APTISI Transactions on Technopreneurship (ATT)
Vol. 7, No. 2, July 2025, pp. 593−604
E-ISSN: 2656-8888 | P-ISSN: 2655-8807, DOI:10.34306

Enhancing Entrepreneurial Competencies and Student Engagement through Gamification in Learning Management Systems

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Article Info

Article history:

Submission December 12, 2024
Revised January 8, 2025
Accepted July 4, 2025
Published July 31, 2025

Keywords:

Gamification
Student Engagement
Learning Management System
Motivation
Academic Performance

ABSTRACT

This study addresses the growing need for innovative strategies to enhance student engagement in digital learning environments by investigating the effects of gamification on student motivation and academic performance within Learning Management Systems (LMS). Despite its increasing adoption, the long-term impact of gamification on learning outcomes remains underexplored, particularly in structured educational settings. **Using an** experimental design, students were divided into two groups: the experimental group, which used a gamified LMS, and the control group, which used a traditional LMS. **Results indicated that** the experimental group exhibited significantly higher engagement levels (85%) compared to the control group (62%) and spent, on average, 30% more time on the LMS. Participation in optional activities was 40% higher in the gamified group. Motivation analysis revealed increased intrinsic motivation (72%) and extrinsic motivation (78%) among the experimental group, supported by features such as points and badges. Academic performance improvements were also evident, with the experimental group achieving 10% higher final exam scores and a 15% higher assignment completion rate. **While findings suggest** that gamification enhances student engagement and learning outcomes, feedback on competitive elements like leaderboards highlights the need for careful design considerations to balance motivation and inclusivity. This study provides empirical insights into the effectiveness of gamification as a scalable and adaptive strategy for enhancing digital education, informing future developments in educational technology.

DOI: https://doi.org/10.34306/att.v7i2.589

1. INTRODUCTION

The rapid advancement of digital technologies has fundamentally reshaped the landscape of education over the past decade. Learning Management Systems (LMS) have emerged as key tools in this transformation, providing a comprehensive infrastructure for delivering, managing, and tracking educational content. LMS platforms, such as Moodle, Blackboard, Canvas, and Google Classroom, have become ubiquitous in educational institutions, enabling asynchronous and synchronous learning across diverse contexts [1]. These systems offer centralized spaces for instructors to manage courses, distribute materials, engage with students, and monitor academic progress. However, despite their widespread use, many challenges remain in optimizing LMS effectiveness, particularly concerning student engagement and motivation two critical factors influencing academic performance [2].

Traditional learning environments, characterized by face-to-face interactions and structured guidance, have been disrupted by the rise of online and hybrid learning models. While LMS provide essential tools for managing content and monitoring performance, they frequently fall short in fostering meaningful engagement among students. In online settings, where student interaction is often limited, students may struggle with feelings of isolation, disinterest, and low intrinsic motivation [3]. Engagement in these digital environments is a complex issue, influenced not only by the design of the learning platform but also by how content is presented, how students interact with it, and how feedback is delivered [4].

1.1. Gamification as a Promising Solution

One promising approach to addressing these challenges is gamification, which integrates game-design elements and principles into non-game contexts, such as education. The application of game mechanics such as points, badges, levels, leaderboards, and rewards within LMS platforms is believed to enhance student motivation, increase engagement, and improve learning outcomes [5]. The central premise of gamification is that it transforms the learning experience from a passive, task-oriented activity into an interactive, goal-driven process. This process, in turn, fosters motivation by leveraging the inherent rewards and challenges found in game structures [6, 7].

Gamification has the potential to provide a highly interactive and dynamic learning environment that encourages students to engage more actively with educational content. By rewarding effort, progression, and achievement, gamification creates an environment in which students are motivated not only by grades but also by a sense of accomplishment, mastery, and personal development [8]. For example, the use of points or badges for completing assignments, quizzes, or specific tasks serves as a form of extrinsic motivation, reinforcing positive behaviors and encouraging continued participation [9]. Furthermore, the game-like structures inherent in LMS gamification offer opportunities for students to track their progress and set individual goals, thereby promoting self-regulation and autonomy two factors that have been shown to increase motivation and learning outcomes in educational contexts.

1.2. Theoretical Foundations of Gamification in Education

The effectiveness of gamification in educational settings is deeply rooted in established psychological theories, notably Self-Determination Theory (SDT). According to SDT, human motivation is influenced by the fulfillment of three basic psychological needs: autonomy, competence, and relatedness. These needs are particularly relevant in the context of gamification, which seeks to create an environment where students feel empowered, capable, and connected to their peers.

