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THE IMPACT OF DIGITAL GAMIFICATION AND TRADITIONAL BASED LEARNING ON STUDENTS' MATHEMATICS ACHIEVEMENT: EVIDENCE FROM THE PHILIPPINES

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Abstract – *the study focused on The Impact of Digital Gamification and Traditional-Based Learning on Grade 10 Students' Mathematics Achievement. The study utilized a quasi-experimental research design. This study focuses on gamified learning approaches and traditional-based learning and their impact on students' achievement in Mathematics. Moreover, the study occurred at Bantayan National High School, Ticad, Bantayan, Cebu. The participants of this research are the grade 10 students of Bantayan National High School. Two sections will be assigned to the control group, while another two will be assigned to the experimental group. The findings of the study indicated that the use of digital gamification can significantly improve students' mathematical skills, aligning with the need to leverage technological advancements in education. Likewise, adapting to technological developments is crucial for educators, emphasizing the value of incorporating tools such as gamified teaching approaches to enhance student engagement and learning effectiveness.*
Keywords: *Digital Gamification, Mathematics Achievement.*

Introduction

Education professionals are very interested in gamification—the application of game elements and mechanisms to non-gaming contexts—as a possible way to raise student motivation, engagement, and academic outcomes. The study of mathematics significantly contributes to the development of logical reasoning, problem-solving, and critical thinking skills. By adding gaming features, such as challenges, prizes, and progress monitoring, into mathematics education, digital gamification can help achieve these objectives. Traditional, teacher-to-student learning, on the other hand, places a strong emphasis on knowledge transfer. Common elements of traditional learning methods include readings, assignments, and lectures (Villar et. al, 2022). Traditional learning has been the most common method of education for many years. It is based on the notion that the best ways for students to learn are through exposure to professional knowledge and practice applying that knowledge through assignments and assessments.

According to Hattie (2009), traditional teaching strategies like guided practice and direct instruction can help students learn more effectively. Hattie did find that the effect size of these techniques' ranges from moderate to high, indicating that further research is necessary. This suggests that to satisfy the needs of every student, teachers should focus on enhancing an enjoyable learning environment, providing efficient feedback, and using different teaching approaches. Clear results about the best approaches to assist students in learning mathematics

will come from additional research on the effects of traditional, classroom-based instruction (Canque et. al., 2021).

Moreover, according to Setambah, et. al. (2023) about non-digital gamification: Effects of teaching on mathematics achievement, this study also demonstrates how engaging and appropriate teaching strategies can influence students' behavior and perceptions of mathematics. As per the comprehensive research findings, NDGBL is among the educational resources that aid in establishing a productive learning atmosphere. To compare samples from urban and rural locations, researchers recommend doing another study. This will be facilitated in large part by our research on Digital Gamification Based Learning (DGBL). Taking into consideration the students' tech-savvy and digital gaming experience, this study will specifically examine how digital gamification impacts students' academic performance.

As teachers, we should be aware of the student's interest in learning different sets of lessons (Carredo et. al., 2022). There is no one-size-fits-all strategy in teaching so teachers should consider utilizing various strategies (Montero et. al., 2022) There are cases in which students who are digital natives may not easily respond to traditional instructional approaches (Derasin et. al., 2021, and Canque et. al., 2021). Understanding the potential benefits of digital gamification for improving learning outcomes is important especially since students are more engaged in computers and technology-based activities (Abojon et. al., 2022). When students are given a gamified learning technique that enables them to view and experience the lesson differently, students who are initially not interested in learning mathematics become more hyper and motivated. These are some of the reasons why research on digital gamification and traditional-based learning should take place as it also aligns with the needs of modern education, especially in the field of mathematics.

This study about the impact of digital gamification and traditional-based learning can establish a concept of the effects of gamification compared to traditional-based learning on student achievements in Mathematics. To improve students' achievement in school, teachers, administrators, and curriculum designers can use these research findings to make a proper evaluation about integrating gamification or traditional-based approaches into educational practices. By understanding the impact of digital gamification and traditional-based learning on student achievements in Mathematics, educators can make informed decisions on which approach to adopt to enhance student performance. This research study can also provide valuable insights into the potential benefits and drawbacks of each approach, allowing for more effective and targeted implementation of educational practices.

