, Beilock [42] said that if a person does not actively engage in mathematics, it will be difficult to improve their mathematical abilities.

After the intervention in Table 5, among the 20 items, students in the Computer-based Gamification Strategy rated "fair." Five items with higher means in the Computer-based Gamification Strategy are "I have difficulty in understanding problem in Mathematics." (3.30), "Parents monitoring for homework." (3.35), and "I feel that I am not doing well on my Mathematics lesson." (3.43), "I worry for my poor performance" (3.75) and "I worry that I will fail my parent's expectation." (3.82). Also reflected in table 5 are five items with lower means in the Computer-based Gamification Strategy, and they are "I feel stressed when listening to the strict teacher" (2.32), "I get suffocation and short breath feeling every math class" (2.38), "I feel uncomfortable during Mathematics class." (2.43)" I get sweating and nausea when taking a math test.)" (2.43) and "I have a problem of recalling Mathematics at home" (2.45).

The overall mean score of Student's Anxiety in Mathematics after the intervention is 2.96 in the Computer-based Gamification Strategy group. This shows that students have fair anxiety in Mathematics. This means that after exposure, students are less anxious in Mathematics; with the help of a Computer-based Gamification Strategy, they can gain knowledge from the computer-based gamification and learning materials sent by the teacher via modular and messenger. Also, students are more anxious in Mathematics when they worry that they will fail their parent's expectations. More significantly, students worry about their poor performance.

The outcomes of this research complement the study that was conducted by Saligumba and Tan [8], who came to the conclusion that the students' anxiety about Mathematics during the pretest was moderate for both the Flipped Classroom and the Non-Flipped Classroom. Also, the outcomes of this research lend credence to the findings of Dagaylo-an and Tancinco [44], who came to the conclusion that the method of instruction that instructors use while instructing students in Mathematics had no impact on the students' level of mathematical anxiety. In addition, they arrived at the conclusion that there is no substantial association between the degree of mathematics anxiety that children experience and the performance that they have in Mathematics.

Table 4 shows the Student's Anxiety in Mathematics of Non-Computer-based Gamification Strategy before intervention. Among the 20 items, students in the Computer-based Gamification Strategy group rated "fair." Table 4 also shows that prior to intervention, five items with higher means in the Computer-based Gamification Strategy group are "I feel that Mathematics is unusual hard subject." (3.35), "Parents monitoring for homework." (3.48), "I worry for my poor performance." (3.52), "I have difficulty in understanding problem in Mathematics." (3.67) and "I worry that I will fail my parent's expectation." (3.77).

Also reflected in table 4 are five items with lower means in the Computer-based Gamification Strategy group. They are "I get suffocation and short breath feeling every math class" (2.40), "I feel uncomfortable during Mathematics class." (2.48), "I get sweating and nausea when taking a math test." (2.53), "I get nervous during math class." (2.72) and "I get physically agitated during Mathematics class." (2.73).

The overall mean score of Student's Anxiety before intervention in Mathematics is 3.06 for the Non-Computer-based Gamification Strategy group. This shows that students have fair anxiety in Mathematics. Students' anxiety about Mathematics is high when they feel that Mathematics is an unusual hard subject and when their parents monitor for homework. They are more anxious about the subject when they have difficulty understanding mathematics problems. Also, they worry that they will fail their parents' expectations.

Table 4. Student's anxiety in mathematics of non-computer-based gamification strategy before and after intervention

