The Use of Gamification Approach in Teaching Science

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ABSTRACT

This study aimed to assess the effectiveness of implementing a gamification approach to the improvement of academic performance in Science to Grade IV students of Sultan Ali Dimaporo Memorial Integrated School. The data was gathered on October 2024, data were consolidated, tabulated, analyzed and interpreted using frequency and percentage, and t-test as statistical tools. This study anchored on the following theories: Self-Determination Theory (1985) by Decci and Ryan, The Flow Theory (1970) by Mihaly Csikszentmihalyi and Constructivism Theory (1973) by Jean Piaget. In relation to gamification approach for enhancing the science ability of the learners, these approaches entail that learners should be constantly encouraged to explore the world, to learn by doing especially in the discipline of science, to look at things in different ways, to discuss their world view with others and as a result continuously transform their understanding of world in light of these experiences. This study used quasi-experimental design. The numbers of respondents needed to complete this study were thirty (30); fifteen (15) students per group. Results show that both control and experimental group got "Achieved" in their pre-test. However, most of the respondents in the control group got "Achieved" in their post-test while in the experimental group, all of them got "Highly achieved." Moreover, this study found out that there is a significant difference of the pre-test and post-test scores of the control group and the experimental group. Overall, this study shows that gamified learning has a significant positive impact on education, enhancing students' academic performance, engagement, and motivation in Science education. Furthermore, future researchers may explore on the capability of the method in improving Science ability of the students.

Keywords: Gamification, Science, Science ability, Approach and Motivation.

INTRODUCTION

Gaining insight into the scientific aptitude of young children is vital for planning successful educational methods that nurture their growth in this crucial area. The early years of childhood serve as a fundamental stage in which youngsters initiate their comprehension of the natural environment, underscoring the importance of exploring their scientific potential during this developmental phase. This study seeks to examine how implementing a gamification approach influences the Science ability among Grade IV students.

Science education plays a pivotal role in fostering critical thinking, problem- solving skills, and scientific literacy among learners, thereby contributing to the development of a scientifically inclined society. In the context of the Philippines, efforts to enhance Science education have been underway, aiming to address challenges related to the delivery and effectiveness of science curricula in various educational settings (Napal, 2020).

According to SEAMEO INNOTECH, the Republic Act No. 10533, more commonly known as the Enhanced Basic Education Act of 2013, mandated in Section 5 that the curriculum shall use pedagogical approaches such as Constructivism, Inquiry-based, Reflective, Collaborative and Integrative.

According to Smiderle et al. (2020), research on gamification in education explores enhancing abilities, setting learning objectives, engaging students, and optimizing outcomes, supporting behavior change, and fostering social interaction. Studies show positive effects on engagement, retention, knowledge, and cooperation, but understanding how gamification interacts with user personality traits is limited. Games can increase the motivation of children to learn. Game- Based Learning used to enable students to engage and increase interest in the learning process while playing and engagement in the game has an affirmative learning outcome (Ismail et.al, 2020).

The implementation of gamification in Science education has been an intriguing area for many researchers as it is something familiar to students, and at the same time, it draws their interest. Moreover, it can facilitate scientific thinking compatible with scientific theories, methodologies, and learning strategies related to

education and gamification. Thus, the growing popularity combined with mixed results has further increased the need to explore the specific processes relating to education to figure out their impact (Kalogiannakis et al, 2021).

This study also aimed to assess the effectiveness of implementing a gamification approach to the improvement of academic performance in Science to Grade IV students of SADMIS, as well as to compare their Science proficiency levels before and after the implementation of gamification in the classroom. The goal was to investigate whether employing the gamification approach could potentially enhance students' Science ability.

MATERIALS AND METHODS

Research Design and Participants

This research employed a quasi-experimental method to assess how gamification affects the Science ability of Grade IV students at Sultan Ali Dimaporo Memorial Integrated School. Using a non-equivalent controlled group post-test-pre-test design, the study administered interventions to the respondents.

