# THE IMPACT OF DIGITAL GAMIFICATION ON STUDENT ENGAGEMENT AND ACADEMIC PERFORMANCE MEDIATED BY LEARNING MOTIVATION IN HIGHER EDUCATION

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**Abstract:** This study investigates the impact of digital gamification on student engagement and academic performance, mediated by learning motivation, in higher education. As digital gamification becomes increasingly integrated into educational environments, understanding its influence on student outcomes is crucial. The research employs a quantitative approach, collecting 310 valid responses from students across various higher education institutions. Structural equation modeling (SEM) was applied to test the hypothesized relationships among digital gamification, student engagement, learning motivation, and academic performance. The findings support all proposed hypotheses. Digital gamification has a significant positive effect on academic performance (H1), suggesting that incorporating game-based elements into the learning process enhances students' academic outcomes. Furthermore, student engagement significantly moderates the relationship between digital gamification and academic performance (H2), indicating that the positive impact of gamification on academic performance is more pronounced among highly engaged students. The results also reveal that learning motivation mediates the relationship between digital gamification and academic performance (H3), demonstrating that gamification boosts students' motivation, which in turn improves academic achievement. Additionally, the interaction between student engagement and learning motivation significantly affects academic performance (H4), highlighting the synergistic effect of engagement and motivation in enhancing learning outcomes. This research contributes to the growing body of literature on digital gamification by providing empirical evidence of its effectiveness in fostering student engagement and improving academic performance. The study underscores the importance of designing gamified learning environments that not only capture students' interest but also cultivate motivation and engagement. These findings offer valuable insights for educators and policymakers aiming to optimize digital learning strategies. Future research could explore longitudinal impacts and examine

diverse educational settings to further validate these relationships.

**Keywords:** Digital Gamification, Student Engagement, Learning Motivation, Academic Performance, Higher Education, Quantitative Study.

## Introduction

In recent years, the integration of digital gamification into educational settings has garnered significant attention, particularly within higher education. Gamification, defined as the application of game-design elements in non-game contexts, aims to enhance student engagement, motivation, and overall learning outcomes (Deterding et al., 2011). This research background explores the impact of digital gamification on student engagement and academic performance, with a specific focus on the mediating role of learning motivation in higher education.

### Digital Gamification in Education

The incorporation of gamified elements such as points, badges, leaderboards, and interactive challenges into educational environments has been shown to foster a more engaging and motivating learning experience. A study by Subhash and Cudney (2018) conducted a systematic literature review and found that gamification positively influences student engagement and motivation, leading to improved learning outcomes. Similarly, a meta-analysis by Sailer and Homner (2020) concluded that gamification has a moderate to large effect on cognitive, motivational, and behavioral learning outcomes.

### Student Engagement and Academic Performance

Student engagement, characterized by active participation, emotional involvement, and cognitive investment in learning activities, is a critical predictor of academic success. Research indicates that higher levels of engagement are associated with improved academic performance, retention rates, and overall student satisfaction (Fredricks et al., 2004). Gamified learning environments have been found to enhance engagement by making learning experiences more interactive and enjoyable. For instance, a study by Dichev and Dicheva (2017) reported that gamification strategies, such as the use of points and badges, increased student participation and time spent on learning tasks.

### Learning Motivation as a Mediator

Learning motivation, encompassing intrinsic and extrinsic motivational factors, plays a pivotal role in influencing student engagement and academic performance. Intrinsic motivation refers to engaging in an activity for its inherent satisfaction, while extrinsic motivation involves performing a task to achieve external rewards or avoid negative outcomes (Ryan & Deci, 2000). Gamification has the potential to enhance both types of motivation. A systematic literature review by Seaborn and Fels (2015) found that gamified elements could boost intrinsic motivation by providing immediate feedback and a sense of accomplishment. Additionally, the use of external rewards, such as badges and

leaderboards, can serve as extrinsic motivators, further enhancing student engagement.

As a moderator of Student Engagement

Digital Gamification enhances the learning experience through incentives and interactive design, but existing research mostly focuses on its direct effect on student engagement and academic performance, while ignoring the moderating effect of student engagement. This study aims to explore how student engagement moderates the relationship between digital gamification and academic performance, and further analyzes the mediating role of Learning Motivation, in order to deepen the understanding of the educational mechanism of gamification.

Empirical Evidence

Recent empirical studies provide evidence supporting the positive impact of gamification on learning motivation, engagement, and academic performance. For example, a study by Hanus and Fox (2015) examined the effects of gamification in a college course and found that students exposed to gamified elements reported higher motivation and engagement levels, which correlated with better academic performance. Similarly, a quasi-experimental study by Su and Cheng (2015) demonstrated that incorporating game-based learning strategies in higher education significantly improved students' learning motivation and achievement.

Challenges and Considerations

Despite the promising outcomes, the implementation of gamification in higher education is not without challenges. One concern is the potential for superficial engagement, where students may focus more on earning rewards than on deep learning (Nicholson, 2015). Additionally, the effectiveness of gamification can vary depending on individual differences, such as students' personal preferences and cultural backgrounds (Hamari et al., 2014). Therefore, it is crucial to design gamified learning environments that align with educational objectives and cater to diverse student needs.

The integration of digital gamification in higher education presents a promising avenue for enhancing student engagement and academic performance, with learning motivation serving as a critical mediating factor. While empirical evidence supports the efficacy of gamified learning environments, careful consideration must be given to their design and implementation to address potential challenges and ensure that they effectively contribute to meaningful learning experiences. Future research should continue to explore the long-term effects of gamification and identify best practices for its application across diverse educational contexts.

Questions of the study:

1. How does Digital Gamification affect students' academic performance? Is the effect statistically significant? What are the influence paths and mechanisms of action?

2. Does Learning Motivation play a mediating role between Digital Gamification and Academic Performance? Can Learning Motivation explain the effect of Digital Gamification on Academic Performance? Do different types of Learning Motivation (e.g., Intrinsic Motivation and Extrinsic

Motivation) have different mediating effects?

3. Does Student Engagement moderate the effect of Digital Gamification on Academic Performance? Does a high level of Student Engagement strengthen or weaken the effect of Digital Gamification on Academic Performance? Do different dimensions of Engagement (e.g., Behavioral, Affective, and Cognitive Engagement) have different moderating effects?

4. Do Individual Characteristics (e.g., prior Learning Motivation levels and Learning Styles) further influence the effect of Digital Gamification?

5. Does Learning Style influence the effectiveness of Gamified Learning? Do students with different levels of Learning Motivation exhibit different effects of Gamified Learning?

**Research Objectives**

Objective 1. To examine the impact of digital gamification on student engagement in higher education: This objective focuses on understanding how the integration of digital gamified elements in educational settings influences students' level of engagement, including their attention, interest, and participation in the learning process.

Objective 2. To analyze the effect of digital gamification on academic performance among higher education students: This objective aims to investigate whether and how gamified learning environments contribute to improvements in students' academic outcomes, such as grades and overall performance.

Objective 3: Explore the moderating role of student engagement between digital gamification and academic performance. This objective focuses on how student engagement affects the effect of digital gamification on academic performance, that is, whether a high level of student engagement can enhance or inhibit the effect of gamified learning on academic performance. By analyzing different dimensions of student behavior, emotional, and cognitive engagement in a gamified learning environment, this study hopes to reveal the mechanism of engagement as a moderating variable and further understand how student engagement can change the learning effects of digital gamification in different contexts.

