Investigating the Effectiveness of Gamification for Enhancing the Engagement of Secondary School Students in Learning Science

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DOI: https://doi.org/10.47772/IJRISS.2026.10200031

Received: 09 February 2026; Accepted: 14 February 2026; Published: 22 February2026

ABSTRACT

This study investigates the effectiveness of gamification in enhancing secondary school students' interest and engagement in science learning. Gamification refers to an instructional approach that incorporates game elements, such as points, badges, and leaderboards, to enhance learners' motivation and promote active participation. This study addresses the common issue of student disengagement in science education by examining how gamified learning strategies influence students' involvement in the classroom. The primary objectives of the study are to examine students' perceptions of gamification, compare engagement levels between male and female students, and analyze the relationship between the level of gamification and student engagement. A quantitative research design was employed, and data were collected through surveys administered to Form 4 science stream students at SMK Shah Alam. Descriptive and inferential statistical analyses were used to interpret the data and identify significant patterns and relationships. Preliminary findings indicate that students generally have positive perceptions of gamification, suggesting that it is a well-accepted instructional approach. The results also reveal a positive correlation between the use of gamification and student engagement, indicating that higher levels of gamified elements are associated with increased student involvement in learning activities. In addition, the findings suggest no significant differences in engagement levels between male and female students. This study has important implications for educational practices and policy development, highlighting the potential of gamification to create more interactive and engaging science learning environments. To better understand the long-term effects of gamification on student engagement and academic achievement, future studies should adopt mixed-method approaches, employ longitudinal research designs, and examine its implementation across diverse educational contexts.

Keywords: gamification, interactive, student engagement

INTRODUCTION

Nowadays, higher education students in Malaysia have experienced rapid changes in learning approaches aligned with the demands of the twenty-first century. Twenty-first century learning emphasizes the integration of learning, literacy, and life skills within the classroom experience (Al-Rousan et al, 2025, Nurhayati & Fathurrohman, 2025) Among these, key learning skills such as critical thinking, creativity, collaboration, and communication are widely recognized as essential competencies for successfully adapting to contemporary work environments. (Wismer et al, 2021). Literacy skills focus on understanding numerical information, evaluating the reliability of sources, and comprehending modern machinery and computer networks on which society depends. These skills help students in project planning, maintaining efficiency, and engaging in social networking (Ajri et al, 2025)

In recent years, the integration of gamification into educational settings has garnered significant attention among educators, researchers, and policymakers. Gamification refers to the use of game design elements in non-game contexts with the aim of enhancing engagement, increasing motivation, and enriching the overall learning experience. The rapid advancement of digital technology and the popularity of video games among students have encouraged educators to explore innovative approaches to make learning more interactive and appealing. As traditional teaching methods often struggle to sustain student interest and motivation, gamification presents a promising alternative to address these challenges. Sugano and Mamolo (2021) found that cooperative learning had a significant positive effect on students' attitudes, whereas traditional teaching methods did not significantly influence student motivation. The concept of gamification is grounded in the idea that elements that make games engaging can be harnessed to promote positive educational outcomes. Game elements such as points, badges, leaderboards, and narratives create a sense of achievement and healthy competition, motivating students to participate actively in the learning process. By incorporating these elements, gamification taps into fundamental human motivations, including autonomy, competence, and relatedness, resulting in enjoyable and meaningful learning experiences (Trenholm, 2023). This approach not only makes learning more engaging but also fosters intrinsic motivation, where students are driven by personal interest and enjoyment in the subject matter. Consequently, improved student engagement may lead to better academic performance (Chou, 2018).

