ISSN: 2584-0231(Online)
International Journal of Multidisciplinary Research in Arts, Science and Technology
© IJMRAST | Vol. 3 | Issue 8 | August 2025
Available online at: https://ijmrast.com
https://doi.org/10.61778/ijmrast.v3i8.167

GAMIFICATION AS A TOOL FOR ENHANCING LEARNERS' OUTCOME AND MOTIVATION

Renato A. Tiria Jr.[1*], Viernalyn M. Nama[2]

[1]Graduate School, University of Perpetual Help System - Dalta, Las Pinas, Philippines

[2]Graduate School, University of Perpetual Help System - Dalta, Las Pinas, Philippines

[*]**Corresponding Author Email Id:** renato.tiria@gmail.com

ABSTRACT

This research investigated the effects of gamification in improving academic performance, self-efficacy, engagement, and motivation of Senior High School (SHS) Biology students. It was prompted by perennial problems in science education in the Philippines, such as resource deficit, lack of technology use, and decreasing students' motivation toward difficult concepts in biology. Adopting a mixed-methods sequential explanatory design, the study focused on the positive influence of gamified lessons with video game mechanics (points, badges and leaderboards) on the learning experience of students. Quantitative surveys used in conjunction with qualitative FGDs give rise to a detailed examination of the effect of adopting gamified learning strategies on students' confidence whilst participating in school and their motivation towards biology. Results from the quantitative data collected from 52 Grade 11 STEM students showed beneficial points of impact of gamification on self-efficacy, specifically mastery experiences and social persuasion. Students also showed greater confidence in addressing challenging biological ideas, as they scored better on post-intervention tests. In addition, gamified learning enhanced engagement and motivation because students perceived lessons as more interactive and fun. The qualitative results added to the richness, such as students describing that gaming lowered their anxiety, increased collaboration, and made daunting topics (as photosynthesis and cellular respiration) more accessible and enjoyable. Themes emerging from the qualitative phase emphasized increased confidence through mastery, reduced stress through playful learning, and sustained motivation by fostering both individual achievement and group collaboration. The results of the study shed light on the significance of developing contextually appropriate educational gamification interventions, suited to the diverse contexts and issues of the learners. It showed that gamification is not a trend, but a teaching method that works both cognitively as well as emotionally. The study's implications, beyond the benefit to students' learning, are also meaningful for teachers, curriculum developers, and educational policymakers. Teachers can leverage gamification to promote positive learning environments, and administrators and policymakers are urged to integrate gamified approaches into more extensive educational reforms. The development of gamification being ongoing, future studies may focus on long-term effects of gamified intervention across differing academic domains and samples and ascertain whether gamified education is also fair and effective for different learning fields.

Keywords: *gamification; self-efficacy, engagement and motivation*

I. Introduction

Over the past few years, gamification has evolved into a powerful tool for altering traditional educational settings to become more interactive and engaging. It is the application of video game design elements like points, badges, levels, leaderboards, and reward systems within a context that is not a game, such as the classroom. As a result, there is this added strategy to education, where games' innate motivating and engaging elements are put into use to stimulate students' other academic subjects (Deterding et al., 2011).

Incorporating gamified activities in topics such as mathematics, language, and science has shown remarkable progress in students' understanding of difficult concepts while also helping them develop a positive attitude toward learning (Hamari et al., 2014). In addition, the interactive and stimulating nature of gamification has shown extraordinary results in STEM (Science, Technology, Engineering and Mathematics) faculties, where new and innovative ways of teaching are often required to cope with difficult and abstract ideas.

Schools have introduced advanced and extremely demanding courses such as molecular biology, genetics, and ecological systems to students in senior high school. The subject matters mentioned here encompass higher-order thinking skills and the graphical comprehension of a defined level. With these prerequisites, students often get demotivated, or worse, frustrated. The concepts and the graphical analysis involved force the students to zone out of the learning process. With that said, students in the Philippines are provided a K-12 biology course as part of their curriculum and are required to master the fundamental concepts, as biology is required for students who want to enter into health science, environmental science, and biotechnology, which are relevant in boosting the economy of the country. The most crucial question is, what can we do about these challenges? The answer is new pedagogies. Learner engagement and an improvement in content knowledge are two key behavior that need to be changed to overcome these three challenges.

Statement of the Problem

This study aimed to investigate how gamification can enhance learners' outcomes and motivation. It addresses the need for empirical evidence on the effectiveness of gamified learning, particularly within the context of Philippine education, where such innovative approaches remain unexplored. Specifically, it sought to answer the following questions:

1. To what degree does gamification influence students' self-efficacy in studying senior high biology in terms of
    - 1.1. Mastery Experiences
    - 1.2. Vicarious Experiences
    - 1.3. Social Persuasion
    - 1.4. Emotional and Physiological States?
2. Is there a significant difference in self-efficacy among students after the use of gamification?
3. To what extent does gamification enhance students' level of engagement and motivation in senior high school biology class?

4. Is there a significant difference in the level of students' engagement and motivation after gamification?

5. What meanings may be formulated based on the most significant experiences of senior high school students on the use of gamification?

6. What themes emerged from the experiences of the students in the use of gamification?

7. What gamified activities are made for the Biology lessons?

Hypotheses

The following were the hypotheses of the study tested at $\alpha = 0.05$:

Ho1: There is no significant difference in the influence of gamification on students' self-efficacy in terms of:

a. Mastery Experiences

b. Vicarious Experiences

c. Social Persuasion

d. Emotional and Physiological States?

Ho2: There is no significant difference in the level of engagement and motivation among the senior high school students after gamification.

II. Related Studies

Nature of Gamification

Gamification is the incorporation of game-based design elements into activities that are not traditionally classified as games. Gamification has grown to be a very useful approach towards improving user participation in marketing, education, health and even others. This type of technique leverages the engaging nature of games to encourage user participation and enjoyment, thus accomplishing the target goals in non-gaming situations (Alhammad and Moreno, 2018; Nguyen and Meixner, 2019). The self-driven motivation from the gamified approach can accelerate user engagement as well as behavioral actions, and in the long term, their overall satisfaction with the service (Fadzillah et al., 2023; Silic et al., 2020).

One of the major benefits of gamification is the opportunity to make monotonous tasks more fun and bearable. For instance, users' psychological needs like competence, autonomy, and relatedness have been met through gamification in online learning, resulting in increased engagement levels (Shrestha et al., 2021). As long as users are made to feel competent and purposefully energized, they will immerse themselves in the learning process, and the outcomes will be very positive.

The use of gamification has increased in many fields, including finance and stress management, which improves audience participation and satisfaction with the use of tools such as points and badges (Raza et al., 2023). The use of leaderboards and virtual rewards is meant to create a challenge that increases user interaction with the service content (Balci et al., 2022). The same applies to mobile applications, as the newer technologies make it easier to use gamification for improved user experience (Fadzillah et al., 2023; Rakhmanita et al., 2022).

Not every target group, situation, or user responds to gamification in the same way. Clusters of users can be expected to have different attitudes towards different gamification mechanisms, which implies that an approach that is too general is not feasible should be avoided (Koivisto and Hamari, 2019). This strategy can be made more precise and accurate by elaboration of user types and incorporation of targeted gamification elements (Neave et al., 2019). In this case, even if gamification is a very attractive target, it is important to design it in such a way that it still lies within the interest of the intended user; otherwise, it can have counterproductive results (Kelders et al., 2018).

Gamification incorporates game aspects in order to increase user participation in non-game activities such as online discussions. This is a widely accepted theory since incorporating gamification, many areas have undergone intensive engagement to study users' behavior. The designs and attitudes of the users and their context are what are more important for the proper or optimal use of gamification than the elements or areas that can engage users.

Gamification in the Field of Science Education

Gamification in science education is one of the most powerful approaches that seeks to improve students' interest, engagement and learning achievements. Through the inclusion of game-like elements, science-based activities in the curriculum can be made more fascinating and enjoyable that results in better outcomes. Macayan et al. (2022) point out that online game-based activities can be very well utilized in science education as they are sociocultural and educational tools that enhance the quality of the teaching-learning process. These ideas are consistent with those shared by Ismail et al. in who the latter has argued that certain gamification techniques can prove to be effective in motivating students and achieving good performance in science subjects, especially in cases where students tend to lack motivation and comprehension (Ismail et al., 2021).

This finding on the effectiveness of gamification in increasing student motivation and participation towards subject matter is confirmed by Hürsen & Bas (2019) as who claimed that gamification practices address the gap in students' motivation and participation in science classes. Their studies imply that gamification can improve students' interest as well as their willingness to participate in various activities involving science. This is also supported by (Botes, 2022), who affirmed that interactive educational board games can serve as an important supplementary resource in science learning since games are fun and can enhance the students' interest in science concepts.

Moreover, effective design is important in the creation of educational games. According to Öner et al. (2024), educational games need to be managed using serious concepts and should not forget the necessity of being mentally stimulating but easy for a wider scope of users. Ateş & Polat (2025)and Öner et al. (2024) shared the same idea by expressing the significance of engagement when integrated in a game-style approach for learning, stating that game-based experiences can enrich the learning of science in many ways, such as improving knowledge and fostering a scientific attitude.

The literature also points toward the attention that should be paid to the elements of competition in gamification. Competition, as Huizenga et al. (2017) observed, may serve to motivate learners, but not

necessarily all of them. Learners' varied expectations and responses to educational engagement through games are important in achieving better educational objectives.

Alahmari et al. (2023) and Kalogiannakis et al. (2021) have conducted systematic reviews where they present the advantages of using gamification strategies in science teaching as one way to address the lack of interest in students and encourage them to think scientifically. Such evidence demonstrates the need for the use of gamification as part of teaching strategies in science classes.

It has emerged that gamification is an effective tool that can be utilized to improve science education by increasing the level of interest and understanding of science concepts that learners acquire. The results of these studies emphasize the fact that a great deal of attention needs to be paid when designing and implementing gamified approaches to learning.