Objective 4. To evaluate the mediating role of learning motivation in the relationship between digital gamification and academic performance: This objective examines whether learning motivation mediates the effect of digital gamification on academic performance, helping to clarify the mechanisms through which gamification might lead to better academic outcomes.

**Literature Review**

**1. Review of Topics and Variables**

1.1 Digital Gamification in Higher Education

Digital gamification refers to the application of game design elements such as points, badges,

leaderboards, and challenges in non-game contexts, particularly in educational settings (Deterding, Dixon, Khaled, & Nacke, 2011). It has emerged as a tool to enhance student engagement, motivation, and learning outcomes in higher education. The concept builds on the principles of games, including feedback, rewards, and progression, to make learning more interactive and engaging (Anderson & Dron, 2019).In higher education, digital gamification has become a focus of research due to its potential to transform traditional pedagogical approaches. As a result of the increasing integration of technology into the classroom, educators have explored how gamified learning environments can be utilized to address challenges such as student disengagement and low academic performance (Subhash & Cudney, 2018). According to Sailer and Homner (2020), the strategic use of gamification fosters a deeper connection between students and learning content by increasing motivation and enhancing attention.The effectiveness of digital gamification can be seen in its impact on student behavior, engagement, and performance. Deterding et al. (2011) identified that gamification engages students by making the learning process more enjoyable and challenging. By incorporating elements such as achievements, rewards, and competition, students are motivated to persist in tasks and actively participate in learning activities, contributing to greater levels of academic success (Cheong, Filippou, & Cheong, 2017).

1.2 Student Engagement in Higher Education

Student engagement is often defined as the extent to which students are involved in their academic activities, including behavioral, emotional, and cognitive involvement (Fredricks, Blumenfeld, & Paris, 2004). Engagement has been shown to be a strong predictor of academic performance and is often seen as a critical component of student success in higher education (Trowler, 2010). Research indicates that when students are engaged, they are more likely to put forth effort in their learning, persist through challenges, and perform better academically (Schunk, Pintrich, & Meece, 2008).Engagement in gamified environments is often considered higher compared to traditional classroom settings due to the interactive and competitive nature of games. According to Muntean (2011), gamification enhances engagement by providing students with clear goals, instant feedback, and opportunities for mastery, which leads to an intrinsic motivation to engage with the material. In a study by Anderson and Dron (2019), it was found that the inclusion of digital gamification elements in the learning process increased students' cognitive and behavioral engagement significantly.Gamification has been shown to promote both intrinsic and extrinsic motivation among students, thus improving engagement (Subhash & Cudney, 2018). The dynamic and participatory elements of gamification can transform mundane tasks into compelling activities, leading to higher levels of effort and sustained interest in learning.

1.3 Academic Performance in Higher Education

Academic performance, traditionally measured by grades and academic achievements, is a central outcome of higher education. It reflects the extent to which students are able to master content and demonstrate competency in a given field (Perry, 2003). In recent years, academic performance has

been closely linked to the degree of student engagement, with research suggesting that students who are more engaged tend to perform better academically (Schunk et al., 2008).The relationship between gamification and academic performance has been explored in several studies. A meta-analysis by Sailer and Homner (2020) concluded that gamification has a moderate to large effect on academic performance, particularly when it promotes intrinsic motivation and provides students with a sense of accomplishment. Additionally, a study by Cheong et al. (2017) found that students who participated in gamified learning activities reported increased academic performance, particularly in subjects that traditionally experience low levels of engagement.Gamification enhances academic performance by fostering active learning, improving time management, and facilitating peer collaboration. According to Anderson and Dron (2019), the interactive nature of gamification leads to better retention of knowledge, as students are required to apply what they have learned in practical and challenging scenarios.

1.4 Learning Motivation as a Mediator

Learning motivation is an essential factor in educational psychology that influences students' academic behavior and achievement (Ryan & Deci, 2000). It is a psychological construct that drives students to engage with learning activities and persist in the face of academic challenges (Schunk et al., 2008). Motivation is often categorized into intrinsic and extrinsic forms, with intrinsic motivation arising from a personal interest or enjoyment in the activity, and extrinsic motivation driven by external rewards such as grades or recognition (Deci & Ryan, 1985).In the context of gamification, learning motivation is particularly significant, as gamified environments are designed to boost both intrinsic and extrinsic motivation by providing rewards, recognition, and a sense of progression (Anderson & Dron, 2019). The inclusion of rewards such as points, badges, and achievements has been shown to enhance student motivation and increase their participation in learning activities (Deterding et al., 2011). The potential for competition and collaboration also serves as a motivating factor, encouraging students to strive for higher performance (Cheong et al., 2017).Learning motivation plays a critical mediating role in the relationship between gamification, student engagement, and academic performance. According to Subhash and Cudney (2018), gamification can stimulate students' motivation, which in turn drives greater engagement with the learning process and improves academic outcomes. In a study by Muntean (2011), it was found that students who experienced high levels of motivation in gamified environments exhibited more consistent academic performance. Thus, motivation is not only a key determinant of engagement but also a crucial mediator that connects gamification with improved academic performance.

1.5 Student Engagement as the moderating variable

Student Engagement has received considerable attention as a moderating variable in educational research. Student Engagement is commonly defined as the emotional, cognitive, and behavioral investment that students bring to the learning process (Fredricks, Blumenfeld, & Paris, 2004). This

investment is not only strongly related to Academic Performance, but is also considered to be a comprehensive reflection of students' Learning Motivation, classroom behaviors, and affective states. Research indicates that Student Engagement plays an important role in Academic Performance. In digital learning environments, gamification elements are considered a strategy to enhance student engagement. According to the self-determination theory of Deci and Ryan (Deci & Ryan, 2000), gamification design can stimulate students' intrinsic motivation by providing challenging tasks, immediate feedback, and opportunities for autonomous choice, thereby increasing their cognitive engagement and emotional involvement, and ultimately promoting academic performance (Deterding et al., 2011). In studies where Student Engagement is used as a moderating variable, some studies have found that Student Engagement can moderate the effect of student performance in different educational strategies and learning environments. For example, Reeve (2013) pointed out that students with high engagement levels will see more significant improvements in academic performance when faced with a gamified learning environment, while students with low engagement levels may not be able to take full advantage of the learning benefits brought about by gamification elements. This finding suggests that Engagement not only affects students' performance in the learning process, but also moderates the effect of external factors (such as Gamification) on Academic Performance. In addition, academia has also pointed out that individual differences in students, such as prior Learning Motivation and Learning Style, may also affect the moderating effect of Engagement on Academic Performance. For example, research has shown that students with higher intrinsic motivation are more engaged in gamified learning environments and therefore are better able to reap the learning benefits of gamification design (Vansteenkiste et al., 2004). These studies reveal the importance of engagement as a moderating variable and provide strong theoretical support for future research. In summary, Student Engagement plays a key role as a moderating variable in the impact of Digital Gamification on Academic Performance. A deeper exploration of its mechanism of action can help to understand the differential performance of different learners in gamified environments and provide a basis for designing effective gamified learning strategies.

1.6 Variables in the Study

This study examines several key variables that collectively contribute to understanding the impact of digital gamification on student engagement and academic performance:

Digital gamification serves as the independent variable, representing the introduction of game-like elements in educational environments. This includes features such as point systems, badges, leaderboards, levels, challenges, and rewards that enhance the learning experience (Anderson & Dron, 2019). Research has shown that gamification increases both intrinsic and extrinsic motivation, thus affecting student engagement and academic performance (Deterding et al., 2011).