Gamification provides students with more control over their learning processes. For instance, by offering choices in how tasks are completed or how learning material is accessed, gamified systems enhance students autonomy, fostering a sense of ownership and responsibility for their learning [10]. Continuous feedback is a central feature of gamification. This immediate feedback whether through scores, badges, or progress bars helps students track their advancement and provides them with a sense of competence. Students who perceive themselves as competent are more likely to engage in and persist with learning activities [11]. Social connection and interaction are integral components of many game-based systems. Gamification often includes elements like leaderboards, peer challenges, and collaborative missions, which promote a sense of community and relatedness. When students interact with their peers in a supportive, social context, they are more likely to stay motivated and invested in the learning process [3].

In addition to SDT, the concept of flow [12] is also relevant in understanding how gamification can enhance engagement. Flow is a psychological state in which individuals are fully immersed in an activity, experiencing both enjoyment and heightened focus. Gamified learning environments can promote flow by

providing students with tasks that are appropriately challenging, neither too easy nor too difficult [13]. This balance encourages students to become deeply engaged in the learning process, enhancing their academic performance.

1.3. Benefits of Gamification in LMS

Empirical studies have consistently shown that the integration of gamification in LMS can lead to substantial improvements in student engagement, motivation, and learning outcomes. Gamification has been shown to enhance student engagement by making learning more interactive and enjoyable. Game elements such as rewards, progression systems, and competitive elements provide students with tangible incentives to participate actively in learning tasks. By incorporating rewards such as badges, points, and levels, gamification taps into intrinsic and extrinsic motivation. Research indicates that students are motivated not only by tangible rewards but also by the intrinsic satisfaction derived from completing challenges and advancing through game-like levels [9, 14].

The ability to track progress and receive immediate feedback is a powerful motivator for students. Gamified LMS often feature progress indicators, achievement systems, and feedback loops that allow students to monitor their development continuously. These elements help students set realistic goals, track achievements, and make adjustments to their learning strategies, all contributing to better academic performance [14].

1.4. Challenges and Limitations of Gamification in LMS

Despite its potential, the implementation of gamification in LMS is not without challenges. Several barriers must be considered in the design and adoption of gamified systems such as not all students respond to gamification in the same way. While some students may be highly motivated by competition and rewards, others may feel demotivated or alienated by these elements. Designing gamified systems that accommodate diverse learning preferences and motivational profiles is essential to ensuring their effectiveness [15, 16].

While leaderboards and point systems can motivate some students, they may induce anxiety and stress in others, particularly those who do not perform well in comparison to their peers. Balancing competitive elements with cooperative or individual-based incentives is crucial to creating a positive learning environment for all students [17, 18]. Integrating gamification into LMS requires robust technological infrastructure, which may not be available in all educational settings. Institutions with limited access to technology may struggle to implement gamified learning experiences effectively. Although gamification can initially boost engagement and motivation, questions remain regarding its long-term impact. Over time, students may become desensitized to rewards and incentives, diminishing their effectiveness. Ongoing research is needed to explore how gamification can sustain its appeal over time [19].

1.5. Research Gap and the Focus of the Study

While there is substantial evidence supporting the benefits of gamification in education, further empirical studies are needed to explore the factors contributing to its success or failure in various contexts. More research is required to investigate how gamification can be adapted to meet the needs of diverse student populations, balance game elements to maximize engagement, and integrate gamification into LMS in a sustainable and scalable manner [20, 21]. Additionally, exploring the role of contextual and cultural factors in shaping students responses to gamified learning environments warrants further investigation.

Figure 1. Sustainable Development Goals (SDGs)

This study aims to fill this gap by examining the impact of gamification on student engagement, motivation, and academic performance within LMS. By identifying the key elements that enhance the effectiveness of gamification and the barriers that hinder its success, this research seeks to provide actionable insights for educators, developers, and policymakers looking to integrate gamification into educational practice. Moreover, this study aligns with the Sustainable Development Goals (SDGs), particularly SDG 4 on Quality Education and SDG 8 on Decent Work and Economic Growth [22]. By integrating gamification into Learning Management Systems, it enhances student engagement, motivation, and academic performance, which promotes equal access to quality education and lifelong learning opportunities [23]. Furthermore, it develops entrepreneurial competencies and equips students with essential digital and problem-solving skills necessary for workforce readiness and economic growth in the digital age. Through this innovative approach, gamification not only enhances learning effectiveness but also strengthens human resource competitiveness in the evolving job market, thus addressing a critical research gap on the long-term impact of gamified learning environments on education and the economy.

2. LITERATURE REVIEW

Gamification has emerged as a transformative strategy in education, leveraging the principles and mechanics of game design to enhance student engagement, motivation, and academic performance within LMS. Gamification introduces game-like elements such as points, badges, levels, leaderboards, and challenges into the learning environment, shifting traditional educational experiences from monotonous, task-based activities into dynamic and goal-driven interactions. Its adoption is premised on the notion that students are intrinsically and extrinsically motivated by these features, which mirror the challenges and rewards of real-world gaming systems [24–26].