III. METHODS AND MATERIAL

Research Design

The research design used a mixed-methods sequential explanatory approach, which spanned two distinct phases. The first phase used a quasi-experimental post-test design to evaluate how a gamified Biology curriculum affected student engagement and motivation, and interest levels. Students received gamified tasks before taking a post-test to measure their shifting learning perspectives. The second research phase collected qualitative data through semi-structured interviews and focus group discussions to understand students' emotional responses and perceptions about gamified learning.

The research combined quantitative and qualitative data to create a complete understanding of gamification's effects. The research design enabled the investigators to assess learning results while studying how gamification affected students emotionally and behaviourally, which provided a complete understanding of its impact on Biology motivation and engagement and interest.

Research Locale

The research took place at Elpidio Quirino High School located in Bacood, Sta. Mesa, Manila , under the Senior High School Department. The researcher's current workplace provided practical benefits because of their familiarity with the curriculum and available resources. The school operates in Manila's 6th district and provides the STEM strand, which teaches Biology, Chemistry, Physics and Mathematics to prepare students for college and Science, Engineering and Technology careers.

Population and Sampling

A non-probability purposive sampling technique was used to select intact STEM classes because they were the most relevant to the study objectives. Fifty-two students participated in the quantitative phase, providing data through questionnaires on self-efficacy, motivation, and engagement. For the qualitative phase, eight students were purposively chosen based on the following criteria: completion of the questionnaires, active participation in gamified classroom activities, completion of performance tasks and quizzes, and willingness to be interviewed with informed consent. Performance levels further categorized these students: three were classified as high-performing with strong participation and high scores, three were

moderate performers with average engagement and mixed results, and two were low-performing, showing limited engagement but still involved in gamified tasks. Interviews and focus group discussions with these participants offered deeper insights into their varied experiences and perceptions of gamified learning.

Research Instrument

Students evaluated their self-efficacy across four dimensions—mastery experiences, vicarious experiences, social persuasion, and emotional and physiological states—using a five-point Likert scale questionnaire while also assessing their engagement and motivation in learning Biology.

The research collected qualitative data through semi-structured interviews and focus group discussions , which took place after the gamified learning cycle. Students used these tools to share their thoughts about their experiences , which provided understanding about how gamification affected their motivation and participation and their overall attitude toward Biology. The eight-participant focus group discussions allowed students to share their thoughts while examining group interactions. The research questions were designed to match the quantitative components to achieve both consistency and better comprehension of the study's research goals.

The research instruments underwent validation by three master teachers to ensure the reliability and validity of the research instruments. The interview and focus group discussion procedures included structured questions but gave participants the chance to share their thoughts freely. Qualitative data analysis employed thematic analysis to discover recurring patterns that existed in student responses. The analysis of coding and theme identification received support from Atlas.ti25 software , which assisted in data management and improved the accuracy of interpretation. The data revealed themes about test difficulty and conceptual understanding , as well as motivation and perceived value of gamified lessons, which provided a complete understanding of how gamification influenced Biology student learning.

Gamification of the Lessons

The gamified lesson development started by setting specific learning objectives that matched the curriculum requirements. The objectives established the target student achievements that students needed to reach before the lesson ended. A suitable subject that supported active student engagement through game-based learning was chosen after establishing the learning objectives.

The game structure required the creation of a narrative that connected to the lesson material. The gameplay structure included an opening sequence followed by a peak point, and a concluding section, which contained rules and tasks that guided the game. Students could earn points, receive rewards, and progress through different achievement levels. RPG Playground enabled the creation of a game that used interactive maps and assigned scientists and explorers as characters with powers related to biology subjects, including photosynthesis and respiration. The game developers created quests and challenges that supported critical thinking while reinforcing content as the game advanced.

The game incorporated assessment features that required students to answer questions to advance through the story. The game underwent testing and face validation before classroom implementation to verify its operational functionality and clear instructions and learning goal alignment. The feedback from testers

allowed the development team to improve both the gameplay mechanics and educational content. The game received validation before its classroom introduction, which started with a detailed explanation of objectives and rules, and character roles, while promoting teamwork for problem-solving and biology concept understanding.

Data Gathering Procedure

The data collection method employed in this study was done in a structured manner. It included securing permissions, developing and implementing the research instruments, as well as collecting and analyzing data.

Statistical Treatment

The analysis of self-efficacy, engagement, and motivation after the gamified intervention started with descriptive statistics, including the calculation of means to determine the average scores for each variable and standard deviations to assess the variability of student responses. This provided a general view of how students perceived the intervention and whether their experiences were consistent or varied. To assess the statistical significance of the changes, a one-sample t-test was used. This test compared the post-test scores against a zero-based reference point, with the null hypothesis stating that there was no effect from the intervention. A significant result would indicate that gamification had a measurable Impact on student outcomes. The calculation of t-scores allowed for determining whether the observed changes in self-efficacy, engagement, and motivation were statistically meaningful.

Ethical Consideration

The research maintains absolute ethical standards regarding participant consent and confidentiality, and privacy protection. The research needs approval from school authorities, including the Division Superintendent and Principal, before data collection to verify policy compliance. The research authorities will receive non-identifying general summaries of findings that protect participant anonymity.

IV. RESULTS AND DISCUSSION

The following are the results of the study based on the presentation of the statement of the problem:

Degree of Gamification in Influencing Mastery Experience

Table 1 shows the level of gamification impact that is influenced by students' self-efficacy in studying senior high school Biology, particularly mastery experience. In this study, the utilization of gamified learning elements consistently contributed to facilitating the creation of mastery experiences for students. The implications for this set of results show an aggregate mean of 4.03, a category that is in the "Effective" score range. This indicates that, in general, students believed that the gamified Biology instruction provided significant contributions to their confidence and perceived competence.

The item that generated the greatest level of agreement, with a mean score of 4.23, was that students strongly agreed that gamification aided in their understanding of more complex Biology content. This suggests that gamification was actually more than a motivator; it was creating the structure, scaffolding, and support, helping students work through the cognitive complexity of the content. According to Wang et al. (2022), in the case of video games and game-based learning environments, cognitive load can be reduced by means of visuals, feedback loops and chunking.

Table 1. Respondents' Assessment on the Degree of Gamification Influencing Students' Self-Efficacy in Studying Senior High Biology in terms of Master Experiences

Indicators	Mean	VI
1. Participating in activities that are supplemented with gamification gave me better competence in the biology concepts.	4.15	E
2. Now, can I apply the biology knowledge learned in the works that are augmented with gamification	4.06	E
3. I have also observed that the activities which are blended in the world of gaming aided me in understanding more challenging topics in biology.	4.23	HE
4. Doing biology-related activities in the gaming format has improved my ability to deal with biology issues.	4.10	E
5. Gamified activities have greatly assisted me in my biology self-tests, and I will now perform better.	3.94	E
6. I improved even further in biology through the highly engaging and interactive nature of the gamified activities.	3.92	E
7. Affiliated activities enabled me to grasp the more fundamental elements of the subject matter in biology.	3.90	E
8. My increase in knowledge regarding biology facts and concepts can be associated with the benefits attained from engaging in gamified activities.	4.17	E
9. II was also able to refine my biology skills with the help of the gamified activities.	4.10	E
10. Due to my exposure to gamified activities, I am ready to tackle more advanced aspects of biology.	3.75	E
Composite Mean	4.03	**E**

****Legend: 4.21-5.00-Highly Effective; 3.41-4.20- Effective; 2.61-3.40 – Moderately Effective; 1.81-2.60 –Slightly Effective; 1.00-1.80 – Not Effective*

These dynamics serve to support student learning, especially in difficult STEM topics, by providing them with repeated exposure to challenging material in low-stakes activities that are conducive to exploration and practice. The second-highest rated, with a = 4.17, was a form of gamified learning that increased student knowledge of biology facts and concepts perceived by students themselves. This is supported by Subhash and Cudney (2018), who noted that gamification enhances students' conceptual learning through the students' repetitive practices, engagement and adaptive learning paths. Gamified lessons create a more fluid, narrative-rich environment to learn and help students remember what they have learned. On the other hand, immediate feedback of the gamification entails that when the student fails are corrected, so it is made in between, clarification of the concept and reflection on the explanation. (López-Belmonte et al., 2020).

Some items had a mean between 4.06 and 4.15, suggesting that students were increasingly confident and more confident in applying biological knowledge and problem-solving tasks due to the improved instruction. This knowledge indicates that students didn't learn mere facts but that they applied this knowledge to higher-order thinking. For instance, the statement "doing Biology activities in the game format assisted me in dealing with biology problems" (M = 4.10) supports Alsawaier (2018), that game-based learning leads to analytical thinking by putting the learner in situations that would demand critical thinking and application of past knowledge.

Similarly, the self-assessment promoting performance (M = 3.94), continuous improvement (M = 3.92) and readiness for more advanced content (M = 3.75) factors could also be rated as positive to a somewhat smaller degree. These findings suggest that students recognized that gamification supported the development of their understanding and problem-solving skills; however, they were somewhat skeptical of the use of the experience to self-assess and predict successful learning of future advanced topics. But that's within the "Effective" category, so overall, a net positive. The implementation of gamification systems in learning environments enhances self-regulated learning through reward systems and real-time feedback, which motivates learners and keeps them engaged while promoting goal-setting and reflective practices. (Alhalafawy and Zaki, 2022). Therefore, the lower scores may indicate the possible need for structured reflection tools/ debriefing procedures following gamified activities.

Degree of Gamification in Influencing Vicarious Experience

Table 2 illustrates the degree of gamification influencing students' self-efficacy in studying senior high biology in terms of vicarious experience. Vicarious Experience Table 2 tabulates the respondents' perception of the effects of gamified learning on students through vicarious experience learning on studying Senior High School Biology. It refers to the increased confidence in their competencies from observing the successes and imitation of behaviors in learning environments (Schunk and DiBenedetto, 2020). The findings also indicate overall high ratings for perceived effectiveness, with a composite mean score of 4.14, classified as being Effective according to the study criteria.

The top-rated item (M = 4.29) showed that "observing classmates succeed in achieving a goal in the simulation game" effectively increased students' self-efficacy beliefs. This finding highlights the motivational value of peer modeling and social comparison, particularly in a playful learning context.

According to Zainuddin et al. (2020), gamified platforms offer visual feedback and peer accomplishments as motivational scaffolds, enabling students to internalize success through observation of others they witness already succeed.