Methods and Materials

This study is a quasi-experimental research design. This study focuses on gamified learning approaches and traditional-based learning and its impact on students' achievement in Mathematics. Since it is experimental, there will be a control group and an experimental group. The gamification group and the traditional-based learning group. While the traditional learning group will receive education using conventional techniques like lectures and homework assignments, the gamification group will receive instruction utilizing Kahoot, an online game-based learning platform featuring game components like leaderboards, badges, and points. The

same test will be used to assess the math proficiency of both groups using pretest and post-test. The scores will serve as the achievement of the students during the period with and without the use of gamified learning approaches. The gathered data will be analyzed and evaluated with the help of an appropriate statistical tool.

In addition, the research took place in Bantayan National High School, Ticad, Bantayan, Cebu. It is a public school that is under the Department of Education, Cebu Province. It was established in 1993 and has been catering to Grades 7-10 year levels. Each year level is composed of 12 sections with approximately 35-45 students per section. In the current school year, it has a population of 1,934. It caters to students that are mostly from the Municipality of Bantayan, one of the three municipalities of Bantayan Island.

Bantayan National High School (BNHS) adheres to the K-12 Curriculum, focusing on Outcome-Based Education. Every quarter, teachers are responsible for submitting a Curriculum Map, Budget of Work, and Course Outline to ensure proper lesson planning. Additionally, each teacher is required to submit a Weekly Lesson Log (WLL). The WLL undergoes a thorough review by the Subject Area Coordinator (SAC) before the lesson is taught.

Research Respondents

The participants of this research are the grade 10 students of Bantayan National High School. Two sections will be assigned to the control group, while another two sections will be assigned to the experimental group. Each section comprises approximately 35-40 students, resulting in a total of 72 students for the experimental group and 77 students for the control group.

Research Instruments

To obtain the data that are needed to answer the problems in this study, the following tools are used:

Pretest Examination. A pretest examination is given before their involvement in either gamification groups or traditional-based learning. A pretest examination is designed to gather data about participants so that it can be used to measure their prior knowledge and compare them to the general population or find any potential confounding variables.

Post-test Examination. A posttest examination is given to participants in a study or experiment after the administration of either gamification or traditional-based learning. Posttest examinations are used to gauge participants' knowledge and actions after intervention exposure.

Sampling Procedure

In conducting this study, the researcher will submit a letter to the principal of Bantayan National High School. The researcher will ask permission to conduct an experimental study with the selected Grade 10 students. In addition, the researcher will collect a copy of the scores of the students.

This study will be carried out using a cluster sampling design. In cluster sampling, a probability sampling technique, the population is divided into clusters which will be the grade

sections, and a subset of the clusters is chosen at random. The researcher would identify the clusters first based on the student's mathematics classrooms. Following cluster identification, a random selection of a subset of the clusters would be made by the researcher to take part in the investigation. The study would then comprise every student in the chosen clusters.
The following steps will be followed through cluster sampling:

1) Identify the clusters: Grade 10 Mathematics classroom.
2) Randomly select some of the clusters/sections to participate in the study: There will be two sections for gamified learning approaches and two mathematics class for traditional-based learning approaches.
3) Administer pretest to the two clusters.
4) Run the lesson plan incorporating gamification for the experimental group and traditional-based teaching for the controlled group.
5) Administer the posttest to both clusters.
6) Analyze the data gathered and treat it accordingly.

Ethical Consideration

Digital Gamification and Traditional-based learning is used to in order to improve student motivation and mathematics achievement to determine which of these strategy have more impact to the students. The ethical considerations of gamification and traditional-based learning must be carefully considered too, especially in relation to Mathematics proficiency. In data gathering, analysis of the results the following ethical consideration will be observed by the researcher:

Confidentiality. The researcher will treat the data of the participants with utmost confidentiality. The researcher will make sure to consider the privacy of participants by carefully examining the test results. The responses of each participant are not disclosed to anyone or anywhere. The data gathered should be marked as anonymous or name should be optional to preserve student privacy. Any sensitive data should only be permitted to access by the researchers of this study.
To avoid unwanted access, loss, or misuse, the researcher should set up a proper and secure storage of the data gathered. And to minimize the possibility of identifying the data of each participant, precise and clear protocols should be followed for both data gathering and publishing the findings of this study.