The numbers of the respondents needed by the researchers to complete this study. were thirty (30) students. Two sections were needed to determine the exact contribution of gamification approach to the Science ability of the target respondents; fifteen (15) students for the control group and the other fifteen (15) students for the experimental group. The pairing was based on their average grade in Science during their Grade III level. Each student per sections has the same average in Science and the decision of the chosen to be the control or experimental group was by tossing of coin. The head was the section A, represented as the control group and the tail was the section SPJ, represented as the experimental group.

Instrument and Data Gathering Procedure

The researchers first conducted a pilot testing to determine the validity of the tests. Before doing so, they submitted their manuscript to the ethics committee for assessment and evaluation. After the committee's review and approval, a certificate of approval to conduct the study was issued. A letter of permission was then presented to the school principal or head of the school to request authorization to conduct the study. Once approved, the researchers coordinated with the adviser and the subject teacher to formally inform them about the study's schedule and activities. The researchers also provided an Assent Form for the approval of the participants.

Tests were administered by the researchers. Results of the test served as the vital instruments for the data needed for this study. Five-day classes were conducted with the aid and assistance of the adviser and the subject teacher. The researchers administered pre-tests before the intervention and post-tests after the intervention that were answered by the respondents every day inside the five-day classes. There were five topics to be taught according to the curriculum guide for Grade IV Science in first grading; Recognizing Useful Materials Harmful Materials, Changes in the Materials that is useful and Harmful to the Environment, Major Organs of the Body, Body Parts of the Animals that live on Land and Water and Animal Life Cycle.

The researchers administered a pre-test to the participants before beginning the intervention. The lessons, following both traditional and gamification approaches in Science, were personally delivered by one of the researchers, with the guidance of the adviser and subject teacher. Each teaching session lasted one hour, conducted over the course of one week for both approaches. After the intervention, a post-test was given to the participants. The collected questionnaires from both groups were then gathered for analysis, evaluation, and interpretation by the researchers.

Statistical Analysis

Data was consolidated by the researchers and analyzed by descriptive means based on the variables mentioned in the different components of the study.

To further support the analysis, frequency and percentage distribution were used to clearly present the pupils' pre-test and post-test scores in both the control and experimental groups. This helped show the improvement or changes in their performance after the implementation of the gamification approach. In addition, the independent samples t-test was applied to determine whether the difference between the scores of the two groups was statistically significant.

These statistical tools allowed the researchers to systematically analyze the results and draw valid conclusions regarding the effectiveness of the study.

RESULTS AND DISCUSSION

Table 4.1. Pre-test and Post-test Scores of the Control Group (n=15).

Table: Pre-test and Post-test Results

Range Interval	Pre-test Frequency	Pre-test Percentage	Post-test Frequency	Post-test Percentage	Verbal Interpretation
12–15	1	6.7	3	20.0	Highly achieved
8–11	11	73.3	12	80.0	Achieved
4–7	3	20.0	0	0.0	Moderately achieved
0–3	0	0.0	0	0.0	Not achieved

Note: Post-test results indicate improvement in higher achievement levels.

Table 4.1 shows the pre-test scores of the control group that indicates a generally good level of understanding, with most respondents falling into the "Achieved" or "Moderately achieved" categories. On the other hand, the control group's post-test scores show an improvement compared to their pre-test scores, with a notable increase in the proportion of students achieving "Highly achieved" results. This indicates that there is some improvement in the overall performance of the control group after the intervention.

According to Thomas (2018), pre-test scores can be a quantifiable measure of the knowledge that students already possess for a particular topic. On the other hand, Majka (2024) reported that the post-test provides empirical evidence of whether the intervention has had a meaningful impact on the targeted outcomes.

Table 4.2. Pre-test and Post-test Scores of the Experimental Group (n=15).