This was closely followed by others' success in gamified activities, causing students to believe that they could be successful in gamified activities (M = 4.19). These are indicative of the essentiality of social learning theory, where learners develop their estimation of their abilities on the basis of the observed performances of others in common contexts. (Artino, 2012; Zhao, 2016). This suggests that not only can gamification lead to an engaging environment, but it can also help create a community of learners who promote confidence-building and peer encouragement.

Signals, like seeing other students complete challenges (M = 4.13) and seeing classmates play games in biology (M = 4.10), attest to this dynamic. This is in line with the previous work of Alhammad and Moreno (2018), highlighted the visibility of peer success in game-based learning environments, increasing students' sense of attainability of learning goals. Furthermore, gamification is naturally designed for collaboration, competition, and social interaction, which is important for enhancing vicarious learning.

Other positive responses, such as peer use of strategies (M= 4.04) and confidence built through observation (M= 4.08), similarly support the idea that game-based environments facilitate the modeling of strategies and reflective thinking, contributing to students' beliefs that they can master biology content. According to Wang (2015) and Wang et al. (2022), peer-influenced learning in gamified learning environments increases deep-level learning does not enhance just content retention; it also promotes resilience and adaptive learning strategies.

Table 2. Respondents' Assessment on the Degree of Gamification Influencing Students' Self-Efficacy in Studying Senior High Biology in terms of Vicarious Experience

Indicators	Mean	VI
1. Watching my colleagues perform well in the biology activities with game elements made me consider that I, too, would do well.	4.15	E
2. Watching my classmates engage in the gamified biology activities spurred me on to do better.	4.10	E
3. I get encouraged when I see other students working on challenging tasks in biology during the game elements.	4.13	E
4. Seeing my peers perform well in the gamified challenges made me believe I could too.	4.13	E
5. Seeing my classmates achieve a goal in the simulation game made me believe I would be able to do the same.	4.29	VE
6. Observing my peers as they worked on biology problem-solving activities during the gamified approach made me more confident.	4.08	E
7. I applied the methods used by others in overcoming problems in the gamified biology activities.	4.04	E
8. My classmates participating in the gamified biology activities made me want to engage as well.	4.23	VE
9. I became more confident after watching other students work on the gamified tasks in biology.	4.10	E
10. Those succeeding in the gamified activities made me believe I can succeed as well.	4.19	E
Composite Mean	4.14	**E**

****Legend: 4.21-5.00-Highly Effective; 3.41-4.20- Effective; 2.61-3.40 – Moderately Effective; 1.81-2.60 –Slightly Effective; 1.00-1.80 – Not Effective*

Even when the lowest mean score (M = 4.04) is considered and still meets the mean "Effective," this means there is room for growth in encouraging peer collaboration and reflective debriefing in the context of gamified biology lessons. Organized situations where students express how they approach problems and succeed in them might enhance the vicarious benefits of such activities.

The findings further demonstrate the importance of vicarious experience in gamified instructional scenarios. Watching other students succeed, becoming involved, and solving challenging tasks helps students have more confidence in their biology skills. Such results provide strong support for the

implementation of gamified social, interactive, peer-visible, and achievement-oriented elements in science education instructional design.

Degree of Gamification in Influencing Social Persuasion

The results in Table 3 disclosed the effect of social persuasion on the self-efficacy of students to learn Senior High School Biology in the gamified learning environment, with a composite mean of 3.99. These aspects of self-efficacy were most directly related to teacher support, peer feedback, and positive reinforcement, and all three influenced learners' confidence, engagement and motivation to work on biology tasks.

The greatest mean was evident for teacher praise and the number of students selected for inclusion of voice (M = 4.13). Students' perceptions of their ability to handle difficult material received support from oral encouragement provided by a trustworthy external source, which strengthened their self-efficacy (Li et al., 2023). Next came motivational indicators and feedback on game play (M = 4.08, M = 4.06), highlighting the importance of providing positive reinforcement online for student effort and success in skill-based tasks. These results are consistent with Bandura (1997) who claimed that verbal persuasion, particularly from credible sources, strengthens a sense of efficacy by lowering self-doubt.

Table 3. Respondents' Assessment on the Degree of Gamification Influencing Students' Self-Efficacy in Studying Senior High Biology in terms of Social Persuasion

Indicators	Mean	VI
1. Taking part in gamified biology activities gave me confidence as the teachers supported and motivated me.	4.08	E
2. Verbal appreciation of my classmates helped me grasp biology concepts better.	3.87	E
3. The idea of my self-gamified activities made me more optimistic about my education in biology.	4.06	E
4. The comments given to me by my peers while having gamified activities enhanced my ability in biology.	3.90	E
5. The words my teacher shared with me while I was talking about activities encouraged me to enhance my efforts in biology.	4.02	E
6. Encouragement from others provided during the gamified activities, spaced my context of achievement in educational biology.	4.00	E
7. Friendly expressions from my classmates made me more confident in my ability to tackle biology issues.	3.83	E
8. Positive words from my teacher, directed toward me, reassured me that I could cope with the difficult areas of biology.	4.13	E
9. To receive appreciation from my classmates made me more engaged in the gamified activities.	3.98	E
10. Teacher comments given to me during the gamified activities boosted my ability to perform in biology.	4.06	E
Composite Mean	3.99	**E**

****Legend: 4.21-5.00-Highly Effective; 3.41-4.20- Effective; 2.61-3.40 – Moderately Effective; 1.81-2.60 –Slightly Effective; 1.00-1.80 – Not Effective*

Peer-related factors, e.g., classmates' appreciation, aiding comments and friendly expressions, also contributed to the development of a collaborative and supportive learning environment. While averaged to a lesser extent (M =

3.83, M = 3.98), these social cues contributed to the learners feeling comfortable and confident to take on the Biology subject through mutual learning experiences. According to García-Monge et al. (2022), peer feedback provided in a gamified context does not contribute only to the understanding, but it also reinforces the academic self-concept of students through social validation. Of particular interest, self-initiative gamified activities were also meaningful (M = 4.06) and revealed that learners who felt autonomous but socially supported became more optimistic and resilient in their Biology learning. This demonstrates that self-regulation enhanced with social support is a potent force to develop academic efficacy (Chen and Yau, 2021; Ismail et al., 2021; Su and Cheng, 2015).

The appropriate application of social persuasion in gamified instruction increased learners' self-efficacy through shoring up competence, social belonging, and achievement. The uniform effectiveness in terms of all the measures (M > 3.80) provides some strong evidence that the verbal reinforcement and social reinforcement strategies embedded in gamified science education are beneficial for promoting students' self-efficacy.

Degree of Gamification in Influencing Emotional and Psychological Efficacy

Table 4 illustrates the degree of gamification influencing students' self-efficacy in studying senior high biology in terms of emotional and psychological state. It has a composite mean (4.02) that reflects a general effectiveness of gamification where emotional engagement, as well as psychological well-being, are concerned during the learning of biology.

The top items with a mean score of 4.17 show the emotional excitement and stress that students experienced throughout the gamified activities. The sense of fun and excitement created by gamification can be perceived as a major motivating factor that encourages learner participation. Li et al. (2024) are consistent with others who stress the importance of learner engagement and intrinsic motivation in learning. Furthermore, the impact of gamification on reducing the levels of anxiety and building s positive emotional climate aligns with the work of Dichev et al. (2020), who argue that gamification of learning can decrease stress and enhance the emotional fitness of learners by making difficult content approachable and fun.

Table 4. Respondents' Assessment on the Degree of Gamification Influencing Students' Self-Efficacy in Studying Senior High Biology in terms of Emotional and Psychological State

Indicators	Mean	VI
1. I was able to think of solutions to biology problems after gamified activities, as I was deeply willing to engage with the subject.	3.98	E
2. I felt immersed and tranquil while doing the gamified biology activities.	4.00	E
3. The biology tasks in this format helped me alleviate my stress.	3.98	E
4. Gamified biology activities created a thrill within me.	4.17	E
5. I felt emotionally and mentally involved in learning through gamified biology activities.	4.00	E
6. Biology activities in this format were quite soothing.	3.79	E
7. After finishing a gamified biology task, I felt proud, and my effort was worth it.	4.06	E
8. I felt very active after finishing the biology gamified activities.	4.02	E
9. I felt a desire to learn more about biology due to the positive emotion I experienced during the gamified activities.	4.04	E
10. The fun and interactive nature of the gamified biology activities helped me manage any anxiety I felt about the subject.	4.17	E
Composite Mean	4.02	**E**

****Legend: 4.21-5.00-Highly Effective; 3.41-4.20- Effective; 2.61-3.40 – Moderately Effective; 1.81-2.60 –Slightly Effective; 1.00-1.80 – Not Effective*

Students reported a sense of pride and satisfaction after having finished the gamified tasks (M = 4.06), which attests to the importance of the accomplishment and self-worth belief in promoting academic persistence (López-Belmonte et al., 2020). This sense of pride can serve to bolster self-efficacy beliefs, supporting Bandura's (2006) proposition that positive emotional feedback drives motivation and persistence.

The perception of the items for positive affective states includes feeling active (M = 4.02), desire to learn (M = 4.04), and being emotionally and mentally involved (M = 4.00), demonstrating the extent to which gamification helps deepen learner engagement. These results are in line with motivational concepts focusing on the relevance of affect and interest in cognitive processing and long-term learning (Sailer and Homner, 2020).

Notably, items coded into immersion/enjoyment and relaxation also scored high (M = 4.00) along with those describing gamification and its role in calming and relaxing participants (M = 3.79) and stress relief (M = 3.98). These results are consistent with research that has defined gamified learning as a means to induce flow—wherein learners exhibit focused attention and reduced anxiety—to create optimal learning conditions (Hamari et al., 2014; Koivisto and Hamari, 2019).

The ability to think critically and solve biology problems post-activity (M = 3.98) suggests that emotional engagement is not solely affective, but also cognitive, supporting the relationship between positive psychological states and enhanced capacity for problem-solving (Paloma et al., 2020).