Fair Treatment. The researcher will treat all participants with equality, respect, and dignity regardless of their status in life, religion or beliefs, learning styles, and individual needs. Gamified learning environments and traditional-based learning should be accessible and inclusive for all students. Researchers should address potential biases and inequalities that gamification may influence. The pretest and posttest should be fair and equitable, measuring student learning outcomes accurately and objectively, regardless of the learning method used.

Transparency. The researcher will see to it that the research methods, data-gathering procedures, and results are all presented with appropriate documentation and is supported with the necessary documents. The findings of this research will be shown in a way that it can be accessed easily with the participants and the community involved in the study.

Consent. The researcher will clearly explain the purpose and procedures of the study to the school administration and participants. Getting informed consent requires that students, as well as their parents or legal guardians, be informed clearly and simply about the research's goals, procedures, risks, advantages, and withdrawal policies. Participants should be able to access and comprehend this information.

Results And Discussion

In Gamification, points and leaderboards are the game aspects that the teacher used in the research. Leaderboards show all players' scores, indicating who is leading and how pupils are performing about their classmates. Leaderboards can be used to monitor students' progress over time, promote healthy competition, and inspire pupils to raise their test scores. Points can be given for finishing tasks, providing assistance to fellow students, or providing accurate answers. Points can be utilized for competing with others, earning rewards, and monitoring progress.

In Traditional-Based Learning, the teacher employs drill and practice, lectures, and direct instruction. In direct instruction, the teacher explains new ideas and skills in detail and gives examples of them. Following that, students have the chance to put what they have learned into practice through both individual and guided practice. During a lecture, the teacher presents the material to the class, usually utilizing a mix of spoken explanations, visual aids, and interactive exercises. Additionally, in drill and practice, students must practice a skill or concept multiple times to fully understand the lesson. Below are the results of this experimental study:

Table 1: Experimental and Controlled Group Performance

GROUP	Minimum	Maximum	Mean	Std. Deviation
Experimental pretest	5.00	17.00	9.9583	2.41729
Controlled pretest	2.00	15.00	8.0649	2.47268
Experimental post-test	2.00	21.00	11.6667	3.52456
Controlled post-test	3.00	15.00	10.4675	2.57817

Table 1 shows the mean and standard deviation of the performance of the experimental group and the control group. The mean of the scores of the students in the control group is 8.06 with a standard deviation of 2.47. This is the same as the mean score of the experimental group of 9.9 with a standard deviation of 2.41. This indicates that the two groups' starting math proficiency was equal. This implies that the experimental intervention is responsible for any variations in their post-test scores.

The table also shows the post-test scores of the students in the controlled group with a mean score of 10.46 and a standard deviation of 2.57. This is lesser compared to the mean score of the experimental group which is 11.67 with a standard deviation of 3.52. This suggests that the experimental intervention had a positive effect on students' mathematics performance.

Table 2: Significance Difference between pretest and posttest of Controlled and Experimental Group

GROUP	Mean	Standard Deviation	t	df	P - Value	Decision	Interpretation
Experimental group post-test Control group post-test	11.6667 10.4675	3.52456 2.57817	2.547	71	.013	Reject the null Hypothesis	Significant Difference

Table 2 shows the significant difference between the post-test of the experimental group and controlled group. The p-value of 0.013 which is less than the level of significance at 0.05 significance with degree of freedom of 71. This means that the study's results offer strong proof that, in terms of posttest scores, the gamification-enhanced experimental group fared better than the standard learning-controlled group. This suggests that gamification may be a useful technique for improving the mathematical learning outcomes of students. The two groups' statistically significant differences indicate that the gamified method was more successful in fostering students' comprehension of mathematical ideas and their capacity to use those ideas to solve problems. Numerous elements contribute to gamification's beneficial effects on student learning. Gamification can enhance student engagement and motivation by incorporating elements of competition, challenge, and play into the learning process. Furthermore, gamification can give students instant feedback and incentives, enabling them to monitor their development and solidify their knowledge.

The findings of this study are consistent with earlier studies that have demonstrated the advantages of gamification in the classroom. Gamification improved student motivation, engagement, and learning outcomes, according to a meta-analysis of using seventy-eight (78) studies (Sailer and Homner, 2020).