Despite the growing interest in gamification, comprehensive empirical research on its impact on student motivation remains limited. Although preliminary findings indicate positive outcomes, further research is required to explore the underlying mechanisms by which gamification affects motivation. Additionally, it is important to examine the effects of gamification across different age groups, subjects, and educational contexts to design more effective and inclusive gamified learning environments. Another critical consideration is the potential challenges associated with gamification in education. Although gamified approaches can enhance motivation, excessive reliance on rewards may reduce students' intrinsic motivation (Baah et al., 2023). Critics also argue that gamification may function as a marketing strategy influenced by the gaming industry rather than a genuine pedagogical tool (Bogost, 2011). Therefore, a balanced approach is necessary to maximize motivational benefits without undermining students' genuine interest in learning. Furthermore, effective implementation requires careful planning, adequate resources, and proper teacher training.

LITERATURE REVIEW

According to Gamified Learning Theory (GLT), gamification refers to the process of influencing learning-related behaviors or attitudes outside the game environment through the application of game attribute categories. GLT posits that gamification does not directly influence learning outcomes; rather, it promotes learning indirectly through mediating or moderating processes that encourage learning-related behaviors. Learner behavior can, to some extent, be predicted based on how individuals perceive, process, and utilize information, which is referred to as learning tendencies (Zaric et al., 2021). GLT identifies two primary processes through which gamification affects learning: mediation and moderation. In the mediating process, gamification influences learning by encouraging behaviors or attitudes that directly enhance learning outcomes. In this case, learning-related behaviors mediate the relationship between game elements and learning. For example, the originator of GLT, Landers, illustrated that the use of storytelling as a game element can increase students' time spent engaging with course material. As increased time on task is associated with improved learning outcomes, gamification indirectly supports learning through this mechanism. In contrast, the moderating process involves using gamification to enhance existing instructional strategies. In this context, game elements are designed to encourage behaviors that support learning; however, if the instructional content is ineffective, gamification alone will not result in improved learning. Thus, GLT emphasizes that high-quality instructional design is a prerequisite for successful gamification. Therefore, for gamification to be effective, instructional content must be pedagogically sound, and the targeted behaviors or attitudes must positively contribute to learning outcomes. GLT also highlights the role of personal, situational, and contextual moderators that may influence how gamification affects learning. This theory underscores the importance of integrating gamified elements thoughtfully within well-designed instructional frameworks to maximize their educational impact (Zaric et al., 2021).

Analyzing students' perceptions of gamification is crucial for evaluating its effectiveness in educational settings. Students' attitudes, emotions, and opinions serve as key indicators of whether gamification supports or hinders the learning process. Positive perceptions, such as increased enjoyment and interactivity, suggest enhanced motivation and engagement, whereas negative perceptions, including feelings of distraction or pressure, may signal potential drawbacks. Understanding these perspectives enables educators to refine gamification strategies to better align with learners' needs and preferences, thereby improving instructional effectiveness and learning outcomes.

Empirical studies have consistently reported positive student perceptions of gamification. A review by Pratama (2020) found that students perceived gamification as enjoyable, engaging, and motivating. Similarly, Al-Samarraie et al. (2025) reported that gamified learning environments supported more effective learning and improved academic performance. Students also value the immediate feedback provided by gamified systems, which allows them to monitor progress, identify learning gaps, and adjust their strategies accordingly. This sense of achievement enhances confidence and encourages sustained engagement in learning activities.

Several studies have explored gender differences in student engagement, suggesting that engagement levels may vary between male and female students. Prior research has reported that female students often demonstrate higher engagement levels and fewer disruptive behaviors compared to male students (Rimm-Kaufman et al., 2015). Female students have also been found to exhibit greater perseverance (Kenney-Benson et al., 2006), while academic motivation has been shown to differ across genders. However, these findings are not consistent across all contexts. For instance, King (2016) reported no significant gender differences in student engagement in a study conducted in the Philippines, indicating that contextual factors may influence engagement outcomes (Korpershoek, 2021).

Research has also demonstrated a strong relationship between gamification and student engagement. Ab Rahman et al. (2018) noted that gamification can enhance student engagement in a manner similar to digital games by improving skill development and optimizing learning. Chans and Castro (2021) further described gamification as an effective strategy for increasing engagement by embedding game elements into educational environments. The primary objectives of gamification include enhancing skills, establishing purposeful learning goals, promoting engagement, supporting behavioral change, and facilitating social interaction (Knutas, 2014).