Difference in Students' Self-efficacy

Table 6 delineates the significant difference in self-efficacy among students after the use of gamification. The average result from Mastery Experience is 4.03 (SD = 0.82) with a t-value of 34.162 and p-value =. 000), indicating that students' perception of their success in learning Biology was far above neutral. The 95% confidence interval of the mean difference (3.90-4.38) reinforces that: all the students perceived to have always voluntarily manipulated good results in the face of Biology academic activities. From the statistical perspective, I may reject the null hypothesis (Ho: μ = 0) and conclude that the entire population of players holds a strong positive belief regarding mastery.

Table 6. Difference in Self-Efficacy Among Students After the Use of Gamification

Indicators	Test Value = 0									
	Mean	Std. Deviation	Mean Difference	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)	Decision Ho	Interpre-tation
				Lower	Upper					
Mastery Experience	4.03	.82360	4.14423	3.9007	4.3878	34.162	51	.000	R	S
Vicarious Experience	4.14	.87479	3.99231	3.7468	4.2378	32.648	51	.000	R	S
Social Persuasion	3.99	.88181	4.02115	3.7752	4.2671	32.822	51	.000	R	S
Emotional and Psychological State	4.17	.98461	4.03269	3.8034	4.2620	35.308	51	.000	R	S

The features of immediate feedback and goal-setting, and progressive challenges in gamification systems help students achieve mastery and repeated practice, which leads to learning success and achievement (Sailer and Homner, 2020). Students in a gamified biology class advance through photosynthesis and cellular respiration stages by completing "quests," which provide them with a concrete feeling of accomplishment. These scaffolded gaming-like challenges enable learners to incrementally develop new skills and to acknowledge their accomplishments. This procedure fosters mastery experiences by allowing students to connect effort with success. Learning games that support trial and failure and feedback cycles have been empirically demonstrated to support inquiry-based learning and mastery (Zhang, 2024; Zhang and Hasim, 2023).

Vicarious Experience

Vicarious experience includes acquiring knowledge by observing others and is an important secondary form of self-efficacy. This factor obtained a mean of 4.14 (SD = 0.87) in the study, t = 32.648 and p = 000) was significant, indicating that there was a statistically significant divergence from the test value of 0. The 95% confidence interval (3.75-4.24) indicates that students place a high value on observing young peers as a meaningful and motivational experience. The rejection of the null hypothesis here indicates that the modeling of success by peers or instructors contributes to a major portion of students' beliefs about their capabilities.

Peer modeling in collaborative classroom settings can significantly boost student confidence. Students who witness the academic success of their peers, especially in areas such as Biology, instigate feelings of personal competence by way of reinforcement. This aligns with recent evidence that highlights the value of learning from the example and practice of skilled others that constitutes a motivational and cognitive scaffold, reinforcing an individual's confidence that they can attain the expected outcome (Kim et al., 2020; Kim and Kim, 2022; Lee et al., 2021; Usher and Weidner, 2018). This vicarious reinforcement affects the motivation for students to keep going because they are making a self-regulatory assumption: if their peers can do it, they can do it.

Social Persuasion

Statistical results for social persuasion in gamified Biology instruction yield a mean score of 3.99 (SD = 0.88), a t-value of 32.822, and a p-value of <.001 (Sig.<.001). 000, indicating a statistically significant difference from the test value of 0. Its 95% confidence interval (3.78 to 4.27) strongly demonstrates that students continue to perceive verbal encouragement and feedback to be the motivational critical elements in such gamified learning. These findings support the importance of the shared belief in the ability of students to accomplish academic tasks for their academic motivation and emphasize the power of social cues to strengthen this shared belief, including verbal and symbolic behaviors.

In the process of gamification, well-designed social persuasion mechanics are organically created through responsive feedback loops (e.g., point systems, digital badges, leaderboard position, and narrative-

based praise that rewards effort as well as competency). These details act as emblematic reminders that students are able to overcome complicated sets of biological ideas. According to Ryan and Deci (2000) Self-Determination Theory, such encouragement increases perceived competency, particularly when acknowledgment is timely, specific, and inductive of intrinsic goals. For instance, when a learner reaches an advanced mission, with its associated public ranking of all the learners within the class, then the symbolic reward serves as a type of social persuasion that affirms the previous effort and increases motivation to participate further. (Gong et al., 2022) provide empirical support: academic encouragement framed around challenge-focused tasks significantly strengthened students' academic self-efficacy, through mechanisms such as enhanced hope and campus connectedness.

Emotional and Physiological

State The emotional/psychological domain of self-efficacy appeared to be the most positively rated among students who experienced gamified Biology instruction, attaining a mean score of 4.17 (SD = 0.98), t = 35.308, p =. 000. The 95% confidence interval (3.80–4.26) also indicates that these findings were robust to between-participant variations. These results suggest that the students felt emotionally activated and comfortable when participating in the gamified learning classes. This is particularly relevant because Biology, as a subject, generally requires high levels of cognitive and concept complexity that may lead to students feeling stress or anxiety. Emotional dimensions of well-being are central to maintaining engaged students during challenging academic activities. Suppose students do not have the set of skills that are required to handle difficult cognitive demands. In that case, frustration and anxiety can develop in these domain acquisition efforts and students withdrawal from domain learning.

Extent of Gamification in Enhancing Students' Engagement and Motivation

Table 7 illustrates the extent of gamification in enhancing the students' level of engagement and motivation in senior high school biology classes.

The results show students agreeing on the importance of the contribution of gamification to stimulate engagement and motivation in Biology. All the indicators, which had an average of 3.97, had a mean within the "Extent" range (3.41–4.20), showing a clear perception of overall improvements. The items related to competence, i.e., comprehension of biology concepts (M = 4.10), understanding basic content (M = 4.06), and development of biology-related skills (M = 3.96) received higher scores.

These findings indicate that gamifying activities encourage learners' cognitive engagement and the ability to use knowledge in real contexts. Recent empirical literature corroborates that gamified learning environments can positively impact students' intrinsic motivation, increase active engagement and enhance or even change the learning process, provided they are embedded within a well-structured instructional design. According to (Segura-Robles et al., 2020), adding gamified elements such as instant feedback, leveling, and player choice yields significant gains in student motivation and academic achievement when learning within a blended or flipped learning environment. These design elements serve more than the

purpose of greater engagement; they scaffold students' SRL [self-regulated learning] tendencies and their metacognition."

Results like these are consistent with the constructivist educational model, which holds that learners are not simply vessels to be filled with information, but are participants in constructing their knowledge through interactivity, challenge, and reflection. Game-based learning's motivational effectiveness, as described by Sailer & Homner (2020) in a massive meta-analysis, depends on fulfilling learners' psychological needs for autonomy, competence, and relatedness--the underpinnings of Self-Determination Theory (Ryan & Deci, 2020), which is very congruent with constructivist philosophy.

Table 7. Respondents' Assessment on the Extent of Gamification in Enhancing the Students' Level of Engagement and Motivation in Senior High School Biology Class

Indicators	Mean	VI
1. Participating in activities that are supplemented with gamification gave me better competence in the biology concepts.	4.10	E
2. Now I can apply the biology knowledge learned in the work, which is augmented with gamification.	3.94	E
3. I have also personally observed that the activities which are blended in the world of gaming aided me in understanding more challenging topics in biology.	4.02	E
4. Doing biology-related activities in the gaming format has improved my ability to deal with biology issues.	3.94	E
5. Gamified activities enabled me to grasp the more fundamental elements of the subject matter in biology.	4.06	E
6. I feel that I improved even further in biology through the highly engaging and interactive nature of the gamified activities.	3.90	E
7. Gamified activities enabled me to grasp the more fundamental elements of the subject matter in biology.	3.94	E
8. My increase in knowledge regarding biology facts and concepts can be associated with the benefits attained from engaging in gamified activities.	3.98	E
9. I was also able to refine my biology skills with the help of the gamified activities.	3.96	E
10. Due to my exposure to gamified activities, I am ready to tackle more advanced aspects of biology.	3.88	E
Composite Mean	**3.97**	**E**

****Legend: 4.21-5.00-Great Extent; 3.41-4.20- Extent; 2.61-3.40 – Moderately Extent; 1.81-2.60 –Slightly Extent; 1.00-1.80 – Not at All*

Learner control, deliberate progression, and immediate formative feedback are reinforced through gamified systems to foster perceived competence and involvement with relevance. These characteristics not only foster the development of intrinsic motivation but also foster cognitive persistence and personalized knowledge-building paths, in line with the broader shift toward student-centered teaching in the learning sciences.

The potential of gamification to transform students' interest beyond typical tasks is further indicated in their responses to applying knowledge outside of class work (Item 2, M = 3.94) and readiness to master additional advanced biology topics (Item 10, M = 3.88). These data elements show the increase in learners'

academic belief in science education. Gamification seems to have a positive effect on deep learning and emotional involvement. Students agreed that biology game tasks enabled them to grasp challenging concepts (Item 3, M = 4.02) and interact with basic subject matter (Item 7, M = 3.94). Furthermore, gamification is capable of decreasing stress and cognitive stress by presenting a narrative-based challenge, role-playing, and collaborative learning, which help in simplifying complexity information. When students learn from games that are based on stories or missions, they become more emotion- ally engaged, less anxious, and they learn more and remember better (Lo and Hew, 2020). This is consistent with the idea that the use of a story and interactive elements for gamified systems are motivational and emotional regulation strategy. In addition, the consistency of high scores across all indicators suggests that gamified learning effects are not limited to academic performance but also appear to impact resilience and science engagement, two attributes that are essential for success in the long term.

The findings also provided statistical evidence for the pedagogical value of gamified learning environments in motivating and engaging students in Biology. By mixing game elements with educational content, students felt they were learning more, becoming more skilled, and were more confident in the face of biological questions. Based on the theoretical foundations of constructivist learning theory, self-efficacy models, and motivation science, gamification represents a potential and successful approach to enhancing the quality of science education. It links the kids' natural dispositions to instructional accomplishments and turns the classroom into a zone of deep, emotionally grounded learning.

Difference in Students' Engagement and Motivation

Table 8 delineates the significant difference in the level of students' engagement and motivation after gamification. The results provide a significant reflection of the effect of gamification on students' engagement and motivation in senior high school Biology.