Anxiety in Mathematics Indicators	Non-Computer-based Gamification Strategy			
	Before		After	
	Mean	QI	Mean	QI
I get suffocation and short breath feeling every math class	2.40	N	2.33	N
I feel uncomfortable during Mathematics class.	2.48	N	2.55	F
I get sweating and nausea when taking a math test.	2.53	F	2.53	F
I get nervous during math class.	2.72	F	2.73	F
I have a problem of recalling Mathematics at home	3.10	F	2.78	F
Rediculation by peer group for poor performance.	3.18	F	2.78	F
I feel stressed when listening to the strict teacher	3.07	F	2.82	F
I get physically agitated during Mathematics class.	2.73	F	2.83	F
I am afraid of asking questions during class discussion.	3.10	F	2.90	F
I am unable to think during math class.	3.02	F	2.92	F
I am afraid of being asked.	3.12	F	2.97	F
I lose concentration on taking Mathematics test.	2.90	F	2.98	F
I feel that I am not doing well on my Mathematics lesson.	3.13	F	2.98	F
I worry while learning Mathematics.	2.92	F	3.03	F
Parents monitoring for homework.	3.48	F	3.03	F
I worry that I will fail my parent's expectation.	3.77	P	3.12	F
I feel nervous and unease during Mathematics class	2.97	F	3.27	F
I have difficulty in understanding problem in Mathematics.	3.67	P	3.58	P
I feel that Mathematics unusual hard subject.	3.35	F	3.60	P
I worry for my poor performance	3.52	P	3.85	P
Overall Mean	3.06	F	2.98	F

Legend: (*) means scoring is reversed

Rating	Scale	Descriptive Rating	Qualitative Interpretation (QI)
5	4.51-5.00	Strong agree	Highly Positive (HP)
4	3.51-4.50	Agree	Positive (P)
3	2.51-3.50	Undecided	Fair (F)
2	1.51-2.50	Disagree	Negative (N)
1	1.00-1.50	Strongly disagree	Highly Negative (HN)

The student's anxiety in Mathematics of CGS and Non-CGS group before and after the intervention is fair, which means that even if there is intervention, the level of anxiety is the same. In addition, students exposed to CGs and Non-CGS have different performances even if they have the same level of anxiety. The findings of this study disprove the findings of a previous study by Zakaria, et al. [45] titled "Mathematics anxiety and achievement among secondary school students." This earlier research discovered that pupils who had lower levels of mathematics anxiety tended to have better levels of mathematical achievement. The result of this study disproves that finding. In addition, the non-computer-based gamification approach group had lower anxiety levels. However, their performance on the pre-test was worse than that of the group that used the computer-based gamification strategy.

After the intervention in Table 6, among the 20 items, students in the Non-Computer-based Gamification Strategy rated "fair." Five items with higher means in the Non-Computer-based Gamification Strategy are "I worry that I will fail my parent's expectation." (3.12), "I feel nervous and unease during Mathematics class." (3.27), "I have difficulty in understanding problems in Mathematics." (3.58), "I feel that Mathematics unusual hard subject." (3.60) and "I worry for my poor performance" (3.85).

Also reflected in table 4 are five items with lower means in the Non-Computer-based Gamification Strategy, and they are "I get suffocation and short breath feeling every math class" (2.33), "I get sweating and nausea when taking a math test." (2.53), "I feel uncomfortable during Mathematics class." (2.55)" I get nervous during math class." (2.73) and "Rediculation by peer group for poor performance." (2.78).

The overall mean score of Student's anxiety in Mathematics after the intervention is 2.98 in the Computer-based Gamification Strategy group; this shows that students have a fair anxiety in Mathematics. This means that after exposure, students are less anxious in Mathematics; with the help of the Computer-based Gamification Strategy, they can gain knowledge from the Computer-based Gamification and learning materials sent by the teacher. Also, students are more anxious in Mathematics when they feel that it is challenging for them; they put more effort into studying well. More specially, students don't get quickly give up when they get the wrong answer but instead, they take action to correct selves.

3.4 Comparison of Students' Mathematics Performance between CGS and Non-CGS

Tables 5 and 6 show the comparison of Mathematics performance between the Computer-based Gamification Strategy group and the Non- Computer-based Gamification Strategy group. The tables that follow give the average performance of CGS and NON-CGS together with an analysis of whether or not there is a significant difference between them. The researcher will be able to decide whether or not to reject the initial hypothesis of this investigation as a result of this.

