Effectiveness of Gamification Strategy in Teaching Science

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INTRODUCTION

Today's generation is dominated by science and technology. It is essential in many industries, including education, health care, agriculture, transportation, and communication. Technology is utilized in education to inspire students to learn and to propel innovative methods of knowledge acquisition, information that acts as a catalyst for change.

To achieve optimal learning results, students should be motivated, and their learning styles should be modified as necessary. Learning style refers to the personal preference that a student brings to bear in a given learning situation; such preferences were the variable learning processes and strategies affecting personal learning outcomes. For this reason, personal learning styles were a consideration in the teacher's teaching strategy and course activity design. Teaching strategy, the motivation of curriculum design, played a critical role in the learning process. Meaningful learning was a teaching strategy, which allowed traditional curriculum design to be tuned to the learner's willingness to actively and positively face learning in order to enhance learning benefits and learning achievement.

Motivation is a key factor in what propels learning. The use of games in the classroom can increase students' motivation. The development of integrated computer, telecommunication, and internet content technologies has offered students with fantastic opportunities to learn (Lin, 2022). The game makes use of technology to make delight more widely available to pupils. In the context of the current educational process, gamification is introduced. Gamification is the incorporation of game components, primarily those from video games, into contexts that are not games in order to increase motivation and engagement in learning. It is a pedagogical strategy that favors student engagement and motivation (Flores, et al., 2022), use of game elements in domains other than games. When used in education, gamification can create a stimulating environment that, when combined with excellent teaching methods, can improve students' learning. (Ahmad, et al., 2020). Gamification is the process of actively involving and motivating audiences while employing game concepts and techniques to address issues (Adebayo Omotosho, et al., 2019). Additionally, this is not a game or a serious game, although these terms have been used interchangeably in the literature. Games are a type of complex, well-designed, structured, rule-based play that are entertaining. Games are competitive with the primary goal of winning. Many students who feel alienated by conventional teaching approaches can find some relief in the application of gamification in a pedagogical context. Furthermore, gamification is a fun way for learners to learn more quickly and effectively. There has been a lot of success for teachers who have gamified their lessons. Students not only complete their learning objectives considerably more quickly, but they also develop a greater desire to learn and engage in their classes. The decline in student motivation and engagement that the educational system is currently experiencing may partially be resolved by the application of gamification. Gamification promotes intrinsic and extrinsic motivation and it is a useful teaching tool to engage students, particularly in online environments. According to the study of Escamez gamification was innovative, engaging, and an efficient strategy to deliver curricula material; moreover, it was perceived as a fun activity. Gamification thus makes advantage of active learning in the sense of involving kids in their own education. Increasingly being accepted as an effective learning strategy used to create highly engaging learning experiences, sought to validate the effects of gamification in support of its potential to improve motivation, engagement and social influence while allowing students to immerse in experiential

learning (Zamzami Zainuddin, et al., 2020). It is not merely the use of information and communication technologies, but rather a student's increased involvement in their education that enables them to accomplish learning goals at various cognitive levels (Guilherme, et al., 2018). In the study conducted by Kavitha Palaniappan et al (2022) gamification is an engaging in video-based games, it directly shows a positive impact on individuals thinking abilities, motivational aspects and development of their emotions.

Furthermore, gamification is a way to develop students' reasoning abilities, and aspects like "environment," "fun," "technology," "pedagogy," and others are crucial to this process in order to increase students' motivation and engagement. Additionally, they believed that group learning and fast feedback were motivational factors (Tasadduq, et al., 2021). On the other hand, revolutionary practice of gamification can be used in many different situations. This discovery was crucial since virtual learning environments had to be developed; as a result, the strategy's contribution was to encourage user participation and raise motivation. Gamification activities encouraged users to engage in particular behaviors or actions. They supported the students' long-term commitment and perseverance in achieving the learning activities' objectives. Even though there have been numerous studies on this subject, gamification still has a lot of room for more investigation, particularly in terms of its effects on learner motivation (Chans, et al, 2021). Moreover, it has a favorable impact on learning performance, competency overall, and learning motivation. Students were encouraged to do better and kept interested by prizes like monetary goods and intangible feelings of success engaging in scientific inquiry activities has a favorable impact on students' academic achievement and sense of self-efficacy (Zhan, et al., 2022). In the study of Nadia Azzouz Boudadi, et al., (2020) gamification also creates dynamic environments in which people can feel the sense of progress by achieving levels. It is also a method for integrating digital game-based learning methodologies into the classroom and giving players (learners) "the sense of engagement, immediate feedback, feeling of accomplishment, and success of striving against a challenge and overcoming it". As mention by Chan, et al., 2018 that in comparison to conventional learning methods, gamification in education can benefit both students and teachers. In the classroom, information is frequently applied outside of its intended context or in ways that are inconsistent with the user's goals, whereas gamification delivers information only when it is needed. Learning through games is difficult but doable, unlike traditional education, which is centered on the lowest common denominator. Gamification in education provides pupils with constructive criticism, which might inspire them to work harder.