The calculated mean score of 3.97 (SD = 0.75) indicated that students, on average, have a high perception of engagement and motivation after using the gamified teaching and learning strategy. This score is situated in the "Extent" range (3.41–4.20), suggesting that students perceived a high degree of increase in engagement and motivation through the use of gamification. Accompanied by a p-value of. 000, demonstrates the statistically significant difference between observed means ($P<0.05$). The confidence interval for the mean difference is between 3.7640 and 4.1822, and it confirms the robustness of the result. Since the p-value is smaller than 0.05, the null hypothesis (Ho), which would indicate no difference in engagement and motivation it is rejected, and therefore considered significant. Gamification has the potential to be a strong contributor to student engagement and educational outcomes, especially when designed in a way that caters to genuine educational issues, such as increasing science learning participation. Gamified learning enhances students' motivation, attention, and performance in school, especially when the design encourages learner autonomy, challenge, and social interaction (Li et al., 2024; Li, 2025).

Table 8. Difference in the Level of Students' Engagement and Motivation After Gamification

Indicators	Test Value = 0					t	df	Sig. (2-tailed)	Decision Ho	Interpretation
	Mean	Std. Deviation	Mean Difference	95% Confidence Interval of the Difference						
				Lower	Upper					
Level of Students' Engagement and Motivation After Gamification	3.9731	0.75098	3.9731	3.7640	4.1822	38.151	51	.000	R	S

Similarly, Sun (2023) noted that gamified approaches in science classrooms resulted in higher cognitive engagement and perseverance, more so for challenging topics such as Biology. On average, the high ratings, which frequently hover near the 4.0 mark on motivation or engagement scales, indicate that this is content to which most students would have agreed or been receptive. The results demonstrate how gamified learning environments transform student potential when they use specific goals and immediate feedback, and active learner participation. The core elements work together to maintain motivation through expectation clarification and progress reinforcement, and accomplishment promotion. Gamified systems achieve cognitive load regulation through their task-based structure and immediate feedback mechanisms. The system design helps learners avoid information overload while improving their ability to focus and process information and self-regulate. Such well-designed gamified experiences use strategic scaffolding of cognitive effort to optimize engagement while creating conditions that support deeper learning.

Formulated Meaning on the Use of Gamification

Table 9 shows the emerging meanings from gamifying biology instructions. It can be gathered from the table that there are seven emerging meanings from the responses of the students:

A. Increased Confidence Through Mastery

Students repeatedly noted confidence gained from gamified Biology lessons. Most of this was because of the games, which offered many chances for practice.

Rather than meeting the stress of a standard quiz or test, students could work with concepts more than once, building on each attempt.

Student no. 1 stated that: **"It boosted my confidence, especially when I saw my scores improve".** This scenario represents what contemporary literature describes as mastery experiences, which are the most powerful source of academic self-efficacy. By overcoming complex challenges with diligence, students develop a belief in their ability to succeed. This phenomenon is particularly pronounced in gamified learning environments. For example, students working on difficult Biology topics like photosynthesis and cellular

respiration inside a gamified space tend to have reduced anxiety and increased cognitive engagement. These are experiences that enable students to know that with effort comes success, and this has an impact on their motivation and academic resilience (Phan et al., 2022)

Table 9. Emerging Meanings from Gamifying Biology Instruction

No.	Meaning	Short Explanation
1	Increased Confidence through Mastery	Through gamification, students feel accomplished for overcoming challenges.
2	Reduced Anxiety by Making Learning Fun	Students felt less pressured due to the interactive and rewarding nature of the game.
3	Shift in Self-Belief and Self-Efficacy	Gamification helped students view themselves as capable learners in science.
4	Learning through Fun and Curiosity	Curiosity about the games motivates learners to persist in studying and completing tasks.
5	Active and Independent Learning	Gamification supported students to apply what they had learned without relying on spoon-feeding.
6	Collaborative Problem-Solving	Games encouraged students to communicate and brainstorm answers with peers.
7	Growth Mindset and Resilience	Students embraced failure as part of learning, working harder after mistakes.

B. Reduced Anxiety by Making Learning Fun

Gamified learning activities also lowered students' anxiety and anxiety compared to a traditional mode of learning. The games' enjoyable and interactive form also eliminated the seriousness commonly associated with schoolwork. Student number 4 shared that, ***"It improves my understanding of the lessons by making teaching more interactive. In addition, the quizzes do not give me any pressure anymore."*** The students no longer feared having the wrong answers in front of their classmates or disappointing their teachers — mistakes were simply part of the game's progression. This aligns with Talan et al. (2020) , who indicated that gamification allows reducing the academic anxiety phenomenon through the generation of enjoyable and entertaining spaces that invite students to experiment. It was a playful, common way of 'doing' Biology, for these students, to learn Biology through gamified tasks.

C. Shift in Self-Belief and Self-Efficacy

The use of gamification played a role in changing students' mindsets in relation to their academic potential. Its students mostly had low self-confidence in their science skills. But after a number of attempts with such gamified tasks, where the subject area was fused with an enjoyable task, the students appeared to gain confidence in themselves as learners. When asked how the use of gamification affected their self-perceptions of their learning capabilities in science, student number 1 said *that* ***"Before the games, I thought I wasn't good at Biology, but now I believe I can understand the topics much better."*** Students' perception of themselves improved greatly through associating good learning experiences with work in

school. The research supports this development because gamified learning environments have been shown to boost student self-efficacy according to recent studies. The research by Sailer and Homner (2020) shows that gamification builds learner confidence through its combination of structured feedback and progressive difficulty levels. The features enable learners to achieve small, achievable successes throughout time, which builds their confidence in their ability to succeed. Learners develop confidence through repeated mastery experiences of challenges while receiving immediate constructive feedback, which motivates them to persist and deeply engage with the learning material.

Enhanced self-efficacy of students in this study resulted in their proactive role in learning, which later on led to stronger involvement and longer persistence in their academic activities.

D. Learning through Fun and Curiosity

Curiosity was identified as a strong force in learning gamified. Educational games often include storytelling, exploration, and a discover sequence that captures their interest and makes them more amenable to engaging the challenging material. Numerous students shared that the games "intrigued their interest to know more" because they were excited to see "what happens next" in the story or game. Student number 2 explained, ***"My curiosity made me want to see what the end will be."*** Autonomy and competence of students promoted by gamified approaches lead to higher behavioral engagement (Lo and Hew, 2020). Likewise, Zainuddin et al. (2020) claimed that using game elements that stimulate curiosity, while providing meaningful challenges, has a positive impact on motivation and cognitive engagement. In this research, the games were not just fun, but rather mental tasks that transformed topics from biology into tasks to accomplish. That is, this challenge aspect kept students interested, engaged and made them think (better recall) beyond the gameplay. For the participants in this research, the games were not only entertainment, but intellectual teasers in which academic material became something to conquer, like opponents, or an obstacle. The interest they all created did more than keep them in the game—it was carried over to their approach to learning biology, enhancing motivation and content retention.

E. Active and Independent Learning

By means of gamification, the students could be more self-dependent and engaged when learning. Unlike teacher-led explanations, the game allowed students to interact directly with the material by decoding clues, using pre-existing knowledge, and solving problems within the game. In this regard, student number 8 said that ***"I noticed I was thinking more clearly and solving difficulties more quickly during one of the games."*** This perception represents a move from the passivity of learning to the active construction of learning. Because students could proceed through the game at their own pace, push-button feedback facilitated strategic thinking (e.g., hypothesis testing, making decisions, pattern searching). These attributes align with the defining properties of active learning, that is, learner self-directed, challenging and based on the 'here and now.'

F. Collaborative Problem-Solving

Although most of the games were intended to be played by an individual, students leaned towards interacting with their peers as they engaged in the tasks/games. Gamification provided a casual space for

students to chat about questions and strategy without the stress of a formal setting. Informal learning communities arose from this. Student number 2 shared that: ***"Yes, because when playing gamified activities, my friends and I tend to brainstorm and argue about the right answer."*** This kind of connection and relationship led to academic and social involvement. Students engaged in discussion, negotiation, and argumentation to exercise higher-order thinking and access deeper understanding of the content.

Games promote peer cooperation and group activity. According to Redondo-Rodríguez et al. (2023) game elements including team-based challenges and cooperative missions, greatly enhanced the EI, motivation, learning strategies and language skills of the students. The authors highlighted that fellowship in gamified learning empowered learners with the ability to assist each other, exchange views, and collaborate to achieve common academic targets, resulting in a more interactive and socially enriched learning experience. Furthermore, they argued that cooperative gamification enhances a sense of belonging and collective responsibility and helps management students perform complex tasks by putting their forces together. Mechanics supporting cooperative play—shared point systems, badges, and progress tracking—foster accountability, participation, and joint end goals, which contribute to cognitive and socio-emotional outcomes.

G. Growth Mindset and Resilience

Gamification fostered a growth mindset as it helped students see failure not as proof of a fixed ability, but as a positive, hopeful precursor of eventual success. The games themselves: Multiple attempts to play, "try agains," chances to practice and to learn from mistakes, opportunities to develop fortitude when the attempt was (as it so often was in the beginning) a "fail." As student number 6 explained, "***It was frustrating dying mid-game because of one wrong answer, but the more I played, the better I got."*** This trial-and-error process of learning emphasized that effort leads to progress, a core component of growth mindset theory, and also how to learn from setbacks. The way the learning process was set up was presented in such a fun way that students were able to separate themselves emotionally from failure and realized that it was a part of the process.

Emerging Themes in the Use of Gamification

Seven emerging themes in the use of gamification in senior high school biology:

A. Confidence and Mastery

The use of gamification in biology instruction directly increased student confidence and knowledge. When students are given difficult tasks to complete in a game-based learning environment, their completion creates a feeling of achievement. By attempting, failing, reflecting, and eventually succeeding on a level playing field in a non-threatening format, students develop a better understanding of complex biological concepts and techniques than with conventional means of instruction. The instant response that is frequent in gamified situations also supports the correct understanding and lets them pinpoint their weaknesses, leading to a stronger learning foundation.