Studies have indicated that higher levels of gamification are positively associated with increased student engagement in science learning. Smiderle et al. (2020) found that gamification elements such as points, badges, and leaderboards significantly influenced student engagement and learning behaviors by motivating task completion and providing immediate feedback. Similarly, Bouchrika et al. (2019) demonstrated that personalized gamification, tailored to individual preferences and learning styles, further enhanced engagement in e-learning environments. These findings collectively suggest that well-designed gamification strategies can foster higher engagement levels and positively influence learning outcomes. Therefore, increasing the level of meaningful gamification may be an effective approach to enhancing student engagement in science education.

METHODOLOGY

Research Design

The investigation was carried out using a quantitative approach in this research design. This strategy was selected because it makes it possible to examine a bigger sample size, offering a wider range of information from which inferences can be made. Furthermore, quantitative methods provide for the numerical expression of data, which facilitates analysis and interpretation. Finding patterns, trends, and links in the data is made easier by this numerical representation, which eventually helps to provide a more thorough and impartial understanding of the research issue. The researcher can make sure that the study's conclusions are trustworthy, broadly applicable, and statistically significant by employing a quantitative technique (Almusaed et al. 2025).

A survey is the kind of quantitative method that was employed to carry out the investigation. Surveys are used because they can effectively and economically gather vast amounts of data. They are perfect for studies that need to collect a lot of data since they are a quick and efficient way to get information from big groups of people.

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume X Issue II February 2026

Surveys have the important benefit of not requiring the researcher to be present while respondents complete them, which can save time and money. Additionally, surveys offer a degree of anonymity that promotes candor among respondents. Respondents are more inclined to give honest and open answers when they are certain that their identities will be kept private and that their answers will be kept private. Because of this anonymity, the data gathered is more likely to represent the individuals' true beliefs and experiences, producing more accurate and legitimate findings. Therefore, the purpose of surveys in this study is to take use of these advantages, guaranteeing the gathering of thorough and precise data to successfully answer the research questions.

Research population

Form 4 pure science students from SMK Shah Alam served as the study's respondents. About 200 secondary students are enrolled in the school's pure scientific programs. To get the necessary data, the study included every student in this population. This cohort was deemed suitable since it offered a sizable enough sample to guarantee accurate and broadly applicable results. The study was able to get precise information about students' levels of involvement and the efficacy of gamification in a real classroom environment by concentrating on this particular group.

Research Sampling

Data was gathered using quantitative methods, which required a high number of respondents to guarantee the study's success. Depending on the level of reliability and the sampling error, a certain formula is used to estimate the right sample size for a quantitative approach. The reliability standard for social science research is usually set at 95%, while the greatest sampling error allowed is usually 5%. To guarantee that the results are accurate 95% of the time, the sample size calculation must take into consideration a 5% margin of error. This method helps guarantee that the sample is representative of the total population, yielding valid and trustworthy results. By employing this technique, the researcher can make inferences from the data with confidence, knowing that it faithfully captures the traits and actions of the larger population.

Additionally, the sample size was determined in this study using Krejcie and Morgan's (1970) Table of Random Samples. Any empirical study where the goal is to infer information about a population from a sample is regarded as having a sample size. A sizable random sample must prevent biases and sampling errors while permitting generalization. A sample's function is to enable researchers to determine how well the full study population is represented. Only students enrolled in science courses were selected as responders for this study. Since there are 81 Form 4 pure science pupils in the population, the sample size is 66 students, per Krejcle, Robert, Morgan, and Daryle's (1970) "Sample Size from Population" table.

Sampling technique

To collect the data for this study, stratified sampling was employed first, then basic random sampling. By splitting the population into discrete subgroups, or strata, that have comparable traits, stratified sampling is used. By guaranteeing that every subgroup is fairly represented in the sample, this technique raises the precision and dependability of the findings (Cohen, 2025). The sample is separated into two gender-based subgroups, or strata, using stratified random sampling: male and female. In total, there are 57 female students and 24 male pupils. The sub-sample size is then calculated by the researcher using a certain formula. The computation's outcome indicates that a sample of 20 male and 46 female students is required.