Here’s your data converted into a clean, formatted table:

Table 4.2: Pre-test and Post-test Results

Range Interval	Pre-test Frequency	Pre-test Percentage	Post-test Frequency	Post-test Percentage	Verbal Interpretation
12–15	4	26.7	15	100.0	Highly achieved
8–11	11	73.3	0	0.0	Achieved
4–7	0	0.0	0	0.0	Moderately achieved
0–3	0	0.0	0	0.0	Not achieved

As shown in Table 4.2, the findings show that the higher proportion of "Highly achieved" scores in the experimental group in their pre-test compared to control group indicates that this group had a higher baseline level of knowledge or skills before the experiment began. On the other hand, the result indicating the frequency and percentage distribution of the students’ post-test scores of the experimental group further revealed that the experimental group demonstrate a major improvement compared to their pre-test scores, with a vast majority achieving "Highly achieved" status. This improvement was considerably greater than that observed in the control group's post-test scores, strongly suggesting that the intervention or the Gamification Approach was effective in improving the Science ability of the students.

According to Sari et.al (2018), students whose learning styles align with teaching methodologies tend to perform better academically, indicating the significant impact of learning style on academic performance.

Table 4.3. Difference of the Pre-test Scores of the Control Group and Experimental Group (n=15).

Table: Test of Significance between Experimental and Control Groups

Variables	p-value	Level of Significance	Remark
Experimental group	0.041*	0.05	Significant
Control group	—	—	—

In Table 4.3 shows that there is a significant difference between the pre-test scores of the experimental group and control group, indicating that the use of pre-test helped pupils gain a clearer understanding of the upcoming lessons.

According to Thomas (2018), Pre-tests can improve student performance, although counter-intuitive, the pre-tests are covering material that the instructor has not covered and that the student is not expected to know. The idea behind the pre-tests is to give the students an indication of material that will be covered and the depth of knowledge required, thus it serves a ‘road map’ for the topics.

Table 4.4. Difference of the Post-test Scores of the Control Group and Experimental Group (n=15). Here's your data presented in a clear table format:

Table: Test of Significance between Experimental and Control Groups

Variables	p-value	Level of Significance	Remark
Experimental group	0.01*	0.05	Significant
Control group	—	—	—

Table 4.4 shows the significant difference of the post-test scores of the control group and experimental group of the respondents. The result shows that the p-value is lesser than the level of significance. Therefore, the null hypothesis is rejected. This indicates that there is a significant difference between the post- test scores of the control group and experimental group in the 15-item test.

Based on the result, post test is the critical component of research and evaluation, serving as the means to assess the effectiveness and impact of interventions, programs, or treatments. By comparing post intervention outcomes to baseline data collected during pre-testing, researchers can determine whether intervention has produced the desired changes or improvements (Majka, 2024).

DISCUSSION

The aimed of this study was to assess the effectiveness of implementing a gamification approach to the improvement of academic performance in Science to Grade IV students of SADMIS, as well as to compare their Science proficiency levels before and after the implementation of gamification in the classroom. The goal was to investigate whether employing the gamification approach could potentially enhance students' Science ability. According to Ismael et al. (2020), Games can increase the motivation of children to learn. Game-Based Learning used to enable students to engage and increase interest in the learning process while playing and engagement in the game has an affirmative learning outcome. Game- based learning was often advocated by proponents aiming to enhance learning through heightened pupil motivation, as playing games was inherently seen as a motivating endeavor. Consequently, students can direct their focus towards engaging in various activities that they find appealing or significant. According to Bennett (2018), Gamification sustains the learner's motivation and engagement in a classroom discussion. The purpose of gamification is to make the learning process more attractive for learners and to ensure that they gain different learning experiences through a learning environment that is numerous fun activities.

On the other hand, the result of the findings strongly suggesting that the intervention or the Gamification Approach was effective in improving the Science ability of the students. According to Fuente (2019), Science Education plays a significant role in the country's economic development. It brings technological advancement, promotes national wealth, and improves health and industry. In conclusion, teachers must consider crucial aspects such as teaching materials, learning resources, and processes to provide valuable learning experiences inelementary Science education. Many researchers in the field of gamification have pointed out that numerous contextual factors influence its efficacy in education, including the content of the gamified activities and the specific demographics of the learners involved. While the literature on game-based learning has predominantly focused on primary and secondary education, gamification has primarily targeted higher education over primary and secondary levels.