This newfound confidence is not only about knowledge but also works to produce a stronger sense of being able to use information they have previously learned, and academic success. As students repeatedly accomplish

boundaries and power-up challenges in a game environment, students acquire a greater belief in their capability when it comes to addressing problems associated with more complex biology questions. This awareness of their improvement (which is often quantified in the form of points, badges, or leaderboards) becomes a strong drive for them to want to achieve greater levels of competence and capability. Gamification can increase academic achievement and self-efficacy of STEM (Science, Technology, Engineering and Mathematics) learning, and biology is no exception due to its power to increase motivation and generate a positive learning space (Li et al., 2024).

B. Reduced Academic Anxiety

One of the most appealing advantages of using gamification in the education of biology is its ability to lower academic anxiety. The classic classroom approach can be scary, preventing kids from participating or trying new things for fear of being wrong or looking silly. Gamified strategies, however, naturally introduce a bit more of a fun/interactive environment. When learning is translated into a game, the stress associated with formal assessment is greatly reduced, which means students can grapple with difficult content in a more relaxed environment. This change of mindset enables students to look at mistakes not as aberrations or failures but as vital components of the process of learning.

Table 10. The Emerging Themes in the Use of Gamification in Biology

Theme	Simple Explanation	Subthemes
1. Confidence and Mastery	Students gained in confidence as they accomplished difficult tasks.	- Mastery of Concepts - Performance Gains - Recognition of Progress
2. Reduced Academic Anxiety	The playful, interactive style of the game eased the fear of failure and helped learning seem more fun.	- Fun Learning Environment - Safe Space for Mistakes - Positive Emotional Responses
3. Empowerment and Self-Efficacy	Students now realize that they can do science.	- Positive Self-Perception - Capability Recognition - Improved Academic Identity
4. Curiosity-Driven Engagement	Interesting game mechanics led students to finish their learning activities.	- Intrinsic Motivation - Anticipation of Rewards - Sustained Interest through Novelty
5. Active Learning	Games motivated students to independently solve problems and apply their learning.	- Independent Problem-Solving - Application of Concepts - Cognitive Engagement
6. Collaboration and Engagement	Games supported teamwork, peer conversations and collective decision-making.	- Peer Discussions - Shared Decision-Making - Supportive Learning Environment
7. Resilience and Growth	Through instruction, students were encouraged to see failure as an opportunity to learn and build resilience.	- Overcoming Mistakes - Perseverance - Motivation to Improve

Gamification thus creates a "fun learning environment" in which making mistakes is safe. Students are more willing to take chances, try various options and even make mistakes because they aren't a part of the

students' capabilities or identities but are simply part of the game mechanic. Less anxiety, then, results in greater positive emotion in relation to learning, which again makes learning pleasanter and more likely. Studies have shown that gamification-based learning can reduce learning anxiety and increase learner engagement in the educational environment, contributing to an environment more suitable for deep learning instead of surface learning, and developing a growth-oriented mindset – one that considers mistakes as learning opportunities rather than failure (Lampropoulos and Sidiropoulos, 2024).

Empowerment and Self-Efficacy

Empowerment and Self-Efficacy development in gamified learning environments is a key psychological milestone, specifically for those learners who have inadvertently felt inadequate in academic tasks. Through gamification in biology education, students develop self-efficacy because they learn to see themselves as capable scientific investigators. Students who participate in simulations and problem-solving tasks and virtual labs within gamified environments move from passive learners to active learners who take charge of their educational journey. The experiential learning method helps students build essential practical abilities together with critical thinking skills needed for scientific research. The instant feedback and specific results in games confirm students' scientific abilities through their achievements in virtual bacterial cultivation and medical patient diagnosis.

The process develops positive academic self-perceptions while building students' scientist identities. The accumulation of game achievements, together with rewards and social validation, increases student motivation to pursue STEM subjects further. AR-based gamification augmented with self-regulated learning strategies led to measurable gains in motivation, performance, satisfaction, and scientific self-efficacy (Ateş & Polat, 2025), and hybrid gamified bridge programs strengthened self-efficacy among underserved STEM students (Cotter, 2023).

C. Curiosity-Driven Engagement

Gamified features, in particular, storylines, special levels, and gradual hurdles, ignite learners' natural desire for exploration and discovery. Learning environments that use storylines and progressive levels and discovery-based challenges activate intrinsic motivation in learners because they create curiosity and anticipation. The features create an exploratory experience that drives students to seek knowledge by moving through virtual quests and accessing new content. The narrative elements in learning materials create newness, which enhances student focus and emotional involvement, thus leading them to continue studying complex material. Gamification approaches created positive and significant effects on student perceptions of autonomy and relatedness (Birgin et al., 2020). According to Self-Determination Theory (SDT), people develop strong autonomy feelings and higher intrinsic motivation when they have the freedom to choose their goals or activities (Hamari et al., 2024). Learners who feel they control their decisions and actions experience increased perceived autonomy, which leads to stronger intrinsic motivation. The internal

motivation students develop leads to better learning outcomes and improved academic results because they focus on understanding the material instead of doing work for external rewards.

D. Active Learning

Active learning, as it appears in the context of gamified instruction, is a situation in which the traditional passive acceptance of information is consciously rejected in favor of the active work of the learner in constructing meaning. The classroom environment transforms into an active learning space through gamified instructional designs, which move students from passive content reception to interactive engagement. Students participate in meaningful tasks that require higher-order thinking skills, including decision-making and problem-solving, and critical reflection, instead of traditional listening or memorization. Students in Biology education experience interactive learning through virtual simulations, which allow them to study cellular respiration pathways and replicate photosynthesis reactions and assemble ecological interactions through game-based puzzles. Through realistic problem-based scenarios, students develop deep scientific concept understanding because these experiences simulate authentic scientific inquiry.

Digital game-based learning boosts both student motivation and academic performance in STEM subjects (Camacho-Sánchez et al., 2022). The interactive gameplay with its immersive elements enhances cognitive engagement, which makes scientific principles more accessible and memorable for learners. Digital educational games lead to improved concept mastery and problem-solving abilities in multiple STEM subjects. This demonstrates how gamification perfectly supports active learning by turning students from information receivers into knowledge creators.

E. Collaboration and Engagement

The Collaboration and Engagement theme focuses on how gamification enables interactive, collaborative learning as prescribed by the principles of social constructivist learning. Although gamified actions are highly individualized, they tend to lead to spontaneous collaboration and cooperation, especially in environments where individuals are encouraged to share strategies or to solve challenges together. This procedure turns the learning space into a participatory scenario where students exchange knowledge, negotiate understanding and elaborate on each other's reasoning. Koivisto and Hamari (2019) identified the association between gamification approaches that leverage common goals, such as leaderboards, collective challenges (clans) and team-based rewards, and peer collaboration leading to more engagement and learning. These interactions are not just social, but a cognitive co-construction of knowledge.

F. Resilience and Growth

Gamifying education allows students to learn skills that build resilience and understand that mistakes are a part of learning. In games, losing is not a failure but a part of the process of getting better. Students who worked through gamified modules performed better on complex tasks when given chances to retry, demonstrating greater resilience and retention (Montero-Izquierdo et al., 2024). Similarly, Rodrigues et al.

(2022) observed that while the initial excitement around gamification may fade, engagement tends to rise again as learners become more comfortable with the system. This suggests that gamified experiences can promote long-term motivation and persistence, helping students develop both confidence and a deeper commitment to their learning goals. The research of Toda et al. (2024, 2019) supports this approach by showing that gamified learning materials help students stay motivated even when they make mistakes. The research shows that students who use gamified content such as quizzes and simulations , and quest-based tasks tend to view mistakes as learning opportunities instead of failures. The gamified environment design, which provides instant feedback and allows retries and rewards small achievements, helps students develop resilience. The learning environment maintains student engagement because they feel more willing to continue through obstacles, which leads to positive learning outcomes.

SUMMARY

This study examined the impact of gamification on the self-efficacy, engagement, and motivation of Senior High School students in studying Biology. Data were gathered through quantitative measures using Likert-scale assessments, complemented by qualitative responses. The four factors of self-efficacy that were examined were as follows: mastery experiences, vicarious experiences, social persuasion, and the emotional/ psychological states.

A. **Degree of Gamification in Influencing Self-Efficacy.** Results indicated that gamification had a positive influence on students' academic self-confidence, critical thinking, and emotional engagement. Among the four self-efficacy dimensions, emotional and psychological state scored the highest, suggesting that gamified learning environments reduced students' anxiety and built psychological readiness for academic tasks. Vicarious learning and mastery experiences also scored positively, indicating that observing peers succeed and experiencing their progress contributed to students' academic motivation.

B. **Difference in Students' Self-efficacy.** The statistical findings showed substantial positive changes in all self-efficacy domains because students developed confidence through their repeated successes and supportive feedback within the gamified environment. The research provided robust statistical data to prove that the null hypothesis should be rejected. The intervention produced substantial improvements in students' success beliefs in Biology through both emotional support and active performance.

C. **Degree of Gamification in Influencing Engagement and Motivation.** In terms of engagement and motivation, results indicated a statistically significant difference in students' behavior after using gamified strategies in Biology. The overall composite mean for engagement and motivation indicated that students felt a very large increase in their engagement and motivation in the subject.

D. Difference in Engagement and Motivation. The study found that gamification proved successful in maintaining student engagement and motivation levels. The implementation of game elements, including levels and point systems and immediate feedback and narrative goals, made students more emotionally invested in their learning process. The environment provided students with a risk-free space to take academic challenges , which maintained their curiosity and focus, and intrinsic motivation during their processing of challenging Biology material.

E. Formulated Meanings. Students reported significant changes in their educational experiences. The gamified activities, according to students, reduced their stress levels while increasing their self-confidence and deepening their interest in Biology. Students learned to see failure as a short-term, low-risk experience instead of a permanent evaluation, which made them perceive themselves as strong and capable learners. The collected reflections demonstrate that gamification produces effects beyond performance improvement because it transforms students' mental perspectives and emotional responses toward scientific learning.