Determination of sample size

Participants are chosen from each stratum using basic random sampling after the population has been stratified. One of the greatest probability sampling methods is simple random sampling since it saves time and money. Because each person in the population has an equal chance of being selected, only by chance, it is a trustworthy way to gather information. In addition to producing an accurate sample, this approach lessens sampling bias and takes population diversity into account (Latpate et al., 2021). Since there is an equal chance of selection for each person, the sample is representative of the population. The selection of simple random sampling was based on

its many benefits. Because every member has an equal chance of being chosen, sample bias is reduced, and the sample is guaranteed to fairly represent the diverse population.

Research Instrumentation

Surveys were used, namely a collection of questionnaires, to gather the data needed for the investigation. According to Roopa and Rani (2012), a questionnaire is an organized series of questions or items intended to collect information from respondents regarding their beliefs, experiences, or viewpoints. Because of their many benefits, the researcher chose to use questionnaires. One important advantage of questionnaires is their ability to be sent to many people at once, which makes them an economical and effective way to gather data. The sample size and the validity of the study's conclusions are increased by the researcher's capacity to reach a wider audience with this method. Additionally, surveys offer a regulated method of gathering information that guarantees uniformity and comparability among answers.

Items from a number of earlier research have been adopted and modified for the instruments that will be utilized in this investigation. First, academics Rafidah Ab. Rahman, Sabrina Ahmad, and Ummi Rabaah Hashim created a study titled "The Effectiveness of Gamification Technique for Higher Education Students Engagement in Polytechnic Muadzam Shah Pahang, Malaysia." Second, a study by Guillermo M. Chans and May Portuguez Castro titled "Gamification as a Strategy to Increase Motivation and Engagement in Higher Education Chemistry Students."

The questionnaires were adopted and adapted, and they were divided into four sections which are section A, B, C and D. The items in Section A centre on the demographic background of the responder. There are four items that make up the first portion. Before and after gamification, the items often ask about the respondent's grade, gender, and age. Multiple-choice questions were used, and the respondents were told to select one response. The 27 items in Section B are designed to find out how respondents feel about the use of gamification. Perceived utility, perceived ease of use, attitude, attention, relevance, confidence, and satisfaction are the seven categories into which these elements were separated. The 15 items in Section C are designed to gauge the respondent's degree of involvement. The four categories of skill engagement, interaction engagement, emotional engagement, and cognitive engagement were used to group these elements. 18 items make up Section D, which gauges how gamified the respondent is. These objects were broken down into six categories: challenges, badges, points, presents, levels, and cooperation.

Reliability and Validity

This study was carried out at SMK Shah Alam, a secondary school. The 60 items on the questionnaires given to randomly chosen Form 4 science stream pupils are in accordance with the estimated sample size. To make sure the survey's items were reliable and valid, a pilot study was carried out. The questionnaire was given to the participants during the pilot test. Using Cronbach's alpha values, the questionnaire's reliability was evaluated. The internal consistency of the questionnaire items is shown by Cronbach's alpha values in quantitative research; a value of more than 0.7 is regarded as indicating a legitimate and dependable degree of dependability. This initial stage guarantees that the research tools are reliable and able to measure the desired variables in the primary study.

Data Collection Procedures

Several essential steps were undertaken to ensure a smooth and ethical data collection process. First, an application was submitted to the Ministry of Education Malaysia (MOE) to obtain approval for conducting the research at SMK Shah Alam. Upon receiving approval from the MOE, permission was then sought from the school principal to carry out the study on the school premises.

Before administering the questionnaire, informed consent was obtained from all selected respondents. Participation in the study was voluntary, and respondents were informed of the purpose of the research. Each respondent was allocated approximately one hour to complete the questionnaire to ensure sufficient time for thoughtful responses. The researcher anticipated that the entire data collection process would be completed

within one week. These procedures were implemented to maintain ethical standards and ensure the integrity of the research process.