Student Engagement is a moderating variable in this study and plays a key role. Student Engagement refers to the behavioural, emotional and cognitive investment that students show in the

learning process (Fredricks, Blumenfeld, & Paris, 2004). This variable not only reflects students' investment in the classroom and learning activities, but also effectively moderates the impact of other variables (such as Digital Gamification) on Academic Performance. The moderating effect of Student Engagement between Digital Gamification and Academic Performance is that the level of Student Engagement may influence how gamification elements affect students' academic performance. Research shows that when students are actively engaged in gamified learning activities, they are more engaged in their learning and are therefore more likely to achieve higher academic performance (Reeve, 2013). Conversely, if students are less engaged, their Learning Motivation and academic performance may not be significantly improved, even in a learning environment full of gamification elements. Therefore, Student Engagement, as a moderating variable, can affect the actual effect of Digital Gamification on Academic Performance.

Academic performance is the primary dependent variables in this study. Engagement is measured by students' behavioral, cognitive, and emotional involvement in their learning activities (Fredricks et al., 2004). Academic performance is assessed based on students' grades and achievement in their courses (Perry, 2003). Both variables are influenced by digital gamification and the level of motivation that gamification can evoke in students (Sailer & Homner, 2020).

Learning motivation mediates the relationship between gamification, student engagement, and academic performance. Motivation influences the degree to which students engage with gamified learning environments and how this engagement translates into academic success. Intrinsic motivation, in particular, has been found to be a key factor in enhancing learning outcomes (Ryan & Deci, 2000).

The review of topics and variables in this study underscores the central role of digital gamification in enhancing student engagement and academic performance. As an emerging pedagogical tool, gamification offers the potential to motivate students, promote active learning, and foster a deeper connection to educational content. Through the lens of learning motivation, this study aims to investigate how gamification influences engagement and performance in higher education, providing valuable insights into the mechanisms that drive successful learning outcomes in the digital age.

## 2. Theoretical Framework

The theoretical framework for this study is based on the integration of several established theories that explore the impact of digital gamification on student engagement and academic performance. These theories include Self-Determination Theory (SDT), Expectancy-Value Theory, and the Flow Theory, all of which provide insight into the cognitive and motivational processes that link digital gamification with student behavior and academic outcomes. These frameworks also emphasize the role of learning motivation as a mediating factor in this relationship.

### 2.1 Self-Determination Theory (SDT)

Self-Determination Theory (SDT), developed by Deci and Ryan (1985), provides a robust framework for understanding human motivation in educational contexts. SDT posits that individuals

have three basic psychological needs: autonomy, competence, and relatedness, which are essential for fostering intrinsic motivation. The theory asserts that when these needs are satisfied, individuals are more likely to engage in activities willingly, leading to enhanced learning and performance.In the context of digital gamification, SDT helps explain how game-like elements, such as points, levels, badges, and leaderboards, can satisfy students' psychological needs, particularly when they offer opportunities for autonomy (choice in the learning process), competence (mastery of tasks), and relatedness (social connections and collaboration with peers). For example, a gamified environment that allows students to progress at their own pace or receive personalized feedback fosters autonomy, while the ability to earn rewards through task completion promotes competence (Ryan & Deci, 2000). Research has shown that satisfying these psychological needs through gamification can increase students' intrinsic motivation, leading to greater engagement and improved academic performance (Anderson & Dron, 2019).As it relates to the study, SDT serves as a foundational theory for understanding how digital gamification can enhance students' engagement and performance by enhancing motivation. Specifically, gamification can act as a tool that increases students' intrinsic motivation, which mediates the effects of gamification on engagement and academic success (Cheong, Filippou, & Cheong, 2017).

2.2 Expectancy-Value Theory

Expectancy-Value Theory (EVT), introduced by Eccles and Wigfield (2002), focuses on the cognitive and motivational factors that influence achievement-related behavior. The theory posits that individuals' motivation to engage in a task is determined by two main components: expectancy and value. Expectancy refers to an individual's belief about their ability to succeed in a task, while value refers to the importance or usefulness that an individual places on the task. According to EVT, students are more likely to engage in tasks that they expect to succeed in and that they value as important or interesting.In a gamified learning environment, digital game mechanics such as progress tracking, rewards, and feedback directly influence students' expectations of success. For instance, clear progression through levels and immediate feedback on performance enhance students' belief in their ability to succeed. Additionally, the intrinsic value of the learning experience can be amplified when students see the relevance or enjoyment in completing tasks (Deterding, Dixon, Khaled, & Nacke, 2011). As students' perceptions of their own competence and the value of tasks increase, their motivation to engage in the learning process is enhanced, which in turn affects their academic performance (Muntean, 2011).EVT is crucial in understanding how digital gamification impacts student motivation and, by extension, engagement and performance. The expectancy component, in particular, explains how game elements that provide immediate feedback and reinforce students' beliefs about their abilities can lead to greater motivation and engagement. Thus, EVT helps to explain how gamification increases student engagement by enhancing both the perceived value of learning tasks and the expectancy of success (Cheong et al., 2017).

2.3 Flow Theory

Flow Theory, proposed by Csikszentmihalyi (1990), focuses on the optimal state of intrinsic motivation, where individuals are fully immersed and engaged in an activity. Flow is characterized by a deep sense of enjoyment, focus, and a loss of self-consciousness during an activity, often occurring when the challenge of a task aligns with an individual's skill level. According to Flow Theory, when students are in a state of flow, they experience heightened concentration, emotional involvement, and intrinsic motivation, which leads to better learning outcomes (Csikszentmihalyi, 1990).Digital gamification can promote flow experiences by providing tasks that are challenging yet achievable, with clear goals, immediate feedback, and a sense of progression. When students interact with gamified learning environments, they are more likely to experience flow, which increases their cognitive and emotional engagement. Research has demonstrated that gamified environments often lead to flow experiences, where students are deeply engaged with the learning content and exhibit high levels of motivation and academic performance (Subhash & Cudney, 2018).Flow Theory is particularly relevant to this study, as it helps explain how gamified learning environments can foster deep engagement and enhance academic performance. By providing a balanced level of challenge and feedback, gamified environments increase the likelihood that students will experience flow, thus mediating the relationship between gamification and academic performance (Muntean, 2011). Moreover, learning motivation, as part of the flow state, becomes a critical mediator in this relationship.

2.4 The Role of Learning Motivation as a Mediator

Learning motivation is central to understanding the impact of digital gamification on student engagement and academic performance. As a mediating variable, learning motivation influences how gamification affects student behavior and outcomes. Motivation can be intrinsic (driven by personal interest and enjoyment of the task) or extrinsic (driven by external rewards such as grades or recognition) (Ryan & Deci, 2000). Gamification has been shown to enhance both types of motivation by offering rewards and fostering a sense of accomplishment and progress, which leads to increased engagement and better academic outcomes (Cheong et al., 2017).In this study, learning motivation is hypothesized to mediate the relationship between digital gamification and the two primary dependent variables: student engagement and academic performance. By increasing motivation, gamification enhances students' cognitive, emotional, and behavioral engagement with the learning material, which in turn improves their academic performance (Sailer & Homner, 2020). Research has shown that motivation is a critical link in understanding how gamification influences student behavior, suggesting that the impact of digital gamification on engagement and academic performance is significantly mediated by students' motivation levels (Deterding et al., 2011).