Moreover, one of the traits of the pupils that may influence how gamification is perceived is their perspective on video games. Gamification bases its effectiveness on the motivational benefits of videogames, but since these benefits vary from person to person, it makes sense that there would be variations in how students interact with videogames. The impacts of gamification on students' motivation were examined in relation to how frequently they played and whether they identified themselves as gamers. While some variations were discovered between the motivation of avid gamers and non-gamers, no clear conclusion could be drawn (Recabarren, et al., 2021).

In addition, social learning hypothesis places a lot of emphasis on noticing the links between other people's attitudes, behaviors, and emotional responses through ongoing reciprocal engagement. Students can increase their attention, memory, and motivation with the help of interactive curriculum design, such as game-based learning, which has a significant impact on cognition development, motivation, and decision-making (Lin, 2022). With the intention of influencing user behavior, game components have been frequently applied to applications outside of games, a practice known as gamification. Gamification has received the most research in the educational field, which is consistent with the idea that it is an educational innovation that can improve learning experiences. Accordingly, empirical data supports its beneficial impact on, for example, behavioral learning outcomes like class attendance and cognitive learning outcomes like test performance (Zamzami Zainuddin, et al., 2020).

Furthermore, given that learning a new language is challenging, gamification is seen as a valuable and effective language instruction method. This study was done to give a general overview of gamification's use and use in language learning. The findings of the study demonstrate the value of gamification as a tool for language instruction and as an additional incentive for teachers. It has been discovered that gamification might boost pupils' motivation and enthusiasm. As a result, it makes the process of learning

and teaching a new language pleasurable (Al-Dosakee and Ozdamli, 2021). According to Zehui Zhan, 2022, the results of the moderator analysis showed that higher education was more affected by gamification than K–12 education. Gamification had a modest to significant positive effect on students' academic performance, motivation, and cognitive abilities in higher education. Gamification, however, was more effective at boosting students' motivation and interest in their learning in K–12 settings, where it also put more of a cognitive strain on students than it did in higher education. However, use of gamification in a variety of contexts has been demonstrated to be a successful way to encourage people to perform tasks for which they have no enthusiasm. This approach produced a competitive environment for the participating staff and forced them to do what they had previously had no desire to do voluntarily (Kelvin Kristianto, Kerin Dela, Handri Santoso, 2018). According to research, reading battles (RBs) are effective at boosting students' enthusiasm and motivation for reading, improving their reading comprehension, and encouraging self-directed learning. By adding game features to the learning platform, such as points, e-badges, levels, and a leaderboard, Reading Battle transforms reading assessments into tasks. It also transforms paper-based reading worksheets into an interactive, demanding system that provides users with instant feedback. (Mak, Martin Ting Fung; Wang, Meng; Chu, Kai Wah Samuel, 2019).

Challenges on the Implementation of Gamification

In the study conducted by McCallister, A., 2019, there is noticeably a dearth of scholarly study on the implementation difficulties that come with gamification. Despite Gartner's prediction that 50% of gamification projects will fail because of bad design, firms still invest in gamification because they see its potential. The research into gamified systems is best done by IS researchers, according to the argument made by failed gamification implementations, which highlight the importance of design decisions and implementation processes in the launch of gamified systems. IS researchers are skilled in designing and evaluating technology systems from a variety of perspectives, including computer science, human-computer interaction, and systems design. Consequently, many pupils who feel alienated by conventional teaching methods can find some relief from it when gamification is applied in an educational setting. The decrease in student interest and engagement that the educational system is currently experiencing may be partially addressed by the application of gamification. In particular, the gamification of college course content and curricula could greatly enhance the campus environment, as well as graduate recruitment methods.

In the field of healthcare, in the study of Panote Siriaraya, 2018, could be especially challenging because different levels of motivation are frequently needed to achieve the therapeutic objectives (i.e., motivation to achieve long-term behavior change, motivation to engage with the treatment or to accomplish short-term therapy objectives, motivation to use gamification within the therapeutic procedure, etc.) and because the outcome of a gamified intervention also frequently depends on multiple stakeholders. Furthermore, it is frequently necessary to incorporate ongoing, active input from these stakeholders into the game system itself. Therefore, it is typically challenging to strike the right balance between the health aim and the attraction of games while creating gamified interventions. Additionally, since gamification is a fresh and innovative idea in higher education, it's important to comprehend its conception, application, results, and workings. Certain gamification mechanics were found to have more positive effects than others, but there were still many unanswered questions about how to frame gamification activities for the best results. They discovered that the literature on this topic was extremely diverse with regard to disciplines, gamification designs, goals, outcome measures, and theories involved (Doris Yin Kei Chong, 2019).