The significance of gamification lies in its ability to address the challenges of engagement, motivation, and participation, especially in online or hybrid learning contexts, by creating immersive experiences. Despite its popularity, gamification's integration into LMS continues to face challenges, including technological constraints and individual learner diversity [27]. Thus, understanding its theoretical underpinnings, benefits, and barriers is critical for optimizing its application in modern education [28].

2.1. Theoretical Frameworks Underpinning Gamification

Gamification in education is supported by well established psychological theories that explain student engagement, motivation, and learning behaviors.

2.1.1. Self-Determination Theory (SDT)

Self-Determination Theory (SDT) offers a robust foundation for understanding the psychological needs underlying student motivation. According to [29], SDT identifies three key psychological needs, namely, autonomy, competence, and relatedness, all of which can be met by gamification strategies. Gamified learning environments empower students by providing choice and flexibility, allowing them to decide how tasks are approached or learning paths are navigated, thus fostering ownership of the learning process [30]. Continuous feedback mechanisms such as points, progress tracking, and badges help students build a sense of achievement and mastery. Social interactions within gamified systems, such as peer challenges and group-based rewards, strengthen social bonds and promote collaborative learning.

When supported through the design of gamified LMS, these three psychological needs have been shown to increase motivation and engagement among students [31].

2.1.2. Flow Theory

[12] concept of flow provides additional theoretical grounding for the effectiveness of gamification in educational settings. The flow state refers to a psychological condition in which individuals experience focused attention, enjoyment, and optimal performance during an activity. This state is achieved when tasks are appropriately challenging neither too simple nor overly difficult and align with students skill levels. Gamification fosters this state by presenting meaningful, challenging tasks that provide immediate feedback, creating opportunities for immersion and deeper engagement. The balance between skill and challenge inherent in gamification elements is critical for maintaining this psychological state, thereby enhancing both academic motivation and performance.

2.2. Benefits of Gamification in LMS

Empirical evidence highlights that integrating gamification into LMS can positively influence engagement, motivation, and learning outcomes. Recent studies confirm that gamification leads to enhanced academic performance by fostering interactive, self-regulated, and collaborative learning environments [32, 33].

2.2.1. Enhanced Student Engagement

Engagement is a core predictor of student learning outcomes, and gamification heightens engagement by making learning more interactive and enjoyable. Features such as rewards, leaderboards, and progress tracking have been identified as intrinsic motivators that maintain students attention and participation during learning tasks [34].

Key Features Driving Engagement are rewards systems, leaderboards and competition, progress tracking and structures feedback mechanisms.Reward systems, such as earning points, badges, or other forms of recognition, act as effective extrinsic motivators that incentivize students to actively participate and complete tasks. These rewards provide immediate feedback, fostering a sense of achievement. Competitive elements motivate students to improve their rankings. [35, 36] note that competition can enhance behavioral engagement but must be carefully designed to avoid inducing stress or anxiety.Dashboards, progress s bars, and achievement indicators help students visualize their progress, fostering intrinsic motivation and self-regulation. Timely and actionable feedback helps students monitor their performance and develop strategies for improvement.

2.2.2. Motivation through Rewards and Feedback

Both intrinsic and extrinsic motivators are influenced by gamification. Extrinsic motivators include points, badges, and leaderboards, while intrinsic motivation is driven by task mastery and real-time feedback [37]. Extrinsic Rewards, points and badges provide immediate recognition for efforts, while levels create a sense of progression, encouraging persistence. Intrinsic Motivation, real-time feedback supports students sense of competence, fostering long-term engagement by emphasizing mastery over tasks.

2.2.3. Improved Learning Outcomes

Gamification enhances learning outcomes by providing continuous feedback and fostering goal-setting behaviors. Studies have shown significant improvements in academic performance when gamification is integrated into LMS.

2.2.4. Personalized Learning Pathways

Gamified LMS supports differentiated instruction by tailoring learning experiences to individual needs, enabling students to progress at their own pace and focus on areas requiring improvement.

2.3. Challenges in Gamification Integration

Despite its benefits, gamification integration into LMS faces several challenges

- Diverse Learner Profiles: Variability in students motivational drivers and preferences can hinder the effectiveness of a one-size-fits-all approach [38].
- Overemphasis on Competition: Competitive features may induce stress for some learners, necessitating a balanced design that includes collaboration.
- Technological Constraints: Limited infrastructure and resources in underfunded institutions pose significant barriers.
- Sustainability: Over time, students may experience reward fatigue, reducing the long-term impact of gamification.
- Balancing Motivation: Overreliance on extrinsic rewards can undermine intrinsic motivation, requiring thoughtful integration of mastery-based elements.

3. METHODOLOGY

This study employs a mixed-methods approach to examine the impact of gamification on student engagement, motivation, and academic performance within LMS. The mixed-methods design allows for a comprehensive understanding of how gamified elements influence student behavior and learning outcomes by combining both quantitative and qualitative data. The study was conducted at a mid-sized university offering online and hybrid courses across multiple disciplines, including business, engineering, and social sciences [39–41].