Table 5. Comparison of students' mathematics performance in the post-test

Group	N	Mean	SD
Computer-based Gamification Strategy	60	19.667	3.869
Non-Computer-based Gamification Strategy	60	15.683	5.299
Total	120	17.675	4.584

Table 6. Analysis of Covariance (ANCOVA) performance posttest scores

Source	Sum of Squares	Degrees of Freedom	Mean Square	F-value	Sig.
Group	318.837	1	318.837	17.861	0.000**
Pre-test (Covariate)	451.768	1	451.768	17.861	0.000**
Error	2088.549	117	17.851		
Total	40505.000	120			

Note: ** – significant at 0.05 level

The table shows that the mean scores of the responses between the CGS and Non-Cgs groups are very similar. Moreover, the students' anxiety toward Mathematics had an overall mean score before the intervention for the CGS group, which was 3.20, while for the Non-CGS group, is 3.06. This implies that the students have fair anxiety towards Mathematics as a subject. In addition, the students' mean scores in anxiety toward Mathematics after the intervention are 2.96 and 2.98 for CGS and Non-CGS groups, respectively. Computer-based Gamification Strategy documented a mean performance of 19.667 with a standard deviation of 3.869.

On the other hand, the Non-Computer-based Gamification Strategy detailed a mean performance of 15.683 with a standard deviation of 5.299. There is a clear distinction

between the performances of both groups in the posttest. Though the performance of the Non-Computer-based Gamification Strategy significantly improved from their pretest scores, it shows that the group's performance under the Computer-based Gamification Strategy was better than the performance of the students in the Non-Computer-based Gamification Strategy.

This assertion is supported by research presented by Bayat, et al. [46]. They state that instructing students in Mathematics via educational games or learning through entertainment is likely to be effective in the students' learning of mathematics. In addition, educational game-based encourage the involvement of students, even the more reserved ones, which directly impacts the level of interest and attitude that a student has towards a specific topic. According to the findings of research conducted by Kapp [4, 46] gamification can boost student engagement in the learning process by striking a balance between educational content and games. This is a critical component of a successful gamified educational project. In addition, researches [8, 26] addressed how incorporating technology is improving conceptual memory, which is a positive trend. This goes against what Coskun [48] said: that slow learners might be adversely impacted in competitive contexts.

The Computer-based Gamification Strategy was essential because at the beginning of the intervention, the two groups couldn't be compared to one another, as shown in the significant pretest (covariate). The probability value of the comparison that can be seen in Table 8 lends credence to these findings. The estimated p-value was 0.000 ($p<0.05$), indicating a highly significant difference; Thus, it implies a substantial difference in the level of academic achievement between students exposed to CGS and those exposed to Non-CGS. This proves that the null hypothesis of no significant difference is rejected. This means that the students perform better in CGS compared to Non-CGS.

3.4 Comparison of Students' Mathematics Anxiety between CGS and Non-CGS

The following tables reflect the comparison of Mathematics anxiety levels of the students who belonged to the two different groups. Table 7 contains the necessary descriptive statistics, such as mean score and standard deviation. In contrast, Table 8 contains information with regards to whether the measured difference is significant enough or to decide not to reject the hypothesis put forward by the researcher.

Table 7. Comparison of students' anxiety levels in the post-test

Group	N	Mean	SD
Computer-based Gamification Strategy	60	2.96	0.523
Non-Computer-based Gamification Strategy	60	2.98	0.461
Total	120	2.97	0.492

Table 8. Analysis of Covariance (ANCOVA) anxiety posttest scores

Source	Sum of Square	Degrees of Freedom	Mean Square	F-value	Sig.
Group	0.089	1	0.089	0.384	0.537**
Pre-test (Covariate)	1.675	1	1.675	7.245	0.008
Error	27.047	117	0.231		
Total	1085.763	120			

Note: ** – significant at 0.05 level

The table shows that the mean scores of the responses between the CGS and Non-Cgs groups are very close. Moreover, the students' anxiety toward Mathematics had an overall mean score before the intervention for the CGS group, which was 3.20, while for the Non-CGS group, is 3.06. This suggests that the students have fair anxiety towards Mathematics as a subject. In addition, the students' mean scores in anxiety toward Mathematics after the intervention are 2.96 and 2.98 for CGS and Non-CGS groups, correspondingly. This suggested that the two (2) groups have fair anxiety about Mathematics as a subject. Students in the Computer-based Gamification Strategy, on the other hand, had lower mathematics anxiety, with a score of 2.96 and a dispersion of 0.523, than those in the Non-Computer-based Gamification Strategy, who had a score of 2.98 and a dispersion of 0.461.