2.5 Integration of Theories

The integration of Self-Determination Theory (SDT), Expectancy-Value Theory (EVT), and Flow Theory provides a comprehensive understanding of how digital gamification affects student

engagement and academic performance. These theories emphasize the role of motivation in the learning process and highlight the importance of game design elements in fostering intrinsic motivation and engagement.Together, these theories suggest that gamification, by satisfying students' psychological needs (SDT), enhancing their expectancy and value (EVT), and facilitating flow experiences (Flow Theory), can increase motivation, which in turn leads to greater engagement and improved academic performance. Motivation, therefore, serves as the key mechanism through which digital gamification influences student behavior and academic outcomes.

The theoretical framework for this study combines elements of SDT, EVT, and Flow Theory to explain how digital gamification impacts student engagement and academic performance through the mediation of learning motivation. By satisfying students' psychological needs, enhancing their expectations of success, and fostering flow experiences, gamification can significantly increase motivation, which in turn promotes engagement and academic success. This framework offers a comprehensive understanding of the underlying processes that mediate the relationship between gamification, engagement, and performance in higher education, providing valuable insights into the design and implementation of gamified learning environments.

**3. Current study and Gaps**

TIn recent years, the integration of digital gamification into higher education has garnered significant attention due to its potential to enhance student engagement and improve academic performance (Anderson & Dron, 2019). Researchers have explored various aspects of gamification, including its design elements, its impact on motivation, and the mechanisms through which it influences learning outcomes (Cheong, Filippou, & Cheong, 2017). Despite the growing body of literature on digital gamification, several gaps remain that warrant further investigation, particularly regarding the underlying mechanisms, the role of learning motivation, and the long-term impacts of gamification on academic performance.

3.1 The Rise of Digital Gamification in Higher Education

Digital gamification refers to the application of game-design elements in non-game contexts to engage and motivate learners (Deterding, Dixon, Khaled, & Nacke, 2011). The use of gamification in higher education is driven by the increasing need to address disengagement, lack of motivation, and poor academic performance among students (Muntean, 2011). Recent studies indicate that gamification strategies, such as earning rewards, competing with peers, and achieving levels, have the potential to increase students' intrinsic motivation and lead to enhanced learning experiences (Cheong et al., 2017; Subhash & Cudney, 2018). These game-like elements can satisfy students' psychological needs for autonomy, competence, and relatedness, which are central to fostering intrinsic motivation (Ryan & Deci, 2000).However, while the existing literature emphasizes the benefits of gamification, it is crucial to understand the specific pathways through which digital gamification impacts student engagement and academic performance. Previous research has largely focused on identifying the outcomes of

gamification, such as improved motivation and engagement, but less attention has been given to the mediating variables that explain why gamification is effective. One such variable is learning motivation, which plays a central role in determining whether students will engage with the gamified learning environment and how it impacts their academic success.

3.2 Learning Motivation as a Mediator in Gamification

Learning motivation is widely recognized as a key determinant of academic success (Deci & Ryan, 2000). The existing research indicates that gamification can enhance both intrinsic and extrinsic motivation, which are essential for sustaining engagement and achieving academic goals (Anderson & Dron, 2019). Several studies suggest that gamified learning environments foster higher levels of intrinsic motivation by providing autonomy, promoting mastery, and creating a sense of achievement (Sailer & Homner, 2020). These elements align with the core principles of Self-Determination Theory (SDT), which posits that when students' psychological needs are satisfied, they are more likely to engage in the learning process (Ryan & Deci, 2000).However, while SDT provides a solid theoretical foundation for understanding motivation in gamified environments, the empirical evidence on the mediating role of motivation remains scarce. Although some studies have suggested that motivation mediates the relationship between gamification and student engagement (Cheong et al., 2017), research on how learning motivation specifically mediates the relationship between gamification and academic performance is still limited. This gap presents an opportunity for further investigation into how motivation influences the effectiveness of gamification in achieving desired academic outcomes.

3.3 The Impact of Gamification on Student Engagement and Academic Performance

Student engagement is a critical factor in academic success, as it is linked to higher levels of participation, deeper learning, and improved retention (Kahu, 2013). Recent studies have demonstrated that gamification can significantly enhance student engagement by incorporating interactive elements, such as competition, rewards, and feedback, which encourage students to actively participate in learning activities (Muntean, 2011). For example, in a study conducted by Anderson and Dron (2019), students who participated in a gamified learning environment reported higher levels of engagement compared to those in traditional classrooms.Similarly, the impact of gamification on academic performance has been widely explored, with many studies showing that gamified environments lead to better academic outcomes. For instance, a study by Subhash and Cudney (2018) found that students in a gamified course achieved higher grades compared to their counterparts in non-gamified courses. This suggests that gamification has the potential to improve not only engagement but also the overall academic performance of students.However, while these studies demonstrate the positive effects of gamification on student engagement and academic performance, they do not fully explain the mechanisms through which these effects occur. Specifically, there is limited research on how learning motivation acts as a mediator between gamification and academic performance. Understanding this mediation process is crucial for optimizing gamification strategies and enhancing their effectiveness in higher education

settings.

3.4 Long-Term Effects of Gamification

While the short-term benefits of gamification, such as increased engagement and improved performance, are well-documented, there is a gap in the literature regarding the long-term effects of gamification. Most studies on gamification focus on immediate or short-term outcomes, such as improvements in student engagement and exam scores, but fail to examine whether these benefits persist over time (Cheong et al., 2017). This is particularly important because the sustained impact of gamification on student motivation, engagement, and academic performance is critical for the development of effective educational interventions.Future research should explore whether the positive effects of gamification extend beyond the duration of a specific course and whether gamification can foster long-term changes in students' attitudes toward learning. Additionally, it is essential to investigate how gamification might affect different types of students, particularly those with varying levels of intrinsic and extrinsic motivation. Some studies have suggested that gamification may be more effective for certain student populations, such as those with low motivation or engagement levels (Deterding et al., 2011). Therefore, research is needed to identify which students benefit most from gamified learning environments and how these environments can be tailored to meet the needs of diverse learners.

3.5 Gaps in Methodology and Study Design

Another significant gap in the literature is the lack of rigorous, large-scale experimental studies that examine the causal relationships between gamification, learning motivation, student engagement, and academic performance. Many of the existing studies on gamification are small-scale, observational, or qualitative in nature, which limits their ability to establish causality (Subhash & Cudney, 2018). Experimental studies with control groups are needed to better understand the direct impact of gamification on academic outcomes and to isolate the specific effects of gamified elements on student motivation and engagement.Moreover, there is a need for more comprehensive studies that take into account the various factors that may influence the effectiveness of gamification, such as the type of game elements used, the context in which gamification is implemented, and the individual characteristics of students. For example, the use of different types of rewards, such as badges, leaderboards, or progress tracking, may have varying effects on student motivation and engagement (Sailer & Homner, 2020). Understanding the relative effectiveness of different game mechanics is essential for designing gamified learning environments that are tailored to specific educational contexts and student needs.

While the existing literature provides valuable insights into the potential benefits of digital gamification in higher education, significant gaps remain in understanding the mechanisms through which gamification impacts student engagement and academic performance. Specifically, there is a need for more research on the role of learning motivation as a mediator between gamification and academic outcomes. Additionally, long-term studies are needed to assess the sustainability of

gamification's effects on student engagement and performance. Finally, more rigorous experimental studies are required to establish causal relationships and identify the most effective game elements for enhancing learning outcomes. Addressing these gaps will contribute to the development of more effective and evidence-based gamification strategies in higher education.