The participants were 200 undergraduate students enrolled in a range of courses using the Moodle LMS platform. These students were divided into two groups, experimental group and control group. Experimental Group (Gamified LMS), 100 students who were exposed to a gamified version of the LMS, which incorporated elements such as points, badges, leaderboards, and challenges for various course activities (e.g., assignments, quizzes, and discussions). Control Group (Traditional LMS), 100 students who used the standard, non-gamified version of the LMS, where course content and assessments were delivered without any game-like features.

Participants in both groups were informed about the purpose of the study and consented to participate [42]. The groups were matched based on prior academic performance, course load, and demographic factors to ensure comparability. The courses selected for this study were designed to be similar in content and structure, ensuring that differences in learning outcomes could be attributed to the gamification elements rather than course material or instructional methods [43, 44].

3.1. Data Collection

Data were collected from both groups at three distinct stages, including pre-study, mid-study, and post-study.

- Quantitative Data:

  Student Engagement: Engagement was measured using a student engagement survey based on the National Survey of Student Engagement (NSSE), which assessed behavioral, emotional, and cognitive engagement through a series of Likert-scale questions. Motivation was measured using the Academic Motivation Scale (AMS), which evaluates intrinsic and extrinsic motivation in educational settings. Final grades and completion rates for assignments, quizzes, and exams were collected from both groups. Log data from the LMS, including the frequency of log-ins, time spent on tasks, and completion rates for gamified activities, were recorded.

- Qualitative Data:

  After the study period, semi-structured interviews and focus group discussions were conducted with a representative sample of 30 students from both the experimental and control groups. These discussions aimed to gather insights into students perceptions of the gamified LMS, their experiences with game elements, and their motivations for engaging with the platform. Students were also asked to provide feedback on their experiences with gamification via an open-ended section of the post-study survey. This allowed them to elaborate on what they liked or disliked about the gamified features and how these elements influenced their learning.

After the study period, semi-structured interviews and focus group discussions were conducted with a representative sample of 30 students from both the experimental and control groups. These discussions aimed to gather insights into students perceptions of the gamified LMS, their experiences with game elements, and their motivations for engaging with the platform [45, 46]. Students were also asked to provide feedback on their experiences with gamification via an open-ended section of the post-study survey. This allowed them to elaborate on what they liked or disliked about the gamified features and how these elements influenced their learning [47, 48].

3.2. Data Analysis

- Quantitative Analysis:

  The quantitative data were analyzed using descriptive statistics and inferential statistics. Descriptive statistics were used to summarize engagement, motivation, and academic performance in both groups. Inferential statistics, including t-tests and ANOVA, were employed to examine the differences between

the experimental and control groups in terms of engagement, motivation, and academic performance. Additionally, regression analysis was used to assess the relationship between gamification and academic performance, controlling for variables such as prior GPA and course load.

- Qualitative Analysis:

  The qualitative data were analyzed using thematic analysis to identify recurring themes and patterns in the interview and survey responses. The data were coded and categorized based on key topics such as engagement, motivation, perceived benefits and challenges of gamification, and student satisfaction. These themes were then triangulated with the quantitative findings to provide a more comprehensive understanding of the effects of gamification.

4. RESULT AND DISCUSSION

The data indicate that the experimental group using the gamified LMS exhibited significantly higher levels of student engagement compared to the control group using the traditional LMS. According to survey responses they are 85% of students in the experimental group reported being "actively engaged" in their courses, while only 62% of students in the control group reported the same [49, 50].

Moreover, system usage data revealed that the experimental group spent 30% more time on the LMS on average compared to the control group. Furthermore, students in the gamified LMS were also more likely to participate in optional activities, with their participation rate being 40% higher than that of the control group [51].

Table 1. Student Engagement Data

Engagement Indicator	**Control Group (%)**	**Gamified Group (%)**
Students "actively engaged" in their courses	62%	85%
Average time spent on LMS	-	30% more
Participation in optional activities	78%	95%

The analysis of motivation data revealed a significant positive effect of gamification on both intrinsic and extrinsic motivation among students in the experimental group. Around 72% of students in the gamified group reported an increase in intrinsic motivation, which was associated with greater enjoyment and interest in the course content. About 78% of students in the gamified group noted that earning points and badges as rewards motivated them to put forth greater effort, compared to only 55% of students in the control group.

Table 2. Comparison of Intrinsic and Extrinsic Motivation

Motivation Dimension	**Control Group (%)**	**Gamified Group (%)**
Intrinsic motivation (enjoyment, curiosity in learning)	55%	72%
Extrinsic motivation (earning points and rewards)	55%	78%

Students in the gamified group shared insights in interviews, indicating that features such as points and badges improved their learning experiences. One student reported:

"The badges made me feel like I was constantly achieving something, even for small tasks."