Research Analysis

The information gathered from the study was used for the research analysis. Software known as the Statistical Package for the Social Sciences (SPSS) was used to calculate these data. The majority of researchers utilize this program due to its ease of use and convenience. In order to accomplish those study goals, both descriptive and inferential statistics were used in this analysis.

RESULTS

The demographic data of the respondents collected in the research consisted of the respondents' gender, age, grade before and after the gamification. A total of 73 respondents were successfully collected for this research. Female respondents (N = 47, 64.4%) had higher frequencies compared to male respondents (N = 26, 35.6%). All of the respondents who participated were 16 years old (N = 73, 100%), which means they are Form 4 students. Before gamification was implemented, grade C had the highest frequency (N = 24, 32.9%), and grade E had the lowest frequency (N = 4, 5.5%). After the gamification implementation, grade A has the highest frequency (N = 24, 32.9%), and grade E still has the lowest frequency (N = 0, 0.0%). Figure 1 and 2 below summarizes the frequency of the respondent's demographic data.

Figure 1. The Percentage of Respondent's Grade Before Gamification

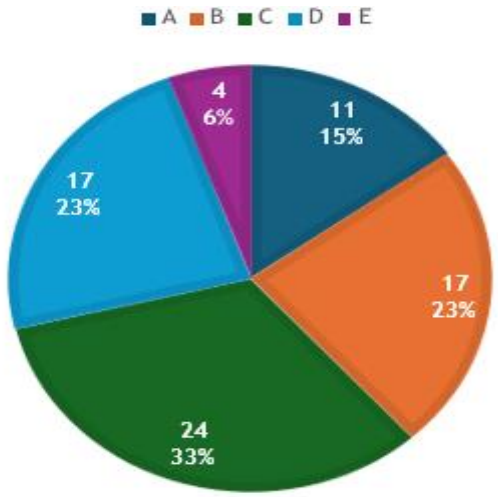
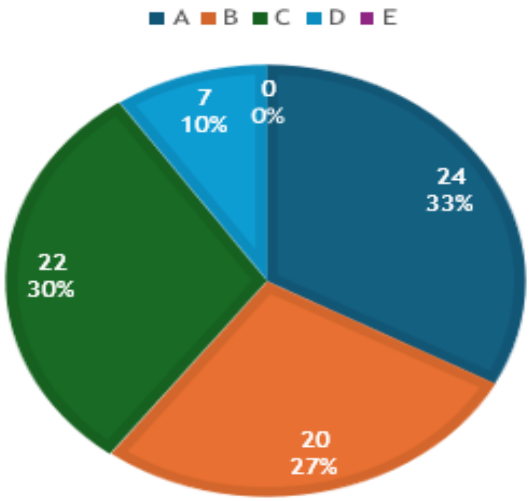


Figure 2.The Percentage of Respondent's Grade After Gamification



The Perceptions of Students towards the Implementation of Gamification

The secondary school student's perception toward the implementation of gamification in learning was determined by using the mean value. With the total inclusion number of respondents', the result shown in Table 1 indicates that the students have a high degree of perception of the implementation of gamification in the classroom (M = 100.3836, SD = 12.16054), since it lies in the range of 100–135. There are seven components of perceptions: perceived usefulness, perceived ease of use, attitude, attention, relevance, confidence, and satisfaction. All of these subdomains are moderate in terms of their degree of perception. Attention has the highest mean score (M = 15.2877, SD = 2.54667), followed by perceived usefulness (M = 15.1781, SD = 2.73528). Attitude has the lowest mean score (M = 11.1507, SD = 2.17097), and the second lowest mean score is shown by confidence (M = 14.3288, SD = 2.19883).