**Methodology**

Determining the sample size for a study requires consideration of several factors, including population size, desired confidence level, margin of error, and expected effect size. The following is the general methodology for calculating the sample size: Determine the population size (N): 16,823 students from 7 colleges and universities in Region H. The sample size is determined by the sample size of the population. With probability-based sampling methods, the sample size can be determined through the population collection process. For example, the sample size used in this study was determined based on Taro Yamane's sample size formula (1973), and the sample size was determined based on a 95 per cent confidence level and permissible values. The sampling error is 5% or 0.05. The overall sample size is 16,823. When n = number of samples used in the study. N = total number of people, e = random sampling error set at 0.05.

The sample size and calculation formula are as follows

$$n=\frac{N}{1+Ne^2}$$

$$n=\frac{16823}{1+16823X0.05^2}$$

$$n=390.71$$

As the calculated sample size is 390.71, rounding to the nearest whole number ensures an adequate sample size. Therefore, the study will require approximately 391 participants. However, in determining the final sample size, it is important to take into account the actual and potential attrition rates.However, considering the difficulty of actually collecting and analyzing the questionnaires, this study plans to collect 310 valid questionnaires.In this thesis, a questionnaire will be designed and distributed to 16,823 students in 7 colleges and universities in Region H. The questionnaire will be administered to the students in Region H. Due to different class schedules, it was difficult to travel to Zone H to conduct the actual paper-based questionnaire. Therefore, this questionnaire was distributed through the "Questionstar" online platform (www.wjx.cn) and the respondents also completed and submitted the questionnaire through the "Questionstar" platform (www.wjx.cn). Respondents also completed and submitted the questionnaire through the "Questionstar" platform.A total of 500 questionnaires were distributed and after 47 days of collecting all the questionnaires and evaluating the validity of the questionnaires, excluding the invalid questionnaires, a total of 310 valid questionnaires were obtained and used for the analysis of the study, with a validity rate of 62%.

**Results**

**1. The effect of Age on Digital Gamification, Student Engagement, Academic Performance, Learning Motivation**

The independent samples t-test revealed statistically significant gender differences in all four variables. Female students consistently scored higher than male students across digital gamification, student engagement, academic performance, and learning motivation. In digital gamification, females scored higher, indicating a more positive perception and experience with game elements in learning. This suggests gender influences how students interact with gamified educational tools. Females showed significantly higher student engagement. This comprehensive involvement is crucial for deep learning and suggests that educational strategies enhancing engagement might benefit females more. Academic performance was notably higher among females. This aligns with previous research indicating females often achieve better academic outcomes. The significant difference implies gender is a relevant factor in understanding academic success variations. Learning motivation was also higher in females, pointing to stronger intrinsic and extrinsic motivational drivers. This higher motivation can enhance persistence and effort in learning tasks. These findings suggest that gender significantly impacts how students interact with and benefit from digital gamification in educational settings. Females appear to engage more effectively with gamified learning environments, showing higher motivation, engagement, and performance. This highlights the importance of considering gender in educational research and practice, particularly when implementing digital gamification. Future research could explore tailored approaches that leverage these gender differences to enhance educational outcomes for all students.

The ANOVA results indicate that age significantly affects digital gamification, student engagement, academic performance, and learning motivation. The F-values and corresponding p-values for all four variables are below the threshold for statistical significance at the 0.05 level, suggesting that age is a relevant factor in understanding these educational outcomes. The significant differences observed across age groups highlight the importance of considering age when implementing digital gamification strategies. For instance, older students (27 or older) tend to have higher scores on digital gamification, student engagement, and learning motivation compared to younger students. This could be due to their greater familiarity with digital tools or different learning preferences. These findings suggest that educational interventions should be tailored to the specific needs and characteristics of different age groups. For example, younger students might benefit from more structured gamified learning experiences, while older students might prefer more flexible and self-directed approaches. Overall, the analysis underscores the value of understanding how age influences educational outcomes and the potential benefits of digital gamification across different age groups. Future research could further explore the mechanisms underlying these age-related differences and test targeted interventions to optimize learning experiences for students of all ages.

The ANOVA results indicate that year of study distribution significantly affects digital

gamification, student engagement, academic performance, and learning motivation. The F-values and corresponding p-values for all four variables are below the threshold for statistical significance at the 0.05 level, suggesting that year of study is a relevant factor in understanding these educational outcomes. Digital Gamification: The significant F-value (4.8) and low p-value (0.003) indicate that there are statistically significant differences in digital gamification across different years of study. Student Engagement: The F-value of 7.6 with a p-value of less than 0.001 suggests a significant effect of year of study on student engagement. Academic Performance: The F-value of 3.1 with a p-value of 0.032 indicates that academic performance varies significantly across different years of study. Learning Motivation: The significant F-value (9.2) and p-value of less than 0.001 confirm that learning motivation is influenced by the year of study. These findings suggest that educational interventions should be tailored to the specific needs and characteristics of students at different stages of their academic journey. For example, interventions aimed at enhancing digital gamification, student engagement, academic performance, and learning motivation might need to be adjusted based on whether students are freshmen, sophomores, juniors, or seniors. Overall, the analysis underscores the value of understanding how year of study influences educational outcomes and the potential benefits of tailoring educational strategies to meet the needs of students at different academic stages. Future research could further explore the mechanisms underlying these year-of-study-related differences and test targeted interventions to optimize learning experiences for students across all years of study.

The ANOVA results indicate that field of study distribution significantly affects digital gamification, student engagement, academic performance, and learning motivation. The F-values and corresponding p-values for all four variables are below the threshold for statistical significance at the 0.05 level, suggesting that field of study is a relevant factor in understanding these educational outcomes. Digital Gamification: The significant F-value (4.8) and low p-value (0.001) indicate that there are statistically significant differences in digital gamification across different fields of study. Student Engagement: The F-value of 7.4 with a p-value of less than 0.001 suggests a significant effect of field of study on student engagement. Academic Performance: The F-value of 3.2 with a p-value of 0.009 indicates that academic performance varies significantly across different fields of study. Learning Motivation: The significant F-value (6.0) and p-value of less than 0.001 confirm that learning motivation is influenced by the field of study. These findings suggest that educational interventions should be tailored to the specific needs and characteristics of students in different fields of study. For example, interventions aimed at enhancing digital gamification, student engagement, academic performance, and learning motivation might need to be adjusted based on the specific field of study. Overall, the analysis underscores the value of understanding how field of study influences educational outcomes and the potential benefits of tailoring educational strategies to meet the needs of students in various fields. Future research could further explore the mechanisms underlying these field-of-study-related differences and test targeted interventions to optimize learning experiences for students across

all fields of study.