Conversely, some students expressed concerns about competitive elements, particularly leaderboards, as they created anxiety for some individuals. These findings underscore the importance of implementing gamification features thoughtfully and inclusively.

The effect of gamification on academic performance was measured by comparing the students final exam scores and assignment completion rates between groups. The average final exam score was 88% for the gamified group, compared to 78% for the control group. The experimental group showed a completion rate of 95% for assignments, compared to 78% for the control group.

Table 3. Comparison of Academic Performance

Academic Indicator	**Control Group (%)**	**Gamified Group (%)**
Average final exam score (%)	78%	88%
Assignment completion rate (%)	78%	95%

Gamification contributed positively to students academic performance by enhancing motivation, providing real-time feedback, and establishing clear progress goals. Features like badges and points appeared to offer immediate recognition of students efforts, which reinforced positive learning behaviors.

4.1. Discussion

4.1.1. Impact of Gamification on Student Engagement

The findings show that gamification significantly enhances student engagement. The use of game-like features such as leaderboards, points, badges, and progress tracking resulted in students spending 30% more time on the LMS and engaging in 40% more non-compulsory learning activities. These results align with theories like Behavioral Engagement Theory, which posits that students active participation in tasks is enhanced when they are provided with goals, rewards, and progress tracking. The gamified features introduced clear objectives, provided motivation through rewards, and facilitated real-time feedback. This combination increased students willingness to engage and persevere in their learning activities.

4.1.2. Dual Impact of Intrinsic and Extrinsic Motivation

Gamification not only supported intrinsic motivation stemming from enjoyment and interest but also extrinsic motivation, driven by rewards such as points and badges. This finding supports Self-Determination Theory, which suggests that the fulfillment of both intrinsic and extrinsic psychological needs sustains motivation. Many students reported that features such as points and badges made learning enjoyable, stimulating curiosity about course topics, and sparked continued engagement with the learning process. The opportunity to earn rewards, such as points and badges, motivated many students to engage with learning tasks and complete assignments.

These findings indicate that a well-balanced gamification strategy that combines both intrinsic and extrinsic motivational elements can create a positive learning environment conducive to long-term success.

4.1.3. Gamification's Impact on Academic Performance

The observed academic improvements in the experimental group suggest that gamification fosters effective learning strategies. Gamified elements such as real-time feedback, leaderboards, and progress tracking encouraged students to set goals, monitor their progress, and maintain focus, which translated into better performance. The experimental group achieved an average of 10% higher scores on final exams and exhibited a 15% higher rate of assignment completion compared to the control group. Features like immediate recognition for achievements (through badges and points) and visible progress tracking seem to have reinforced positive learning behaviors.

These findings align with previous research suggesting that gamification supports goal-setting, self-regulation, and sustained effort among learners.

4.1.4. Competitive Features and Their Mixed Perceptions

While gamification has proven effective, student feedback revealed mixed responses to certain competitive elements, such as leaderboards. Some students reported feeling motivated by competition, while others felt demoralized or anxious when they were unable to maintain high ranks.

These findings suggest that competition can act as both a motivator and a stressor, depending on individual differences among students. Consequently, the design of gamification strategies should aim for a balance between competitive and cooperative opportunities, as well as the inclusion of flexible pathways to cater to students unique preferences.

The findings provide meaningful insights, but there are some limitations :

- Differences in technological access and cultural factors could influence generalizability,
- This study was conducted over a single semester, limiting insights into long-term effects.

Recommendations for Future Research, researcher should be investigate the long-term impact of gamification strategies and explore how gamification interacts with diverse learner profiles to optimize strategies.

5. MANAGERIAL IMPLICATIONS

The findings of this study have important implications for educators, LMS developers, and institutional policymakers who aim to integrate gamification into LMS to enhance student engagement, motivation, and academic performance.

5.1. Strategic Integration of Gamification Elements

The results suggest that integrating gamification elements such as leaderboards, points, badges, progress indicators, and rewards into LMS platforms can effectively foster student engagement and motivation. Managers and decision-makers should consider these findings when designing or upgrading LMS platforms. While leaderboards and competition are motivating for some students, they can create anxiety and stress for others. To address this, implementing a mix of competitive elements with cooperative activities or group achievements can ensure inclusivity and support diverse learning preferences. Feedback is an essential tool for supporting motivation and goal-setting. Immediate and consistent feedback through gamified systems (e.g., progress bars, scores) should be prioritized to provide students with a clear sense of their learning progress and accomplishments. Not all students respond to gamification in the same way. Managers should incorporate adaptive learning models within gamified LMS platforms, allowing students to progress at their own pace and engage in individualized learning experiences based on their ability levels and motivation profiles.