Table 1. The Mean Score of Perception of Students

Components of Student's Perception	**Frequencies, N**	**Mean, M**	**Standard Deviation, SD**	**Degree**
Perceived Usefulness	73	15.1781	2.73528	Moderate
Perceived Ease of Use	73	15.1096	2.07205	Moderate
Attitude	73	11.1507	2.17097	Moderate
Attention	73	15.2877	2.54667	Moderate
Relevance	73	14.4932	2.20557	Moderate
Confidence	73	14.3288	2.19883	Moderate
Satisfaction	73	14.8356	2.33936	Moderate
Perception of Students	**73**	**100.3836**	**12.16054**	**High**

The Level of Engagement Between Male and Female Students in Learning Sciences Using Gamification

The group descriptive statistic and the independent sample T-test was summarized in Table 2 and 3 respectively. It demonstrated that there was no significant difference between gender and the level of engagement in learning science through gamification. The p-value that had been obtained for this research was 0.340, which was greater than 0.05, thus H_1 was rejected. An independent T-test showed that there were no statistically significant differences in scores between the male group (N = 26; M = 54.9615; SD = 6.35283) and the female group (N = 47; M = 53.1489; SD = 8.36654), t (71) = 0.961, p = 0.340. It could be concluded that both males and females had the same levels of engagement. However, the mean value for male students was slightly higher than that for female students.

All the p-values for the components of engagement were greater than 0.05 (Table 3). As a result, there were no significant differences between male and female students' levels of all component engagement in learning sciences using gamification. Both genders also portrayed a moderate level of all-component engagement. According to Table 2, males had a higher mean value in all subdomains of engagement, including skill engagement (M = 10.0769, SD = 1.85306), interaction engagement (M = 14.4468, SD = 2.87272), emotional engagement (M = 14.9615, SD = 2.06844), and cognitive engagement (M = 14.6538, SD = 2.20803). Then followed by female students, which were skill engagement (M = 10.0426, SD = 2.29326), interaction engagement (M = 15.2692, SD = 1.90909), emotional engagement (M = 14.3404, SD = 2.60665), and cognitive engagement (M = 14.6538, SD = 2.20803).

H_0 = There is no significance differences between the level of engagement for male and female students in learning Science using gamification.

H_1 = there is a significance differences between the level of engagement for male and female students in learning Science using gamification

Table 2. The Group Descriptive Statistic for Each Gender

Components	Gender	Frequencies, N	Mean, M	Std Deviation, SD	Level
Skill Engagement	Male Female	26 47	10.0769 10.0426	1.85306 2.29326	Moderate Moderate
Interaction Engagement	Male Female	26 47	15.2692 14.4468	1.90909 2.87272	Moderate Moderate
Emotional Engagement	Male Female	26 47	14.9615 14.3404	2.06844 2.60665	Moderate Moderate
Cognitive Engagement	Male Female	26 47	14.6538 14.3191	2.20803 2.75133	Moderate Moderate
Engagement	**Male Female**	**26** **47**	**54.9615** **53.1489**	**6.35283** **8.36654**	**High High**

Table 3. Independent Sample T-Test for Male and Female

		Levene's Test for Equality of Variances	**t-test for Equality of Means**		
		Sig.	**t**	**df**	**Sig. (2-tailed)**
Skill Engagement	Equal variances assumed	0.221	0.065	71	0.948
	Equal variances not assumed		0.070	61.367	0.945
Interaction Engagement	Equal variances assumed	0.122	1.307	71	0.195
	Equal variances not assumed		1.464	68.470	0.148
Emotional Engagement	Equal variances assumed	0.233	1.045	71	0.299
	Equal variances not assumed		1.117	62.151	0.268

Cognitive Engagement	Equal variances assumed	0.200	0.532	71	0.596
	Equal variances not assumed		0.567	61.665	0.573
Engagement	**Equal variances assumed**	**0.172**	**0.961**	**71**	**0.340**
	Equal variances not assumed		**1.039**	**63.979**	**0.303**

The Correlations of Gamification Level with Engagement Level of Students in Learning Sciences Using Gamification.