Furthermore, as shown in Table 10, the experimental CGS has a significant 'advantage' over the Non-CGS. The difference in mathematics anxiety means scores has a solved probability value of 0.386 ($p<0.05$). Moreover, the null hypothesis is accepted, which talked about having no significant difference between the two groups. This suggests that when students are exposed to CGS, their mathematics anxiety towards the topic is statistically comparable to the mathematics anxiety of those who were exposed to Non-CGS in the research. As a result, both groups are concerned about the problem. Thus, students exposed to CGS and No-CGS have fair in Mathematics subject.

This showed no significant difference in the level of Mathematics Anxiety among students exposed to CGS and those exposed to Non-CGS. Anxiety in Mathematics does not determine their performance in Grade 7 Mathematics. This is supported by the findings of Witt (2012), who found no significant association between the amount of mathematics anxiety that students experience and how well they do in Mathematics.

4. CONCLUSIONS AND RECOMMENDATIONS

Based on the findings of the study, the following conclusions were drawn: The level of students' academic performance of grade 7 students, when exposed to CGS, had very low performance. After the intervention, the level of Mathematics performance of the students when exposed to CGS had a moderate performance which shows an increase from a very low level in the pretest. On the other hand, the level of students' academic performance of grade 7 students when exposed to Non-CGS had very low performance. After the intervention, the level of mathematics performance of the students when exposed to Non-CGS had a low performance which shows an increase in performance of students under the CGS group.

The level of students' anxiety in Mathematics in grade 7 before and after CGS had fair anxiety. On the other hand, the level of students' anxiety in Mathematics in grade 7 before and after Non-CGS had fair anxiety, which shows no changes in the level of anxiety under the CGS and Non-CGS group.

Students exposed to CGS perform better than the students exposed to Non-CGS. Mean scores of the students exposed to CGS compared to those exposed to Non-CGS have a significant difference. Thus, there is a significant difference in

the level of academic performance among students exposed to CGS and those exposed to Non-CGS.

There is no significant difference between the pretest and post-test in the students' anxiety in Mathematics exposed to CGS and Non-CGS.

The results and findings of the study led to many recommendations for further research and action. Mathematics teachers are encouraged to integrate computer games with the students to learn while having fun. The use of a Computer-based Gamification Strategy can improve the mathematics performance of the learners since it is noted in the study that there is an increase in the students' performance before and after the intervention.

Mathematics teachers are encouraged to provide pretests and posttests to monitor the students' progress academically. Moreover, based on the findings of the study, the students exposed to CGS and Non- CGS have fair anxiety in Mathematics. This means that there is a need for a seminar workshop about the effects of anxiety on the performance of every student.

Teachers, administrators, and curriculum are suggested to integrate a Computer-based Gamification Strategy in the curriculum to improve the students' academic performance in the subject. The CGS may help them explore more technology and to use technology as a source of information. Moreover, it can help them to be more globally competitive individuals.

Teachers, parents, and administrators are encouraged to conduct a seminar about math anxiety for the students and parents. A seminar is needed so that the student and the parent can help each other and be aware of the negative impact of mathematics anxiety. It is also necessary to provide activities to develop the self-confidence of every student. The teacher may consider utilizing more engaging tasks to develop the self-esteem of every student. On the other hand, the parents are suggested to regularly communicate with their children to know how they are doing. In addition, in the future educational researchers are encouraged to seek to dig deeper into math anxiety and how it can influence students' mathematic performance.

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