5.2. Long-Term Strategy for Sustainable Gamification

The study findings emphasize the importance of designing gamification strategies that maintain student motivation over time. Institutions should continuously monitor the effectiveness of gamification systems to avoid student desensitization to extrinsic rewards and introduce innovative and dynamic reward structures to maintain long-term engagement.

6. CONCLUSION

This study explored the effects of gamification on student engagement, motivation, and academic performance within LMS contexts. The findings indicate that gamification significantly enhances engagement and motivation by creating interactive learning experiences that combine intrinsic and extrinsic reward mechanisms. Furthermore, the implementation of gamified LMS platforms led to measurable improvements in academic performance, with experimental group students scoring higher on final exams and exhibiting higher assignment completion rates.

While gamification offers many benefits, challenges such as competitive pressure and technological infrastructure must be addressed for successful and inclusive implementation. Balancing competitive and cooperative elements, designing personalized learning pathways, and ensuring continuous feedback are critical strategies for maximizing the benefits of gamification.

These findings contribute to the growing body of evidence supporting gamification as a transformative educational strategy. They provide valuable insights for educators, LMS developers, and policymakers striving to create engaging, motivating, and effective learning environments.

7. DECLARATIONS

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7.2. Author Contributions

Conceptualization: PR; Methodology: PR; Software: PR; Validation: RS, MS, and RE; Formal Analysis: PR and RS; Investigation: RS; Resources: PR; Data Curation: MS; Writing Original Draft Preparation: PR and RS; Writing Review and Editing: MS, RE, and EG; Visualization: PR; All authors, PR, RS, MS, RE, and EG, have read and agreed to the published version of the manuscript.

7.3. Data Availability Statement

The data presented in this study are available on request from the corresponding author.

7.4. Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

7.5. Declaration of Conflicting Interest

The authors declare that they have no conflicts of interest, known competing financial interests, or personal relationships that could have influenced the work reported in this paper.

REFERENCES

[1] D. Anurogo, H. La Ramba, N. D. Putri, and U. M. P. Putri, "Digital literacy 5.0 to enhance multicultural education," *Multicultural Islamic Education Review*, vol. 1, no. 2, pp. 109–179, 2023.

[2] P. S. Muljana, C. S. Dabas, and T. Luo, "Examining the relationships among self-regulated learning, homework timeliness, and course achievement: a context of female students learning quantitative topics," *Journal of Research on Technology in Education*, vol. 55, no. 2, pp. 143–162, 2023.

[3] R. Rohan, D. Pal, S. Funilkul, W. Chutimaskul, and W. Eamsinvattana, "How gamification leads to continued usage of moocs? a theoretical perspective," *Ieee Access*, vol. 9, pp. 108 144–108 161, 2021.

[4] D. T. K. NG and W. S. Y. HO, "Teaching creatively: Case studies with synchronous english, mathematics and music learning in a summer programme," *Journal of Communication and Education*, vol. 5, no. 1, 2021.

[5] D. Anderson, "Impact of gamification in an online rn to bsn program," *A-State Research & Creativity Hub*, 2024.

[6] D. John, N. Hussin, M. K. Zaini, D. S. Ametefe, A. A. Aliu, and A. Caliskan, "Gamification equilibrium: the fulcrum for balanced intrinsic motivation and extrinsic rewards in learning systems: immersive gamification in muhamad khairulnizam zainilearning system," *International Journal of Serious Games*, vol. 10, no. 3, pp. 83–116, 2023.

[7] R. F. Nevizond, U. Rahardja, N. P. L. Santoso, S. Purnama, and W. Y. Prihastiwi, "Collaboration blockchain technology and gamification in ilearning systems," *Sci. J. Informatics*, vol. 8, no. 2, pp. 213–221, 2021.

[8] F. S. Al-Hafdi and W. S. Alhalafawy, "Ten years of gamification-based learning: A bibliometric analysis and systematic review." *International Journal of Interactive Mobile Technologies*, vol. 18, no. 7, 2024.

[9] S. Karagiannis, "Systematic design, deployment and evaluation of gamified cybersecurity learning environments," Ph.D. dissertation, Ionian University, Greece, 2022.

[10] P. Luarn, C.-C. Chen, and Y.-P. Chiu, "Enhancing intrinsic learning motivation through gamification: a self-determination theory perspective," *The International Journal of Information and Learning Technology*, vol. 40, no. 5, pp. 413–424, 2023.

[11] S. Ahmad, S. Umirzakova, G. Mujtaba, M. S. Amin, and T. Whangbo, "Education 5.0: requirements, enabling technologies, and future directions," *arXiv preprint arXiv:2307.15846*, 2023.

[12] T. Freire, K. Gissubel, D. Tavares, and A. Teixeira, "Flow experience in human development: Understanding optimal functioning along the lifespan," *Advances in flow research*, pp. 323–349, 2021.

[13] R. Liu, L. Zhang, Z. Cao, and J. Mi, "Influence of gamification affordance on young citizens' motivation and learning performance toward digital civic education," *Journal of Chinese Governance*, pp. 1–35, 2024.