Furthermore, according to the study of Daniel A. Kaufmann, 2018, some students may become distracted by the challenges they confront in online learning programs and lose sight of the regular resources that students in a typical campus setting would have access to. These forms of assistance include interacting with classmates, having direct conversations with teachers, feeling at ease raising concerns of various significance, and developing one's own identity as a student. The pursuit of a degree can occasionally come at the expense of certain structures that support the development of this identity because there is a psychological disconnect between the factors that drive people to pursue activities in other spheres of

their lives (such as work, family, etc.) and the factors that drive them to finish their academic assignments. This choice's outcome, which has a significant impact on students' general participation in the classroom, can be altered by offering a learning incentive. Doing so could close this gap and increase student satisfaction and success. The faculty member is the first point of integration in the e-learning environment, much like with many other online resources. As mention by Ding, Lu; Orey, Michael (2018), negative outcomes have also been documented compared to students in the non-gamified group, individuals in the gamified group exhibited higher levels of empowerment, motivation, and contentment. The primary cause may be the gamification approach's sensitivity to slight adjustments made to its execution. Gamification is a methodology that integrates multiple game components; the success of a gamified learning exercise much depends on how each component is applied. Therefore, while describing the outcomes of the gamification technique, is it required to include a comprehensive and exhaustive design section. It will be more difficult for others to fairly assess the efficacy of the strategy if studies do not provide enough detail on the gamification design.

However, gamification has the potential to enhance both the volume and caliber of data, providing additional insights into how students are learning. This study also determined the main gaming components that are now employed in science teaching. Although it is debatable, scientific education frequently uses the competitive atmosphere strategy to counteract students' negative feelings and experiences and improve learning outcomes. The three main learning outcomes that were shown to be most impacted were social interaction, learning accomplishments, and motivation and engagement (Kalogiannakis, Papadakis, and Zourmpakis, 2021).

Gamification is effective in different aspects like education, health care, language, it is an engaging and key factor for motivation in learning. This motivates the researcher to study the effectiveness of gamification strategy in teaching science among Bachelor in Elementary Education students.

The study aims to determine the effectiveness of Gamification Strategy in Teaching Science. Specifically, the study seeks answer to the following questions. (1). What is the pre-test and post-test scores of controlled and experimental groups? (2). Is there a significant difference between the pre-test and post-test of the controlled and experimental groups? (3). Is there a significant difference between the post test scores of controlled and experimental groups?

Null Hypothesis

The following hypothesis will be tested in the study

On the difference between pre-test and post-test scores of controlled and experimental groups

H_0 there is no significant difference between the pre-test and post-test scores of controlled and experimental groups.

H_1 there is a significant difference between post-test scores of controlled and experimental groups.

On the difference between the post test scores of controlled and experimental groups

H_0 there is no significant difference between the posttest of controlled and experimental groups

H_1 there is a significant difference between the posttest of controlled and experimental Groups

Scope and Limitations

The study was conducted particularly in Bohol Island State University-Bilar Campus, Zamora, Bilar, Bohol, specifically the second year students of the College of Teacher Education.

To mention on limitation of the study the gamification strategy in teaching science was used only for Bachelor in Elementary Education second year students. Due to limited time and hectic schedule, the

gamification strategy was not well implemented to all colleges and other universities. The gamification strategy was implemented to the second year Bachelor in Elementary Education students because the topic used for the strategy can be found in their curriculum and limited time served as a hindrance of the inclusion of a wider scope.

In order to complete this article, the researchers examined the theories that were frequently used in gamification investigations. These were some of the most important hypotheses that back up the claim that gamification would improve learning results. These ideas suggest variables that could be used to forecast learning outcomes. The study was anchored on the following theories:

A. Self-Determination Theory.

As stated by Sridevi Nair, Jain Mathew, 2018, The Self-determination Theory or SDT was one of the first macro theories that linked motivation, development and wellness. Autonomous motivation is concerned with both intrinsic motivation and the kind of extrinsic motivation that results from the conviction that the activity has value. This type of drive would result in "self-endorsement" of the endeavor. On the other hand, controlled motivation results from the anticipation of consequences or rewards, or from the need for approval, the desire to avoid humiliation, the need for self-esteem, and ego-related outcomes.