Table 4 shows the analysis of Pearson's correlation between the gamification level and students engagement level in learning sciences. Pearson's correlation coefficient was r = 0.616, with a p-value less than 0.001. Since the p-value is less than 0.05, the null hypothesis, H_0, will be rejected, which states that there is no correlation between gamification level and students's engagement level in learning science. It means that there is actually a correlation between gamification level and students's engagement level in learning science.

H_0 = There is no correlation of gamification level with engagement level of students in learning sciences.

H_1 = There is a correlation of gamification level with engagement level of students in learning sciences.

Table 4. Pearson's Correlation on Gamification Level with Engagement Level

Gamification level			**Engagement level**
Gamification level	**Pearson Correlation**	1	0.616
	Sig. (2-tailed) N	73	0.000 73
Engagement level	**Pearson Correlation**	0.616	1
	Sig. (2-tailed) N	0.000 73	73

DISCUSSION

Perceptions of Students Regarding the Implementation of Gamification

The findings of this study indicate that secondary school students generally hold a positive perception of gamification in learning, as reflected by the high mean score (M = 100.3836, SD = 12.16054). This optimistic perspective implies that students find gamified learning both beneficial and engaging, which is consistent with the positive trend in educational research supporting gamification as an effective tool for enhancing student motivation and engagement (Deterding et al., 2011). The high mean value is noteworthy because it suggests that students generally favor gamified learning approaches. This finding aligns with numerous studies demonstrating the potential of gamification to transform conventional learning environments into more interactive and immersive experiences, thereby promoting active and participatory learning (Sailer et al., 2017).

A more detailed understanding of the impact of gamification on students' learning experiences can be achieved by analyzing each of the seven components separately. The attention component recorded the highest mean score (M = 15.2877, SD = 2.54667), indicating that gamification effectively captures and sustains students' attention. This finding aligns with previous research indicating that game elements, including badges, points, and leaderboards, can substantially increase student engagement and attentiveness in educational activities (Hamari, Koivisto, & Sarsa, 2014). These elements, often described as extrinsic motivators, help maintain students' interest by providing immediate feedback and rewards. Therefore, the careful integration of these components is essential to maximize their impact on student engagement.

Perceived usefulness (M = 15.1781, SD = 2.73528) also received a high score, suggesting that students recognize the practical benefits of gamification in their learning process. This perception is significant as it underscores gamification's effectiveness in enhancing both student engagement and the perceived value of educational content (Huang & Soman, 2013). When students recognize learning activities as valuable, they are more likely to dedicate time and effort, which can lead to improved academic outcomes. The high score for perceived usefulness suggests that gamification may facilitate the connection between theoretical knowledge and practical application, thereby making learning more meaningful and relevant.

In contrast, attitude toward gamification recorded the lowest mean score (M = 11.1507, SD = 2.17097). This suggests that although students acknowledge the usefulness and engaging aspects of gamification, their overall attitude may be influenced by factors such as the novelty of the approach, the design quality of the gamified elements, or prior experiences with traditional teaching methods. While gamification appears effective in capturing attention and demonstrating utility, some students may still exhibit reservations regarding its overall effectiveness or suitability as a learning strategy. Understanding and addressing these underlying factors are essential to further improve students' attitudes toward gamified learning. This may involve providing adequate guidance, improving instructional design, and ensuring meaningful integration of game elements into the curriculum.

The second lowest mean score was recorded for confidence (M = 14.3288, SD = 2.19883), suggesting that although gamification enhances engagement, it may not yet fully strengthen students' confidence in their academic abilities. This highlights a potential area for improvement, such as incorporating adaptive and personalized game elements tailored to individual learning styles and paces (Cheong et al, 2013). Since confidence plays a crucial role in academic success, gamification strategies should emphasize constructive feedback, positive reinforcement, and opportunities for mastery learning. By integrating personalized feedback mechanisms and adaptive learning technologies, educators can enhance students' self-efficacy and foster greater confidence in academic settings.