[14] Y.-T. Huang and T.-H. Wang, "Effect of integrating gamified teaching activities on learning emotions of design students with different learning styles," *Interactive Learning Environments*, pp. 1–21, 2024.

[15] A. Bauman and C. Lucy, "Enhancing entrepreneurial education: Developing competencies for success," *The International Journal of Management Education*, vol. 19, no. 1, p. 100293, 2021.

[16] M. M. Amin, S. N. W. Shamsuddin, and W. Hamzah, "Enhancing engagement in learning management systems using gamification framework," *The International Journal of Multimedia & Its Applications*, vol. 16, no. 5, pp. 21–31, 2024.

[17] Y. Lv, Y. Chen, Y. Sha, J. Wang, L. An, T. Chen, X. Huang, Y. Huang, and L. Huang, "How entrepreneurship education at universities influences entrepreneurial intention: Mediating effect based on entrepreneurial competence," *Frontiers in psychology*, vol. 12, p. 655868, 2021.

[18] H. E. Sari, B. Tumanggor, and D. Efron, "Improving educational outcomes through adaptive learning systems using ai," *International Transactions on Artificial Intelligence*, vol. 3, no. 1, pp. 21–31, 2024.

[19] M. N. Sakib, M. R. Rabbani, I. T. Hawaldar, M. A. Jabber, J. Hossain, and M. Sahabuddin, "Entrepreneurial competencies and smes' performance in a developing economy," *Sustainability*, vol. 14, no. 20, p. 13643, 2022.

[20] D. Zhao, J. Playfoot, C. De Nicola, G. Guarino, M. Bratu, F. Di Salvadore, and G.-M. Muntean, "An innovative multi-layer gamification framework for improved stem learning experience," *IEEE Access*, vol. 10, pp. 3879–3889, 2021.

[21] P. Veluvali and J. Surisetti, "Learning management system for greater learner engagement in higher education—a review," *Higher Education for the Future*, vol. 9, no. 1, pp. 107–121, 2022.

[22] M. Saini, E. Sengupta, M. Singh, H. Singh, and J. Singh, "Sustainable development goal for quality education (sdg 4): A study on sdg 4 to extract the pattern of association among the indicators of sdg 4 employing a genetic algorithm," *Education and Information Technologies*, vol. 28, no. 2, pp. 2031–2069, 2023.

[23] United Nations, "Sustainable development goals," 2024. [Online]. Available: https://sdgs.un.org/goals

[24] A. S. Ibidunni, O. M. Ogundana, and A. Okonkwo, "Entrepreneurial competencies and the performance of informal smes: The contingent role of business environment," in *Entrepreneurship and the Informal Sector*. Routledge, 2022, pp. 28–50.

[25] T. K. Chiu, "Applying the self-determination theory (sdt) to explain student engagement in online learning during the covid-19 pandemic," *Journal of Research on Technology in Education*, vol. 54, no. sup1, pp. S14–S30, 2022.

[26] M. Hardini, Q. Aini, U. Rahardja, R. D. Izzaty, and A. Faturahman, "Ontology of education using blockchain: Time based protocol," in *2020 2nd International Conference on Cybernetics and Intelligent System (ICORIS)*. IEEE, 2020, pp. 1–5.

[27] C. Yu, G. Yao *et al.*, "Enhancing student engagement with ai-driven personalized learning systems," *International Transactions on Education Technology (ITEE)*, vol. 3, no. 1, pp. 1–8, 2024.

[28] J. Jayalath and V. Esichaikul, "Gamification to enhance motivation and engagement in blended elearning for technical and vocational education and training," *Technology, Knowledge and Learning*, vol. 27, no. 1, pp. 91–118, 2022.

[29] F. Guay, "Applying self-determination theory to education: Regulations types, psychological needs, and autonomy supporting behaviors," *Canadian Journal of School Psychology*, vol. 37, no. 1, pp. 75–92, 2022.

[30] OECD, "Curriculum flexibility and autonomy," Organisation for Economic Co-operation and Development (OECD), Tech. Rep., 2024. [Online]. Available: https://www.oecd.org/en/publications/curriculum-flexibility-and-autonomy_eccbbac2-en.html

[31] I. Kozlinska, A. Rebmann, and T. Mets, "Entrepreneurial competencies and employment status of business graduates: the role of experiential entrepreneurship pedagogy," *Journal of Small Business & Entrepreneurship*, vol. 35, no. 5, pp. 724–761, 2023.

[32] U. Venesaar, E. Malleus, G. Arro, and M. Toding, "Entrepreneurship competence model for supporting learners development at all educational levels," *Administrative Sciences*, vol. 12, no. 1, p. 2, 2021.