B. Experiential Learning

Sridevi Nair and Jain Mathew, mentioned Kolb about the theory of experiential learning draws from the works of prominent scholars like Jean Piaget, John Dewey, Carl Jung and others, it combines the work of the scholars to provide a holistic and dynamic model of learning. Experiential Learning Theory (ELT) was utilized and first observed in academic learning in the classroom. The model's effectiveness in the academic environment has resulted in acceptability and use in additional contexts, such as organizational training

C. Input-Process-Output Model

This model was proposed by Garris et.al. and mentioned by Sridevi Nair and Jain Mathew. They proposed that the main aim of any training intervention was a motivated learner. Researchers are trying to comprehend how a motivated learner is made. Try to comprehend how to develop motivated learners. Studies have disagreed over whether to concentrate on intrinsic motivation or extrinsic motivation because people can be motivated in both ways.

D. Kraiger's Model of Course Performance

As per Kraiger (2003), there are only three determinants of the outcome of a learning process. The first one has to do with the trainee's motivation or willingness to engage in the training. The learner's trainability or teachability is discussed in the second. This reflects a range of learner traits like intelligence, concentration, etc. These are the participants' more distinctive personal qualities. The learning environment is represented by the final factor. Opportunity is the term used to describe the time and money put into the learning process.

E. Theory of Gamified Learning

According to Landers in the study of Sridevi Nair and Jain Mathew, instead of developing an entirely new set of definitions, taxonomies, models, and frameworks when two concepts are very similar, it is necessary to recognize what makes them unique and consider how the concepts might be connected. This idea was founded on the principle of parsimony as it related to research in science that suggests "many theoretical. When a single construct would enough, constructs should not be employed suffice".

RESEARCH METHODOLOGY

The study utilized quasi-experimental research design with two groups: an experimental group and a

controlled group. The experimental group received gamified learning strategy using (Kahoot), while the controlled group received traditional teaching strategy. The study involved Bachelor of Elementary Education students at the Bohol Island State University-Bilar Campus. Kahoot is an online game-based learning platform. It has learning games, also known as "kahoots", which are user-generated multiple-choice quizzes that can be accessed via a web browser or the Kahoot. A sample of 35 students were selected using purposive sampling, ensuring representation from different proficiency levels and learning styles. The subject where gamification implemented was the TSci-2 (Teaching Science in the Elementary Grades) with the topic Earthquakes focusing its subtopic like Divergent, Convergent, and Transform Boundaries and the Body Waves.

How to conduct

Plan the scaffolding, Intervention, or remediation. The experimental group was engaged in teaching science session that incorporate the gamified learning strategy, which includes visual aids, canva, power point presentation, understanding by design and other intervention. The gamified learning strategy utilized different games about earth's four sphere, and the earth's layer. The control group followed the traditional teaching approach, which may include (lectures, drills, and repetitive exercises). Developed a curriculum or lesson plan that incorporates the gamified learning strategy, including visual aids, oral graded participation, and interactive exercises. Created materials and activities that utilized gamified learning strategies to enhanced focused, concentration, motivates the students, understand and comprehend the lesson.

Duration of the study. The study was conducted during pre-final term to provide sufficient time for the intervention and assessment.

Determine the Control and Experiment Group. Control Group: BEED 3 – Section A students followed the traditional teaching strategy. Experimental Group: BEED 3 – Section B student received the scaffolding intervention using the gamified learning strategy.

Determine the sample size of each group, and sampling technique. Determine the desired sample size for each group based on the available population and resources. Complete enumeration technique or other appropriate methods to assign students to the control and experimental groups.

Administer the Pretest. The researcher conducted a pretest before implementing the intervention to assess the initial scores of both the control and experimental groups

Record the pretest scores of both groups. The researcher recorded and documented the pretest scores of the control and experimental groups for comparison

Implementation the scaffoldings, intervention, or remediation to experimental group. Deliver sessions to the experimental group using the gamified learning strategy as planned in the curriculum or lesson plan.

Session	Control Group	Experimental Group
1	Pretest Enabling Assessment: 30 items	Pretest Enabling Assessment: 30 items
2	Lecture without gamification Topic: Lesson 1. Divergent, Convergent and Transform Boundaries	Lecture with gamification Topic: Lesson 1. Divergent, Convergent and Transform Boundaries
3	Lecture without gamification Topic: Lessin 1. Body Waves	Lecture with gamification Topic: Lesson 1. Body Waves
4	Post-test	Post-test

Conduct the assessment/Evaluation. The researcher administered a post-test or midterm/final examination to assessed the scores of both the control and experimental groups.