F. Emerging Themes. Thematic analysis of students' narratives also generated seven central themes: (1) Confidence and Mastery: Students gained in confidence as they accomplished difficult tasks; (2) Reduced Academic Anxiety: The playful, interactive style of the game eased the fear of failure and helped learning seem more fun; (3) Empowerment and Self-efficacy: Students now realize that they can do science; (4) Curiosity-Driven Engagement: Interesting game mechanics led students to finish their learning activities; (5) Active Learning: Games motivated students to independently problem solve and apply their learning; (6) Collaboration and Engagement: Games supported teamwork, peer conversations and collective decision-making; (7) Resilience and Growth: Through instruction students were encouraged to see failure as an opportunity to learn building resilience.

G. Gamified lesson. The games provide substantial educational benefits to Senior High School Biology students by converting difficult-to-understand complex processes into interactive student-led learning activities. The biochemical pathways of photosynthesis and cellular respiration, including light-dependent and light-independent reactions and the electron transport chain sequence, present difficulties for students to learn through traditional lectures. The gamification of these processes through quest-based adventures and puzzles, and simulations enables students to visualize and interact with each stage of the cycle in a structured, meaningful way.

CONCLUSIONS

The study concludes by highlighting the value of ongoing research to deepen insights and broaden the educational significance of gamification.

1. The gamified learning approach helped students build self-efficacy through reduced anxiety during their Biology classes. The interactive structure established a psychologically safe space, which allowed learners to experiment without fear of failure. Students developed emotional comfort, which led to increased confidence that enabled them to tackle challenging material with determination and assurance.

2. The gamified intervention led to statistically significant improvements in all self-efficacy dimensions according to quantitative findings. The intervention led to improvements in mastery experiences and social encouragement and peer modeling, and emotional regulation. The steady upward patterns indicate that gamified instruction develops academic self-belief through continuous experiential and supportive feedback mechanisms.

3. The students demonstrated high engagement and motivation scores because they were deeply invested in the gamified Biology activities both cognitively and emotionally. The game-based learning environment created an immersive experience that sustained student focus while sparking their curiosity and motivating them to explore. The high level of student participation shows that gamification leads to more significant learning behaviors.
4. The intervention led students to show significant changes in their learning conduct. Through gamification, students transitioned from receiving information passively to taking control of their learning process by selecting activities. The increased student participation led to stronger and longer-lasting interest in the subject.
5. Student reflections showed that gamification helped students build essential personal attributes through independence and emotional resilience. The learning process led students to develop greater curiosity while improving their stress management abilities and encouraging them to take intellectual risks. The results indicate that gamified lessons produce academic benefits as well as positive effects on student well-being.
6. Seven prominent themes emerged from qualitative analysis. The interconnected dimensions revealed the extensive advantages of gamification, which benefit academic and psychosocial development. These dimensions together demonstrate a complete transformation in students' learning attitudes and behaviors and self-perceptions as learners.

RECOMMENDATIONS

The following recommendations are presented formally and professionally, which can be used in academic papers and official documents.

For Biology Educators. The instructional design of teachers should include gamified strategies through point systems and level-based tasks, and narrative-driven learning experiences. These methods create self-confidence while decreasing academic stress and maintaining students' interest in advanced scientific material.

For Curriculum Planners. Science curriculum developers must implement gamification principles into their modules, which should maintain alignment with learning competencies and developmental goals. The instructional content needs to use interactive problem-based tasks that allow students to explore while gaining autonomy and achieving concept mastery.

For School Leaders and Administrators. Educational institutions need to back gamified learning through financial support and training opportunities, and a scheduled time for its implementation. A lasting implementation of innovative teaching methods requires schools to develop a culture that puts learners first.

For Educational Policymakers. The educational community needs policymakers to accept gamification as an effective teaching method for STEM subjects so they can integrate it into national educational standards. The funding should support experimental programs alongside teacher education and digital resources development to improve student achievements.

For Instructional Designers and Technologists. Instructional design professionals need to develop digital platforms that unite curriculum content with game-based features that serve users' needs. The tools need to ensure accessibility while providing real-time feedback and scaffolding features to support different learning styles.

REFERENCES

[1]. Alahmari, M., Jdaitawi, M., Rasheed, A., Abduljawad, R., Hussein, E.T., Alzahrani, M., Awad, N., 2023. Trends and gaps in empirical research on gamification in science education: A systematic review of the literature. Contemporary Educational Technology 15. https://doi.org/10.30935/cedtech/13177

[2]. Alhalafawy, W.S., Zaki, M.Z.T., 2022. How Has Gamification Within Digital Platforms Affected Self-Regulated Learning Skills During the COVID-19 Pandemic? Mixed-Methods Research. International Journal of Emerging Technologies in Learning (iJET) 17, 123–151. https://doi.org/10.3991/ijet.v17i06.28885

[3]. Alhammad, M.M., Moreno, A., 2018. What is going on in agile gamification? Proceedings of the 19th International Conference on Agile Software Development: Companion. https://doi.org/10.1145/3234152.3234161

[4]. Alsawaier, R.S., 2018. The effect of gamification on motivation and engagement. The International Journal of Information and Learning Technology 35, 56–79. https://doi.org/10.1108/IJILT-02-2017-0009

[5]. Artino, A.R., 2012. Academic self-efficacy: from educational theory to instructional practice. Perspectives on Medical Education 1. https://doi.org/10.1007/s40037-012-0012-5

[6]. Ateş, H., Polat, M., 2025. Leveraging augmented reality and gamification for enhanced self-regulation in science education. Educ Inf Technol. https://doi.org/10.1007/s10639-025-13481-0

[7]. Balci, S., Secaur, J.M., Morris, B.J., 2022. Comparing the effectiveness of badges and leaderboards on academic performance and motivation of students in fully versus partially gamified online physics classes. Educ Inf Technol (Dordr) 27, 8669–8704. https://doi.org/10.1007/s10639-022-10983-z

[8]. Bandura, A., 2006. Guide for Constructing Self-Efficacy Scales (Revised) [WWW Document]. ResearchGate. URL https://www.researchgate.net/publication/233894825_Guide_for_Constructing_Self-Efficacy_Scales_Revised (accessed 5.17.25).

[9]. Bandura, A., 1997. Self-Efficacy: The Exercise of Control by Albert Bandura | Goodreads [WWW Document]. URL https://www.goodreads.com/book/show/882815.Self_Efficacy (accessed 11.18.24).

[10]. Birgin, O., Uzun, K., Mazman Akar, S.G., 2020. Investigation of Turkish mathematics teachers' proficiency perceptions in using information and communication technologies in teaching*. Educ Inf Technol 25, 487–507. https://doi.org/10.1007/s10639-019-09977-1

[11]. Botes, W., 2022. Pre-Service Teachers' Experiences on the Development of Educational Science Board Games. European Journal of STEM Education 7, 02. https://doi.org/10.20897/ejsteme/11784

[12]. Camacho-Sánchez, R., Rillo-Albert, A., Lavega-Burgués, P., 2022. Gamified Digital Game-Based Learning as a Pedagogical Strategy: Student Academic Performance and Motivation. Applied Sciences 12, 11214. https://doi.org/10.3390/app122111214

[13]. Chen, L., Yau, J.Y.-K., 2021. Online and blended entrepreneurship education: a systematic review of applied educational technologies. Entrepreneurship Education 4. https://doi.org/10.1007/s41959-021-00047-7

[14]. Deterding, S., Khaled, R., Nacke, L., Dixon, D., 2011. Gamification: Toward a definition, in: ResearchGate.

[15]. Dichev, C., Dicheva, D., Irwin, K., 2020. Gamifying learning for learners. International Journal of Educational Technology in Higher Education 17, 54. https://doi.org/10.1186/s41239-020-00231-0

[16]. Fadzillah, N.H.H., Othman, N.Z.S., Ghazali, M., Ismail, N.A., 2023. Comparing the Effects of Gamification to User Engagement in Stress Management Application. Advanced Research in Applied Sciences and Engineering Technology 30. https://doi.org/10.37934/araset.30.1.290302

[17]. Gong, Z., Jiao, X., Xia, X., Yu, H., Lv, C., 2022. The Relationship Between Academic Encouragement and Academic Self-Efficacy: A Moderated Mediation Model. Front Psychol 13, 644243. https://doi.org/10.3389/fpsyg.2022.644243

[18]. Hamari, J., Koivisto, J., Sarsa, H., 2014. Does Gamification Work? – A Literature Review of Empirical Studies on Gamification, in: 2014 47th Hawaii International Conference on System Sciences. Presented at the 2014 47th Hawaii International Conference on System Sciences, pp. 3025–3034. https://doi.org/10.1109/HICSS.2014.377

[19]. Huizenga, J.C., Dam, G.T.M. ten, Voogt, J., Admiraal, W., 2017. Teacher perceptions of the value of game-based learning in secondary education. Computers &Amp; Education 110. https://doi.org/10.1016/j.compedu.2017.03.008

[20]. Hürsen, Ç., Bas, C., 2019. Use of Gamification Applications in Science Education. International Journal of Emerging Technologies in Learning (iJET) 14. https://doi.org/10.3991/ijet.v14i01.8894

[21]. Ismail, M.F. bin, Iksan, Z.H., Ariffin, R. 'Aqilah M., 2021. Effects of Using Gamification Techniques on Achievement in Science Subject. International Journal of Academic Research in Business and Social Sciences 11. https://doi.org/10.6007/ijarbss/v11-i12/11769

[22]. Kalogiannakis, M., Papadakis, S., Zourmpakis, A.-I., 2021. Gamification in Science Education. A Systematic Review of the Literature. Education Sciences 11. https://doi.org/10.3390/educsci11010022

[23]. Kelders, S.M., Sommers-Spijkerman, M., Goldberg, J.M., 2018. Investigating the Direct Impact of a Gamified Versus Nongamified Well-Being Intervention: An Exploratory Experiment. Journal of Medical Internet Research 20. https://doi.org/10.2196/jmir.9923

[24]. Kim, E., Rothrock, L., Freivalds, A., 2020. The impact of gamification on the motivation and performance of engineering students through the lens of self-determination theory. International Journal of Engineering Education 36, 1117–1131.