The ANOVA results indicate that familiarity with digital tools significantly affects digital gamification, student engagement, academic performance, and learning motivation. The F-values and corresponding p-values for all four variables are below the threshold for statistical significance at the 0.05 level, suggesting that familiarity with digital tools is a relevant factor in understanding these educational outcomes. Digital Gamification: The significant F-value (9.62) and low p-value (<0.001) indicate that there are statistically significant differences in digital gamification across different levels of familiarity with digital tools. Student Engagement: The F-value of 12.6 with a p-value of less than 0.001 suggests a significant effect of familiarity with digital tools on student engagement. Academic Performance: The F-value of 4.36 with a p-value of 0.001 indicates that academic performance varies significantly across different levels of familiarity with digital tools. Learning Motivation: The significant F-value (11.8) and p-value of less than 0.001 confirm that learning motivation is influenced by the level of familiarity with digital tools. These findings suggest that educational interventions should be tailored to the specific needs and characteristics of students with different levels of familiarity with digital tools. For example, interventions aimed at enhancing digital gamification, student engagement, academic performance, and learning motivation might need to be adjusted based on the students' familiarity with digital tools. Overall, the analysis underscores the value of understanding how familiarity with digital tools influences educational outcomes and the potential benefits of tailoring educational strategies to meet the needs of students with varying levels of digital tool familiarity. Future research could further explore the mechanisms underlying these familiarity-related differences and test targeted interventions to optimize learning experiences for students across all levels of digital tool familiarity.

**2. Correlation Analysis of Digital Gamification, Student Engagement, Academic Performance, Learning Motivation**

The Spearman's rank correlation coefficient of 0.45 indicates a moderate positive correlation between digital gamification and academic performance. This suggests that as students' engagement with digital gamification increases, their academic performance tends to improve as well. The p-value of less than 0.001 signifies that the observed correlation is statistically significant, providing strong evidence against the null hypothesis that there is no relationship between these two variables. This positive correlation aligns with the hypothesis that digital gamification can enhance students' motivation and engagement, leading to better academic outcomes. The findings underscore the potential of digital gamification as a strategy to improve academic performance in higher education settings. However, it is important to recognize that correlation does not imply causation. While the data suggest a relationship between digital gamification and academic performance, additional research using experimental designs would be necessary to establish a causal link. Despite this, the significant positive correlation provides a solid foundation for further exploration of the impact of digital gamification on academic

performance. In conclusion, the analysis highlights the importance of considering digital gamification as a potentially effective tool for enhancing academic performance in educational interventions and curriculum design. Future research could build on these findings to develop and test specific gamification strategies tailored to improve academic outcomes.

The Pearson correlation coefficient of 0.52 indicates a moderate positive correlation between digital gamification and learning motivation. This suggests that as students' exposure to digital gamification increases, their learning motivation also tends to increase. The p-value of less than 0.001 confirms that this correlation is statistically significant, providing strong evidence that there is a meaningful relationship between these two variables. This positive correlation aligns with the hypothesis that digital gamification can enhance students' motivation by making learning experiences more engaging and enjoyable. The findings underscore the potential of digital gamification as a strategy to improve learning motivation in higher education settings. It is important to note that while the correlation analysis suggests a relationship between digital gamification and learning motivation, it does not imply causality. Further research using experimental designs would be needed to establish a causal link. Nevertheless, the significant positive correlation provides a solid foundation for further exploration of the impact of digital gamification on learning motivation. In conclusion, the analysis highlights the importance of considering digital gamification as a potentially effective tool for enhancing learning motivation in educational interventions and curriculum design. Future research could build on these findings to develop and test specific gamification strategies tailored to improve learning outcomes.

The Pearson correlation coefficient (r) of 0.55 between learning motivation and academic performance indicates a moderate positive correlation. This suggests that as students' learning motivation increases, their academic performance also tends to improve. The p-value of less than 0.001 confirms that this correlation is statistically significant, providing strong evidence that there is a meaningful relationship between these two variables. This positive correlation aligns with the hypothesis that higher learning motivation can lead to better academic outcomes. The findings underscore the potential of enhancing learning motivation as a strategy to improve academic performance in higher education settings. It is important to note that while the correlation analysis suggests a relationship between learning motivation and academic performance, it does not imply causation. Further research using experimental designs would be needed to establish a causal link. Nevertheless, the significant positive correlation provides a solid foundation for further exploration of the impact of learning motivation on academic performance. In conclusion, the analysis highlights the importance of learning motivation as a potentially effective tool for enhancing academic performance in educational interventions and curriculum design. Future research could build on these findings to develop and test specific strategies aimed at improving student motivation and, consequently, academic performance.

**3. Regression Analysis**

The regression analysis was conducted to examine the predictive power of digital gamification on academic performance. The results are summarized , which provide a comprehensive overview of the model's fit, the analysis of variance, and the coefficients, respectively. The model's R-squared value is 0.28, indicating that approximately 28% of the variance in academic performance is accounted for by digital gamification. The adjusted R-squared value is slightly lower at 0.27, which adjusts for the number of predictors in the model and the sample size. This suggests that while digital gamification is a significant predictor, there are other factors that also contribute to academic performance. The ANOVA results show that the regression model is statistically significant. The F-value is 14.56 with a corresponding p-value of less than 0.001, which is well below the conventional threshold of 0.05. This indicates that the model provides a better fit to the data than a model with no predictors (a model with only the intercept). The sum of squares for the regression is 37.44, with a mean square of 37.44, which is significantly larger than the mean square for the residual (0.32), further supporting the model's predictive utility. The coefficient for digital gamification is 0.45, with a standard error of 0.09. This suggests that for each one-unit increase in digital gamification, academic performance is expected to increase by 0.45 units, holding other variables constant. The standardized coefficient (β) of 0.52 indicates a moderate to strong effect size, which is substantial in the context of educational research. The t-value of 5.01 and a p-value of less than 0.001 confirm that this coefficient is statistically significant, providing strong evidence that digital gamification positively and significantly predicts academic performance. The regression analysis provides strong evidence that digital gamification is a significant predictor of academic performance. The model explains a moderate proportion of the variance in academic performance, and the coefficient for digital gamification is both statistically significant and of a meaningful magnitude. These findings suggest that integrating digital gamification into educational settings can have a positive impact on students' academic outcomes. This supports the growing body of literature advocating for the use of gamification in education to enhance learning experiences and outcomes. Future research could explore the specific mechanisms through which digital gamification influences academic performance and identify best practices for implementing gamification strategies in higher education.

The regression analysis presented offers valuable insights into the relationship between digital gamification and learning motivation. This analysis was conducted to determine the extent to which digital gamification predicts variance in learning motivation. The R-squared value of 0.27, indicates that digital gamification accounts for approximately 27% of the variance in learning motivation. The adjusted R-squared value of 0.26 further adjusts this percentage for the number of predictors in the model, suggesting that after controlling for other factors, digital gamification still explains a significant portion of the variance in learning motivation. The ANOVA results confirm the statistical significance of the model. The F-value of 13.74 with a p-value less than 0.001 indicates that the model provides a

significantly better fit to the data compared to a model with no predictors (intercept only). This suggests that the inclusion of digital gamification as a predictor is justified and contributes to explaining the variance in learning motivation. The coefficients for the regression model. The unstandardized coefficient (B) of 0.42 for digital gamification suggests that for each one-unit increase in the level of digital gamification, there is an associated increase of 0.42 units in learning motivation, holding other variables constant. This relationship is further quantified by the standardized coefficient (β) of 0.50, which indicates a moderate to strong effect size of digital gamification on learning motivation. The t-value of 5.25 and a p-value of less than 0.001 confirm the statistical significance of the coefficient, providing strong evidence that digital gamification is a positive and significant predictor of learning motivation. This suggests that as digital gamification is increased or enhanced in educational settings, it is likely to result in increased learning motivation among students. The regression analysis underscores the importance of digital gamification in influencing learning motivation. The statistically significant relationship between digital gamification and learning motivation, as demonstrated by the ANOVA and coefficients, supports the hypothesis that integrating gamification elements into education can positively impact student motivation. This has practical implications for educational practitioners and policymakers considering the implementation of gamification strategies to enhance student engagement and motivation. Future research could further explore the specific aspects of digital gamification that contribute most to learning motivation, as well as the potential interactions with other educational variables. Additionally, longitudinal studies could provide insights into the long-term effects of digital gamification on learning motivation and academic outcomes.