Additionally, according to Bai et al. (2020) while most studies on gamification implementation have been conducted in the context of computer and information courses, research has also explored its application in other domains such as Mathematics, Literature, and Science. By incorporating gaming mechanics and elements into science lessons, gamification has the potential to overcome the obstacles faced in science education, leading to increased motivation, cognitive and metacognitive achievements, and overall student enjoyment. Unlike traditional school laboratories, gamification applications offer a safe and realistic environment for students to experiment without fear of accidents, providing a valuable learning experience. Furthermore, students are urged to take initiative, explore alternative approaches, and repeat tasks at their discretion, all while maintaining anonymity, thus alleviating their fear of failure. Additionally, the integration of gamification frequently correlates with socially interactive and constructive learning environments. As a result, students participating in gamified settings tend to exhibit increased receptiveness and eagerness to participate in similar teaching methods in the future (Tsai, 2019).

The problem with Science education is that students are not involved enough beyond school to complete their education, which means that there are fewer Science graduates and professionals with the necessary skills (Kaptan et al, 2018). These challenges are often exacerbated by teachers' lack of enthusiasm, insufficient content knowledge, and limited pedagogical skills in teaching science, which can negatively impact students' experiences. To address these issues, it's essential to improve the way students explore and comprehend scientific phenomena and concepts, fostering active and critical thinking. As a solution, there has been a significant increase in integrating gamification into science education to enhance engagement, enjoyment, and

motivation, thereby supporting meaningful activities in science education. By incorporating gaming mechanics and elements into science lessons, gamification has the potential to overcome the obstacles faced in science education, leading to increased motivation, cognitive and metacognitive achievements, and overall student enjoyment. Unlike traditional school laboratories, gamification applications offer a safe and realistic environment for students to experiment without fear of accidents, providing a valuable learning experience.

On the other hand, teaching materials simplify complex teaching tasks, and effective one's aid students in the learning process, tailored to their needs, influenced by environmental factors, technological developments, and societal culture. Regarding learning styles, theorists agree that individuals employ diverse methods to perceive, organize, and process information and experiences. Peirce defines learning style as the preferred method students use to learn lesson materials. Students whose learning styles align with teaching methodologies tend to perform better academically, indicating the significant impact of learning style on academic performance. Improving curriculum quality is a fundamental objective of contemporary education systems, with academic performance referring to students' test score averages in achieving lesson objectives. Failure to address academic underachievement and school dropout leads to societal and national losses, underscoring the importance of intervention to maintain and enhance students' academic efficiency (Sari et al, 2018).

CONCLUSION

The findings of this study concluded that the intervention or the Gamification Approach was effective in improving the Science ability of the Grade IV students. It did not just encourage the students to participate in class discussion but also it transformed their understanding in the field of Science. Overall, this study shows that gamified learning has a significant positive impact on both education and society, enhancing students' academic performance, engagement, and motivation in Science education. This approach caters to diverse learning styles and promotes critical thinking, problem-solving, and collaboration skills. Beyond the classroom, gamification fosters Science literacy, inspires interest in STEM careers, and contributes to technological and scientific progress. It also develops life skills like communication and strategic thinking, preparing students for lifelong learning and future societal contributions. On the other hand, the future researchers could explore the study psychological and generalization of the result. It strongly suggests how Gamification approach is effective in improving the Science ability of the students. Future researchers may also explore on the capability of the method in improving Science ability of students by comparing the effectiveness of Gamification Approach with other method or approaches like the Case Study Approach. In conclusion, the study contributes to Sustainable Developmental Goal 4 which is the Quality Education by ensuring inclusivity and effective teaching strategies that contribute to quality learning experiences and better educational outcomes for young learners.

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