Table 3: Significance Difference between the pretest and posttest of the Experimental Group

GROUP	Mean	Standard Deviation	t	df	P - Value	Decision	Interpretation
Experimental pre-test group - Experimental post-test group	9.95 11.66	2.41 3.52	-.3932	71	.000	Reject the null Hypothesis	Significant Difference

Table 3 shows the pretest and posttest performance of the students in the experimental group. The p-value is 0.000 which is less than the significance level of 0.05 significance. The mean difference between the pretest and posttest results is 1.7104 and the standard deviation

difference is 1.11. The findings show that there is a significant difference between the pretest and posttest performance of the students after performing the digital gamification. This means that when compared to their performance before the intervention, students who were a part of the experimental group performed significantly better than those who were in the controlled group.

Thus, the students' achievement in mathematics was positively affected by the experimental intervention, which is digital gamification. The fact that the pretest and posttest scores differed significantly shows that the gamification strategy was successful in improving the students' comprehension and application of mathematical ideas. It also means that digital gamification on the internet can be a useful strategy for raising arithmetic accomplishment levels.

This also shows that the students who are motivated and engaged before the assessment perform better than those students who were not able to experience digital gamification. The points and leaderboards that were given during the discussion motivate the students to do better and encourage them to participate so they can earn points and be on top of the leaderboards. These results are aligned with the study (Smith, 2018) entitled Integrating Gamification into Mathematics Instruction. The research shows that the measure of a student's success is not limited to academics. Gamification also impacted students' social well-being, as well as lifelong skills such as social interaction, collaboration, perseverance, motivation, problem-solving, and critical-thinking skills.

Gamification is the utilization of game mechanisms to enhance problem-solving abilities and foster higher levels of involvement. The growing utilization of gamification in e-learning settings can be attributed to the fact that digital games facilitate the cultivation of problem-solving, literacy, and active and reflective thinking abilities (Gee, 2003). Furthermore, gamification has been found to increase motivation and engagement among learners, as it taps into their natural inclination towards competition and achievement (Deterding et al., 2011). Likewise, Zichermann and Cunningham (2011) defined gamification as the use of game mechanics and structures to real-world problem-solving activities. While gaming serves as the foundation of gamification, the incorporation of game components seamlessly combines it with the process of learning and teaching. This is particularly beneficial in e-learning settings where learners may lack the immediate feedback and social interaction found in traditional classroom environments.

In line with this, Kimble (2020) states that students use technology programs for several different reasons in elementary math. Gamification may not fix and meet all the desired needs of the students however; it can be used to motivate and engage students while aligning curriculum to class instruction. Teachers may use gamification to improve students' skill mastery and accomplishment levels. Along with gathering information and updating students on their progress, these activities would also involve catering skills, program alignment, and student progress tracking. These are elements that teachers could use in regular lessons in other subject areas, and this methodology could involve technology rotation.

Conclusion

The findings of the study indicate that the use of digital gamification can significantly improve students' mathematical skills, aligning with the need to leverage technological

advancements in education. However, it is acknowledged that challenges exist, particularly in a third-world country like the Philippines, where students may lack equal access to technology. Moreover, adapting to technological developments is crucial for educators, emphasizing the value of incorporating tools such as gamified teaching approaches to enhance student engagement and learning effectiveness. The statement recognizes the diversity in students' learning styles, highlighting the necessity for a flexible teaching strategy that caters to individual preferences. Moreover, a significant challenge lies in the unequal access to technology, particularly for students without reliable internet connections and smartphones. This inequality raises concerns about the equitable distribution of the benefits of digital gamification.

Likewise, the success of implementing gamified teaching approaches relies on teachers who are willing to embrace new strategies. Teachers are crucial in creating an environment conducive to effective learning, and their openness to innovation is vital for the success of the educational process. Ultimately, the goal is to provide quality and sustainable education. This requires educators to proactively explore and implement innovative teaching methods while considering the long-term impact on students' learning outcomes. In summary, while digital gamification holds promise for enhancing mathematical prowess, addressing diverse learning styles, and ensuring equitable access to technology are essential components for inclusive and effective education.

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