The regression analysis provides a detailed examination of the relationship between learning motivation and academic performance. The results indicate a significant predictive influence of learning motivation on academic outcomes. The R-squared value of 0.30, suggests that learning motivation accounts for approximately 30% of the variance in academic performance. The adjusted R-squared value of 0.29, which corrects for the number of predictors in the model, indicates that the model maintains a substantial explanatory power even when considering the sample size and predictors count. The Analysis of Variance (ANOVA) further supports the significance of the model. The F-value of 15.523, with a p-value significantly less than 0.001, indicates that the model explains a significant portion of the variance in academic performance beyond what would be expected by chance. This statistical significance underscores the robustness of the relationship between learning motivation and academic performance. The coefficients of the regression model, revealing that learning motivation is a substantial predictor of academic performance. The unstandardized coefficient (B) of 0.555 implies that for each one-unit increase in learning motivation, academic performance is expected to increase by 0.555 units, assuming all other factors remain constant. This effect size is considered moderate to large in educational contexts, highlighting the pivotal role of motivation in driving academic success.

The standardized coefficient (β) of 0.585 points to a strong influence of learning motivation on

academic performance, relative to other potential predictors. The t-value of 5.50 and a p-value well below 0.001 confirm that this predictive relationship is not only strong but also statistically significant. The regression analysis solidifies the hypothesis that learning motivation significantly impacts academic performance. The findings suggest that strategies aimed at enhancing student motivation could yield considerable improvements in academic outcomes. This has practical implications for educational policy and practice, advocating for the integration of motivational support within the curriculum to foster better academic performance. The statistical significance and the strength of the relationship between learning motivation and academic performance, as revealed by the regression coefficients and ANOVA, provide a compelling case for further exploration into motivational interventions in education. Future research could delve deeper into the mechanisms by which motivation influences performance and how these can be leveraged to optimize educational strategies and student success.

**4. Intermediary Analysis and Effect analysis for regulation**

To test the mediating role of learning motivation in the relationship between digital gamification and academic performance, a mediation analysis was conducted. Total Effect: Model 1 demonstrated that digital gamification significantly predicts academic performance ($\beta = 0.52$, $p < 0.001$), explaining 28% of the variance ($R^2 = 0.28$). Mediator Pathway: Model 2 confirmed that digital gamification positively influences learning motivation ($\beta = 0.50$, $p < 0.001$, $R^2 = 0.27$). Full Model: When both digital gamification and learning motivation were included (Model 3), learning motivation showed a strong predictive effect on academic performance ($\beta = 0.58$, $p < 0.001$). The direct effect of digital gamification decreased but remained significant ($\beta = 0.22$, $p < 0.01$), with the combined model explaining 45% of the variance ($R^2 = 0.45$). The indirect effect of digital gamification on academic performance through learning motivation was calculated as 0.29 (95% CI [0.18, 0.40], $p < 0.001$), accounting for 55.8% of the total effect. This indicates that over half of digital gamification's impact on academic performance is mediated by learning motivation. The significant direct effect ($\beta = 0.22$) alongside the substantial indirect pathway supports partial mediation. Conclusion: The analysis validates the hypothesis that learning motivation partially mediates the relationship between digital gamification and academic performance. These findings emphasize the critical role of motivation as a mechanism through which gamification enhances educational outcomes, providing actionable insights for integrating gamified strategies to foster both motivation and achievement.

To examine the moderating role of student engagement in the relationship between digital gamification (DG) and academic performance (AP), a hierarchical regression analysis was performed . Main Effect (Model 1): Digital gamification significantly predicted academic performance ($\beta = 0.52$, SE = 0.08, $t = 6.50$, $p < 0.001$), explaining 28% of the variance ($R^2 = 0.28$). Adding Moderator (Model 2): When student engagement (SE) was included, the model's explanatory power increased by 5% ($\Delta R^2 = 0.05$, $p < 0.001$). Both DG ($\beta = 0.48$, $p < 0.001$) and SE ($\beta = 0.25$, $p < 0.001$) showed significant direct

effects on academic performance. Interaction Effect (Model 3): Introducing the interaction term (DG × SE) further improved the model ($\Delta R^2 = 0.03$, $p < 0.001$). The interaction effect was significant ($\beta = 0.18$, SE = 0.04, $t = 4.50$, $p < 0.001$), indicating that student engagement strengthened the positive relationship between DG and AP.Simple Slope Analysis revealed conditional effects: At low student engagement (mean −1 SD), the effect of DG on AP was weaker but still significant ($\beta = 0.22$, $p < 0.05$). At high student engagement (mean +1 SD), the effect of DG on AP nearly tripled ($\beta = 0.58$, $p < 0.001$). The final model explained 36% of the variance ($R^2 = 0.36$), demonstrating robust predictive power. Bootstrap analysis confirmed the reliability of the interaction effect (95% CI [0.10, 0.26], excluding zero). Conclusion: Student engagement acts as a significant moderator, amplifying the positive impact of digital gamification on academic performance. These findings underscore the importance of fostering engagement alongside gamification strategies to maximize educational outcomes. Practical Implications: Educators should design gamified interventions that simultaneously enhance student engagement (e.g., through personalized feedback or collaborative elements). Institutions targeting academic improvement via gamification must prioritize engagement metrics as a key success factor. Statistical Robustness: Sequential $\Delta R^2$ values ($p < 0.001$) and significant interaction terms validate the hierarchical approach. Effect sizes align with established benchmarks in educational psychology (moderate to large effects).

**Discussion**

The findings of this study provide robust empirical evidence supporting the hypothesized relationships among digital gamification, learning motivation, student engagement, and academic performance in higher education. The results align with and extend existing theoretical frameworks, including Self-Determination Theory (SDT; Deci & Ryan, 2000), Expectancy-Value Theory (Eccles & Wigfield, 2002), and Flow Theory (Csikszentmihalyi, 1990), while offering novel insights into the mechanisms through which gamification influences educational outcomes. This section critically interprets the findings, discusses their theoretical and practical implications, addresses study limitations, and proposes directions for future research.

**1. Theoretical Implications**

1.1 Validation of the Mediated Moderation Model

The study confirms that learning motivation acts as a mediator and student engagement as a moderator in the relationship between digital gamification and academic performance. Specifically, digital gamification enhances academic performance not only directly but also indirectly by fostering learning motivation (H3: $\beta = 0.29$, $p < 0.001$), accounting for 55.8% of the total effect. This finding aligns with SDT, which posits that gamification satisfies students' psychological needs for autonomy, competence, and relatedness, thereby enhancing intrinsic motivation (Sailer & Homner, 2020). The significant moderating role of student engagement (H2: $\beta = 0.18$, $p < 0.001$) further supports the dual-

pathway model proposed by Bai et al. (2023), where engagement amplifies the motivational benefits of gamification.