The Different Levels of Engagement between Genders

This research found that there were no significant differences between gender and the level of engagement among science students. This indicates that gender does not significantly affect an individual's level of engagement in learning science. In this study, both male and female students demonstrated high levels of engagement, although male students recorded a slightly higher overall mean than female students.

These findings are consistent with a previous study conducted by Kintu et al. (2017), which reported no significant gender differences in learner engagement within blended learning environments. This suggests that both male and female learners can benefit equally from blended learning approaches, as gender does not substantially influence their engagement or performance. Nevertheless, in the present study, male students showed a higher overall mean engagement score compared to female students. This observation aligns with studies by Korlat et al. (2021) and Kuo et al. (2018), which found that male students tended to engage more actively in science-related activities than their female counterparts. Such differences were particularly evident in learning environments designed to be interactive and hands-on, which may traditionally appeal more to male students.

Although the overall engagement levels between male and female students did not differ significantly, a closer examination of specific engagement components provides further insight into gender-related patterns in gamified

science learning. The findings indicate that male students obtained slightly higher mean scores across all four components of engagement (skill engagement, interaction engagement, emotional engagement, and cognitive engagement). However, the differences in mean scores between male and female students were minimal. This suggests that the engagement levels of both genders are relatively comparable, and it is possible that some female students demonstrate higher engagement than male students in certain aspects. Supporting this perspective, Nadeem et al. (2023) reported that female students experienced higher levels of enjoyment and engagement with games compared to male students.

The Correlation of Gamification Level and Student's Engagement Level

The results of this study demonstrate a significant positive correlation between the level of gamification and students' engagement in learning science, as indicated by Pearson's correlation coefficient ($r = 0.616$, $p < 0.001$). This finding suggests that higher levels of gamification are associated with increased student engagement in science education, thereby supporting the hypothesis that gamification can serve as an effective strategy for enhancing educational outcomes.

Overall, the strong positive relationship between the level of gamification and student engagement in science learning underscores the potential of gamification as an effective instructional approach. By making learning more interactive, enjoyable, and motivating, gamification can enhance student engagement and contribute to improved educational outcomes.

CONCLUSION

The study's conclusions provide insightful information about how gamification can improve students' interest in studying the sciences. This study's three primary goals—finding out how students feel about gamification, comparing male and female students' levels of engagement, and figuring out the relationship between gamification and student engagement—were all effectively met. Every goal has important ramifications for future study, legislation, and educational practice.

First, the study found that students have very favorable opinions on the use of gamification in science education. These results imply that teachers should think about adding gamification components to their lesson plans in order to produce more engaging and dynamic learning environments. The favorable opinions of the students highlight gamification's potential as a useful teaching strategy. Second, the study indicated that when gamification was used to teach sciences, there was no discernible difference in the levels of involvement between male and female students. Male students, however, were shown to have somewhat higher mean scores for overall involvement, especially in dynamic and hands-on learning environments. Notwithstanding these minor variations, the general conclusion indicates that gamification can support inclusivity and equity in education and be just as successful for both sexes. Finally, the study found a strong positive relationship between student interest in learning sciences and the degree of gamification. The idea that greater degrees of gamification are linked to higher levels of student engagement is supported by this research. Additionally, this study illustrates how gamification can be a successful tactic for raising student interest in science courses. The advantages of incorporating gamification into teaching methods are demonstrated by the favorable opinions of students, the lack of notable gender disparities in participation, and the robust relationship between gamification levels and engagement. These findings imply that gamification can produce more interesting, pleasurable, and productive learning environments for all students, which has significant ramifications for curriculum design, instructional strategies, and educational regulations.

By investigating the effects of gamification in various subjects and educational levels, using mixed-methods approaches, and carrying out longitudinal studies to evaluate the long-term effects of gamification on student engagement and academic performance, future research should build on these findings. Researchers can gain a more thorough grasp of how gamification affects student learning and improve its application in educational settings by tackling these issues.

ACKNOWLEDGEMENT

The authors thank all the participants who take part in the current study and Faculty of Education, UiTM Selangor Branch, Puncak Alam Campus for the support.

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