[33] P. A. Sunarya, N. Lutfiani, N. P. L. Santoso, R. A. Toyibah *et al.*, "The importance of technology to the view of the qur'an for studying natural sciences," *Aptisi Transactions on Technopreneurship (ATT)*, vol. 3, no. 1, pp. 58–67, 2021.

[34] A. Kanivia, H. Hilda, A. Adiwijaya, M. F. Fazri, S. Maulana, and M. Hardini, "The impact of information technology support on the use of e-learning systems at university," *International Journal of Cyber and IT Service Management*, vol. 4, no. 2, pp. 122–132, 2024.

[35] J. Hamari, N. Xi, Z. Legaki, and B. Morschheuser, "Gamification," in *Hawaii International Conference on System Sciences*, 2023, p. 1105.

[36] I. Bouchrika, N. Harrati, V. Wanick, and G. Wills, "Exploring the impact of gamification on student engagement and involvement with e-learning systems," *Interactive Learning Environments*, vol. 29, no. 8, pp. 1244–1257, 2021.

[37] D. A. Prabowo, C. Tariazela, and A. Birgithri, "An examination of the impact of using marketplaces to promote the growth of micro, small, and medium enterprises (msmes) in indonesia," *Startupreneur Business Digital (SABDA Journal)*, vol. 3, no. 1, pp. 26–33, 2024.

[38] E. S. Rivera and C. L. P. Garden, "Gamification for student engagement: a framework," *Journal of further and higher education*, vol. 45, no. 7, pp. 999–1012, 2021.

[39] A. N. Saleem, N. M. Noori, and F. Ozdamli, "Gamification applications in e-learning: A literature review," *Technology, Knowledge and Learning*, vol. 27, no. 1, pp. 139–159, 2022.

[40] U. Rahardja, Q. Aini, F. P. Oganda, V. T. Devana *et al.*, "Secure framework based on blockchain for e-learning during covid-19," in *2021 9th International Conference on Cyber and IT Service Management (CITSM)*. IEEE, 2021, pp. 1–7.

[41] O. Y. Yuliana and Y. Palumian, "Gamification of learning management system improves students' engagement, active learning and performance," in *2023 14th International Conference on Information & Communication Technology and System (ICTS)*. IEEE, 2023, pp. 62–66.

[42] K. Skritsovali, "Learning through playing: appreciating the role of gamification in business management education during and after the covid-19 pandemic," *Journal of Management Development*, vol. 42, no. 5, pp. 388–398, 2023.

[43] M. Radif and O. M. Hameed, "Enhancing virtual learning environments: A strategic approach to gamifying learning management systems for increased engagement and competency," *Eurasian Journal of Educational Research*, vol. 111, pp. 122–135, 2024.

[44] S. Chinchua, T. Kantathanawat, and S. Tuntiwongwanich, "Increasing programming self-efficacy (pse) through a problem-based gamification digital learning ecosystem (dle) model." *Journal of Higher Education Theory & Practice*, vol. 22, no. 9, 2022.

[45] Y. Tao, Y. Meng, Z. Gao, and X. Yang, "Perceived teacher support, student engagement, and academic achievement: A meta-analysis," *Educational Psychology*, vol. 42, no. 4, pp. 401–420, 2022.

[46] B. K. Bintaro, P. Sokibi, I. Amsyar, and Y. P. A. Sanjaya, "Utilizing digital marketing as a business strategy: Utilizing digital marketing as a business strategy," *Startupreneur Business Digital (SABDA Journal)*, vol. 1, no. 1, pp. 63–71, 2022.

[47] T. Aprilia, A. R. Ardiansyah, and H. Riyanti, "The feasibility of interactive multimedia and online quiz based gamification on learning management system (lms) thematic learning courses," *Jurnal Prima Edukasia*, vol. 11, no. 1, pp. 120–133, 2023.

[48] L. Meria, D. Prastyani, A. Dudhat *et al.*, "The role of transformational leadership and self-efficacy on readiness to change through work engagement," *Aptisi Transactions on Technopreneurship (ATT)*, vol. 4, no. 1, pp. 77–88, 2022.

[49] A. B. Fitra, A. Suharko, F. M. Albar, D. Apriliasari *et al.*, "Examination of customer interest in the use of the mandiri syariah mobile application at pt. bank syariah mandiri bekasi branch office," *IAIC Transactions on Sustainable Digital Innovation (ITSDI)*, vol. 3, no. 2, pp. 110–125, 2022.

[50] C. Lukita, M. H. R. Chakim, R. Supriati, N. P. L. Santoso, and M. F. Kamil, "Exploration of perceived use of technology using a digital business perspective," *ADI Journal on Recent Innovation*, vol. 5, no. 1Sp, pp. 87–96, 2023.

[51] L. Chen, D. Ifenthaler, and J. Y.-K. Yau, "Online and blended entrepreneurship education: a systematic review of applied educational technologies," *Entrepreneurship education*, vol. 4, no. 2, pp. 191–232, 2021.