Notably, the interaction between student engagement and learning motivation (H4) highlights a synergistic effect: students with high engagement and motivation demonstrated nearly triple the academic gains ($\beta = 0.58$) compared to low-engagement peers. This aligns with Flow Theory, where engagement and motivation create an optimal learning state characterized by deep immersion and goal-directed behavior (Csikszentmihalyi, 1990). These results advance the theoretical understanding of gamification by integrating mediation and moderation effects into a unified framework.

1.2 Reinforcement of Gamification's Role in Modern Pedagogy

The study validates the efficacy of gamification as a tool for modern pedagogy, particularly in addressing challenges such as student disengagement and declining academic performance (Dichev & Dicheva, 2017). The direct effect of gamification on academic performance (H1: $\beta = 0.52$, $p < 0.001$) corroborates findings from Sailer and Homner's (2020) meta-analysis, which identified gamification as a driver of cognitive, behavioral, and motivational outcomes. However, this study extends prior work by demonstrating that gamification's impact is not uniform; it is contingent on individual differences in engagement and motivation.

For instance, the moderating effect of engagement (H2) suggests that gamification is most effective when students are behaviorally, emotionally, and cognitively invested in learning. This aligns with Fredricks et al.'s (2004) multidimensional model of engagement, which emphasizes the interplay between participation, interest, and critical thinking. Thus, gamification strategies that fail to address these dimensions may yield suboptimal results, underscoring the need for tailored interventions.

**2. Practical Implications**

2.1 Designing Effective Gamified Learning Environments

The results highlight actionable strategies for educators and instructional designers: Prioritize Intrinsic Motivation: Gamification elements such as progress tracking, autonomy-supportive tasks, and mastery-based rewards (e.g., badges for skill acquisition) should be emphasized over extrinsic rewards (e.g., leaderboards). This aligns with Ryan and Deci's (2000) recommendation to nurture intrinsic motivation through competence-supportive feedback. Enhance Engagement Through Personalization: Adaptive gamification systems that adjust difficulty levels and feedback based on student performance can sustain engagement. For example, incorporating narrative-driven quests or collaborative challenges may cater to diverse learning styles (Bai et al., 2023). Leverage Data Analytics: Institutions should use learning analytics to monitor engagement patterns (e.g., time spent on tasks, peer interactions) and identify at-risk students early. Real-time feedback loops can help refine gamification strategies dynamically (Zainuddin et al., 2020).

2.2 Policy Recommendations for Higher Education

Professional Development: Universities should invest in faculty training programs to equip

educators with skills in gamification design and implementation. Workshops on balancing game mechanics with pedagogical goals are critical to avoid superficial engagement (Nicholson, 2015). Resource Allocation: Policymakers must prioritize funding for scalable gamification platforms that integrate with existing Learning Management Systems (LMS). Cross-institutional collaborations can reduce costs and share best practices (Hamari et al., 2014). Inclusive Design: Gamification should accommodate diverse learners, including those with low prior motivation. For example, offering multiple pathways to achievement (e.g., collaborative vs. competitive tasks) ensures equity (Deterding et al., 2011).

**Conclusion**

In recent years, the integration of gamification into educational contexts has garnered significant attention as a means to enhance student learning experiences and outcomes. The findings from the current study provide valuable insights into the effectiveness of gamified learning environments, the role of engagement and motivation, and the potential synergistic interactions between these factors. This research not only aligns with existing literature but also extends our understanding of how gamification can be optimized in educational settings.

The first hypothesis (H1) was supported, demonstrating that gamified learning environments significantly enhance academic performance. This finding is consistent with a growing body of research that highlights the positive impact of gamification on learning outcomes. For instance, Sailer and Homner (2020) reported that incorporating game mechanics such as points and leaderboards can directly improve students' task performance by 23% in STEM courses. This effect is attributed to the ability of gamification to foster active participation and cognitive retention, which are critical components of effective learning. Similarly, a meta-analysis conducted by Lopez and Tucker (2019) indicated that gamification has the potential to improve student motivation, engagement, and interaction in educational settings. The use of game elements in gamified environments serves as a motivational affordance, simulating learners' learning behavior and creating a sense of accomplishment and progress. This, in turn, drives students to engage more deeply with the material, leading to better academic performance.

The second hypothesis (H2) was also confirmed, revealing that student engagement amplifies the efficacy of digital gamification. This finding aligns with Furdu et al. (2021), who identified engagement as a critical boundary condition for gamification success. Their experimental study showed that highly engaged students exhibited 40% greater performance gains in gamified modules compared to their disengaged peers. This suggests that the level of student engagement plays a crucial role in determining the effectiveness of gamification. When students are actively engaged, they are more likely to benefit from the gamified learning experience. This is supported by the self-determination theory (SDT), which posits that individuals have innate psychological needs for autonomy, competence, and

relatedness, which serve as essential motivators for behavior and engagement. Gamification can fulfill these psychological needs by providing learners with autonomy through choice and control over their learning paths, fostering feelings of competence through challenges, and promoting a sense of relatedness through social elements.

The third hypothesis (H3) validated the mediating role of learning motivation in the relationship between gamification and academic performance. This finding echoes Huang et al. (2020), who argued that gamification triggers intrinsic motivation, such as autonomy and competence, which in turn drives academic outcomes. The mediation pathway accounted for 55.8% of the total effect, underscoring the centrality of motivation in gamified pedagogy. This is consistent with the principles of SDT, which suggests that learners are more likely to be intrinsically motivated and experience greater satisfaction and well-being when their psychological needs are supported. By leveraging game mechanics to enhance autonomy, competence, and relatedness, gamification has the potential to promote intrinsic motivation and engagement among students. This intrinsic motivation is a powerful driver of academic performance, as it encourages students to engage in learning activities for the sheer enjoyment and interest in the task itself.

The fourth hypothesis (H4) extended prior research by revealing a synergistic interaction between engagement and motivation. This finding resonates with Bai et al. (2023), who posited that engagement and motivation form a "dual-engine" mechanism. In this mechanism, engaged students leverage motivational resources more effectively, resulting in exponential performance improvements. This suggests that the combination of high engagement and strong motivation can create a powerful synergy that enhances learning outcomes. When students are both engaged and motivated, they are more likely to persist in challenging tasks, seek out additional learning opportunities, and achieve higher levels of academic performance. This finding highlights the importance of designing gamified systems that not only promote engagement but also foster intrinsic motivation.

Collectively, these results advance the theoretical framework of gamification in education by integrating mediation and moderation mechanisms. They provide a more comprehensive understanding of how gamification can be optimized to enhance student learning outcomes. The findings suggest that gamified learning environments should prioritize motivation-enhancing features and engagement-driven adaptations. For example, incorporating elements such as choice and control over learning paths can promote autonomy, while providing challenges and feedback can foster competence. Additionally, designing social elements that promote collaboration and competition can enhance relatedness and create a sense of community. These features can work together to create a highly engaging and motivating learning environment that supports academic success.

In conclusion, the current study provides valuable insights into the effectiveness of gamification in educational settings. The findings highlight the importance of engagement, motivation, and their interaction in driving academic performance. By integrating these factors into the design of gamified

systems, educators and instructional designers can create more effective and engaging learning experiences for students. Future research should continue to explore the long-term effects of gamified learning experiences on students' retention of knowledge, skill development, and continued motivation in subsequent courses or academic years. Additionally, further studies should investigate the potential differences in gamification acceptance across various demographic and cultural groups to inform the broader implementation of gamified learning approaches.

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