[25]. Kim, H.R., Kim, B., 2022. Effects of Situation-Based Flipped Learning and Gamification as Combined Methodologies in Psychiatric Nursing Education: A Quasi-Experimental Study. Healthcare 10. https://doi.org/10.3390/healthcare10040644

[26]. Koivisto, J., Hamari, J., 2019. The rise of motivational information systems: A review of gamification research. International Journal of Information Management 45, 191–210. https://doi.org/10.1016/j.ijinfomgt.2018.10.013

[27]. Küçükşen Öner, F., Cetin-Dindar, A., Sarı, H., 2024. I arrived at the sun! Developing an educational board game with the collaboration of <scp>pre-service</scp> art and <scp>pre-service</scp> science teachers. European Journal of Education 59. https://doi.org/10.1111/ejed.12629

[28]. Lampropoulos, G., Sidiropoulos, A., 2024. Impact of Gamification on Students' Learning Outcomes and Academic Performance: A Longitudinal Study Comparing Online, Traditional, and Gamified Learning. Education Sciences 14, 367. https://doi.org/10.3390/educsci14040367

[29]. Lee, S., Kwon, S., Ahn, J., 2021. The Effect of Modeling on Self-Efficacy and Flow State of Adolescent Athletes Through Role Models. Front. Psychol. 12. https://doi.org/10.3389/fpsyg.2021.661557

[30]. Li, L., Hew, K.F., Du, J., 2024. Gamification enhances student intrinsic motivation, perceptions of autonomy and relatedness, but minimal impact on competency: a meta-analysis and systematic review. Education Tech Research Dev 72, 765–796. https://doi.org/10.1007/s11423-023-10337-7

[31]. Li, M., 2025. Mapping academic motivation, self-efficacy, achievement emotions, and vocabulary learning in a game-enhanced learning environment from the lens of activity theory. Learning and Motivation 89, 102087. https://doi.org/10.1016/j.lmot.2024.102087

[32]. Lo, C.K., Hew, K.F., 2020. A comparison of flipped learning with gamification, traditional learning, and online independent study: the effects on students' mathematics achievement and cognitive engagement. Interactive Learning Environments 28, 464–481. https://doi.org/10.1080/10494820.2018.1541910

[33]. López-Belmonte, J., Segura-Robles, A., Fuentes-Cabrera, A., Parra-González, M.E., 2020. Evaluating Activation and Absence of Negative Effect: Gamification and Escape Rooms for Learning. International Journal of Environmental Research and Public Health 17, 2224. https://doi.org/10.3390/ijerph17072224

[34]. Macayan, V.D., Baguistan, D.C., Golias, J.B., 2022. Game-Based Activities and Gamification in the Mastery of Science Process Skills: A Systematic Literature Review. EPRA International Journal of Multidisciplinary Research (IJMR). https://doi.org/10.36713/epra10950

[35]. Montero-Izquierdo, A.I., Jeong, J.S., González-Gómez, D., 2024. A future classroom lab with active and gamified STEAM proposal for mathematics and science disciplines: Analyzing the effects on pre-service teacher's affective domain. Heliyon 10, e35911. https://doi.org/10.1016/j.heliyon.2024.e35911

[36]. Neave, N., Briggs, P., McKellar, K., Sillence, E., 2019. Digital hoarding behaviours: Measurement and evaluation. Computers in Human Behavior 96, 72–77. https://doi.org/10.1016/j.chb.2019.01.037

[37]. Nguyen, D.N., Meixner, G., 2019. Gamified Augmented Reality Training for An Assembly Task: A Study About User Engagement. Proceedings of the 2019 Federated Conference on Computer Science and Information Systems. https://doi.org/10.15439/2019f136

[38]. Paloma, G.P., Antonio, P.C.M., Daniel, C.-J., 2020. Psychological well-being and academic performance in university students. International Journal of Educational Policy Research and Review. https://doi.org/10.15739/IJEPRR.20.019

[39]. Phan, H.P., Ngu, B.H., Granero-Gallegos, A., Mensforth, B.P., 2022. Applied educational practice and research development of 'goals of best practice' (GsBP): philosophical inquiries and conceptual analysis for consideration. Heliyon 8, e09689. https://doi.org/10.1016/j.heliyon.2022.e09689

[40]. Rakhmanita, A., Hurriyati, R., Gaffar, V., Wibowo, L.A., 2022. Confirmatory Factor Analysis: User Behavior M-Commerce Gamification Service in Indonesia. JOIV : International Journal on Informatics Visualization 6. https://doi.org/10.30630/joiv.6.2.848

[41]. Raza, A., Rehmat, S., Ishaq, M.I., Haj-Salem, N., Talpur, Q., 2023. Gamification in financial service apps to enhance customer experience and engagement. Journal of Consumer Behaviour 23. https://doi.org/10.1002/cb.2294

[42]. Redondo-Rodríguez, C., Becerra-Mejías, J.A., Gil-Fernández, G., Rodríguez-Velasco, F.J., 2023. Influence of Gamification and Cooperative Work in Peer, Mixed and Interdisciplinary Teams on Emotional Intelligence, Learning Strategies and Life Goals That Motivate University Students to Study. International Journal of Environmental Research and Public Health 20, 547. https://doi.org/10.3390/ijerph20010547

[43]. Ryan, R.M., Deci, E.L., 2000. Self-Determination Theory and the Facilitation of Intrinsic Motivation, Social Development, and Well-Being. American Psychologist.

[44]. Sailer, M., Homner, L., 2020. The Gamification of Learning: a Meta-analysis. Educ Psychol Rev 32, 77–112. https://doi.org/10.1007/s10648-019-09498-w

[45]. Schunk, D.H., DiBenedetto, M.K., 2020. Motivation and social cognitive theory. Contemporary Educational Psychology 60, 101832. https://doi.org/10.1016/j.cedpsych.2019.101832

[46]. Segura-Robles, A., Fuentes-Cabrera, A., Parra-González, M.E., López-Belmonte, J., 2020. Effects on Personal Factors Through Flipped Learning and Gamification as Combined Methodologies in Secondary Education. Front. Psychol. 11. https://doi.org/10.3389/fpsyg.2020.01103

[47]. Shrestha, S., Joshi, M., Bashyal, A., Timilsina, A., 2021. User Engagement in Gamified Online Learning System. World Journal of Educational Research 8. https://doi.org/10.22158/wjer.v8n5p46

[48]. Silic, M., Marzi, G., Caputo, A., Bal, P.M., 2020. The effects of a gamified human resource management system on job satisfaction and engagement. Human Resource Management Journal 30. https://doi.org/10.1111/1748-8583.12272

[49]. Su, C., Cheng, C., 2015. A mobile gamification learning system for improving the learning motivation and achievements. Journal of Computer Assisted Learning 31, 268–286. https://doi.org/10.1111/jcal.12088

[50]. Subhash, S., Cudney, E.A., 2018. Gamified learning in higher education: A systematic review of the literature. Computers in Human Behavior 87, 192–206. https://doi.org/10.1016/j.chb.2018.05.028

[51]. Sun, M., 2023. A Meta-analysis of the Impact of Gamification of Learning on Learning Outcomes in Science Education: Based on 34 Experimental and Quasi-experimental Studies. Sci. Innov. 11, 1–7. https://doi.org/10.11648/j.si.20231101.11

[52]. Talan, T., Doğan, Y., Batdı, V., 2020. Efficiency of digital and non-digital educational games: A comparative meta-analysis and a meta-thematic analysis. Journal of Research on Technology in Education 52, 474–514. https://doi.org/10.1080/15391523.2020.1743798

[53]. Toda, A., Isotani, S., Dias Valle, P.H., 2024. (PDF) The Dark Side of Gamification: An Overview of Negative Effects of Gamification in Education. ResearchGate. https://doi.org/10.1007/978-3-319-97934-2_9

[54]. Toda, A.M., Klock, A.C.T., Oliveira, W., Palomino, P.T., Rodrigues, L., Shi, L., Bittencourt, I., Gasparini, I., Isotani, S., Cristea, A.I., 2019. Analysing gamification elements in educational environments using an existing Gamification taxonomy. Smart Learning Environments 6, 16. https://doi.org/10.1186/s40561-019-0106-1

[55]. Usher, E.L., Weidner, B.L., 2018. SOCIOCULTURAL INFLUENCES ON SELF-EFFICACY DEVELOPMENT, in: BIG THEORIES REVISITED 2, Research on Sociocultural Influences on Motivation and Learning. pp. 141–164.

[56]. Wang, A., 2015. The wear out effect of a game-based student response system. Computers & Education 82, 217–227. https://doi.org/10.1016/j.compedu.2014.11.004

[57]. Wang, L.-H., Chen, B., Hwang, G.-J., Guan, J.-Q., Wang, Y.-Q., 2022. Effects of digital game-based STEM education on students' learning achievement: a meta-analysis. International Journal of STEM Education 9, 26. https://doi.org/10.1186/s40594-022-00344-0

[58]. Zainuddin, Z., Chu, S.K.W., Shujahat, M., Perera, C.J., 2020. The impact of gamification on learning and instruction: A systematic review of empirical evidence. Educational Research Review 30, 100326. https://doi.org/10.1016/j.edurev.2020.100326

[59]. Zhang, F., 2024. Effects of game-based learning on academic outcomes: A study of technology acceptance and self-regulation in college students. Heliyon 10, e36249. https://doi.org/10.1016/j.heliyon.2024.e36249

[60]. Zhang, S., Hasim, Z., 2023. Gamification in EFL/ESL instruction: A systematic review of empirical research. Frontiers in Psychology 13. https://doi.org/10.3389/fpsyg.2022.1030790

[61]. Zhao, W., 2016. Paradigm of Foreign Language Teaching and Learning: A Perspective of Self-Regulated Learning Environment Construction. Open Journal of Social Sciences 04. https://doi.org/10.4236/jss.2016.45020

Cite this Article

Renato A. Tiria Jr., Viernalyn M. Nama, "Gamification as a Tool for Enhancing Leaners' Outcomes and Motivation", *International Journal of Multidisciplinary Research in Arts, Science and Technology (IJMRAST),* ***ISSN:*** *2584-0231, Volume 3, Issue 8, pp. 110-141, August 2025.*

Journal URL: *https://ijmrast.com/*

DOI: *https://doi.org/10.61778/ijmrast.v3i8.167*