Record the Post-test scores of the both group. Recorded and documented the post-test scores of the

control and experimental groups for comparison with the pretest scores.

Compute using test statistics, and analyze the results. Used appropriate statistical test (t-test) to analyze the pretest-post test scores and determined the significance of the differences between the control and experimental groups.

Document the result of scaffolding, intervention, or remediation. The researcher summarized and documented the findings of the study, including the impact of the gamified learning strategy for student engagement and learning outcomes.

Share result. The researcher prepared a research report or presentation to share the results with relevant stakeholders, such as the BEED department, faculty members, and administration, highlighting the effectiveness and potential benefits of gamified learning strategy in teaching science in Bohol Island State University Bilar Campus.

Ethical Considerations. This study abode by the ethical standards, guaranted voluntary participation, informed consent, and confidentiality. Before receiving their agreement, participants were given comprehensive information about the study and its goal. The identified data of participants made anonymous to ensure confidentiality. Additionally, the study adhered to applicable ethical standards and secure the required approvals from pertinent organizations or authorities.

RESULTS AND DISCUSSION

Table 1.1 Students' Result in the Pretest Scores on Gamified learning N=35

Scores	Experimental		Control	
	Frequency	Percentage %	Frequency	Percentage %
0-17	30	86	20	57
18-21	5	14	13	37
22-24	0	0	2	6
25-27	0	0	0	0
28-30	0	0	0	0
Total	*35*	*100*	*35*	*100*

This table described the scores both the experimental and control during the pretest. It was found out that most of the scores was under 0-17 with a frequency of 30 (86%) for experimental and 20 (57%) for the control group. None got 28-30 from both groups as the highest score. However, the result was in contrast to the study of Ozdamli, et al., 2021, that demonstrate the value of gamification as a tool for language instruction and as an additional incentive for teachers. It has been discovered that gamification might boost pupils' motivation and enthusiasm. As a result, it made the process of learning and teaching a new language pleasurable (Al-Dosakee, K., & Ozdamli, F., 2021).

Table 1.2 Students' Result in the Posttest Scores on Gamified learning N=35

Scores	Experimental		Control	
	Frequency	Percentage %	Frequency	Percentage %
0-17	5	14	6	17
18-21	6	17	9	26
22-24	14	40	14	40
25-27	9	26	6	17
28-30	1	3	0	0
Total	35	100	35	100

In this table, it revealed the posttest scores of the two groups experimental and control. For experimental a frequency of 1 (3%) got a score with a range of 28-30; for the control group a range of 25-27 has a frequency of 6 (17%). While both with a score range of 22-24 got 14 (40%) for experimental and control

group. The result agrees on the study of Kristianto, et al., 2018, that gamification had a modest to significant positive effect on students' academic performance, motivation, and cognitive abilities in higher education.

Table 2. Difference between Pretest and Posttest on Gamified Learning N=35

	t	df	Sig.	Decision	Interpretation
Control	-9.079	34	0.000	Reject the H_0	Significant
Experimental	-10.201	34	0.000	Reject the H_0	Significant

Table 2 showed the difference between the pretest and posttest of the two groups experimental and control. The t-value of the control group is -9.079 while -10.201 for the experimental group where both are significant which is 0.000 is lesser than the p value that is 0.05.

Table 3. Difference between Posttest on Gamified Learning N=35

	t	df	Sig. (2-tailed)	Decision	Interpretation
Control **Experimental**	0.779	68	0.439	Accept the H_0	Insignificant

Table 3 was the result on the difference between the posttest of the experimental and control group that it has no significant difference. This indicates that to both experimental and control gamification is effective. This is being justified by Recabarren, M. et al., 2021, about the impacts of gamification on students' motivation were examined in relation to how frequently they played and whether they identified themselves as gamers. While some variations were discovered between the motivation of avid gamers and non-gamers.

CONCLUSION

Therefore, the study concluded that gamification among the Bachelor of Elementary Education teaching Science is effective. Students can learn and gain knowledge even with or without gamification being applied.

RECOMMENDATIONS

With the aforementioned findings and conclusions, the researcher had came up with the following recommendations:

1. Gamification strategy was effective and a powerful tool for increasing engagement, motivation, learning outcomes and retention and be used for teaching to elementary learners, through gamification one may learnt in an engaging classroom environment and boosted interest to the young in the future.
2. Gamification as a teaching approach can be successfully integrated into the science curriculum and deployed.
3. The researcher recommended that the result of this study be used as a reference for future researchers and refinement of the findings who will conduct related studies covering other variables.

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