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Game on for learning: a holistic exploration of Gamification's impact on student engagement and academic performance in educational environments

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Abstract

Purpose – The research paper examines the complex relationship between gamification, student engagement and academic performance in educational environments. The study employed a structural equation model that highlights important connections among key constructs within the educational setting.

Design/methodology/approach – This research aims to explore the connection between gamification, student engagement and academic performance in educational settings. The study employs various statistical techniques such as factor analysis, Kaiser–Meyer–Olkin (KMO), Bartlett's test, component transformation matrix, correlation and regression analysis, descriptive statistics, ANOVA, coefficients and coefficient correlations, residual statistics and confirmatory factor analysis (CFA) to analyze the data.

Findings – It was found that active participation by the instructor and good time management skills have a positive impact on student engagement levels ($\beta = 0.380$, $p < 0.001$; $\beta = 0.433$ and $p < 0.001$). However, peer interaction does not significantly predict student engagement ($\beta = -0.068$ and $p = 0.352$). Additionally, there is a positive correlation between student engagement and performance ($\beta = 0.280$ and $p < 0.001$).

Research limitations/implications – The study highlights the importance of innovative design to fully utilize gamification. Future research should consider design, user characteristics and educational context. The findings can guide informed decisions about gamification in education, fostering motivation and learning objectives.

Practical implications – The study presents a reliable tool for assessing student engagement and performance in educational settings, demonstrating high Cronbach's alpha and robust reliability. It identifies student engagement and time management as significant predictors of Global Learning Outcome. The findings can inform decisions on implementing gamification in educational settings, promoting intrinsic motivation and aligning with learning objectives.

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Social implications – The research highlights the transformative impact of gamification on educational practices, highlighting its potential to enhance student experiences, motivate, promote diversity and improve long-term academic performance, highlighting the trend of integrating technology into education.
Originality/value – In today's ever-changing education landscape, it is essential to incorporate innovative techniques to keep students engaged and enthusiastic about learning. Gamification is one such approach that has become increasingly popular. It is a concept that takes inspiration from the immersive world of games to enhance the overall learning experience.

Keywords Gamification, Student engagement, Student performance, Motivation, Educational technology, Learning outcomes
Paper type Research paper

1. Introduction

Education is currently transforming with the integration of innovative technologies and new pedagogical approaches. One such strategy is gamification, which involves incorporating game design elements into non-game contexts to increase student engagement and performance. By leveraging psychological principles such as competition, rewards, achievement and progression, gamification creates an environment that mirrors gaming experiences. This approach has a significant impact on education, as it fosters intrinsic motivation, transforms focus and retention and improves understanding of course material. Understanding the impact of gamification is crucial for optimizing teaching methods and ensuring educational relevance.

In a comprehensive exploration of gamification's influence on education, Arufe Giráldez *et al.* (2022) conducted a study revealing the substantial impact of a multimodal gamified learning environment on the final grades of 133 Spanish university students. The intervention group, exposed to this innovative learning approach, exhibited higher overall scores and actively engaged in voluntary learning tasks. Further contributing to the discourse, Tan and Hew (2016) discovered that gamification significantly improved student engagement and affective outcomes in a blended learning class, emphasizing the experimental group's increased participation and motivation. In a distinct approach, Duggal *et al.* (2021) harnessed artificial intelligence and machine learning to enhance self-motivation and engagement among 120 higher education students through a gamified framework, successfully addressing disengagement issues and demonstrating improved participation compared to the control group. Alsadoon's *et al.* (2022) exploration into the effects of a gamified e-learning environment on middle school students during the COVID-19 pandemic found enhanced motivation and satisfaction, though the impact on achievement was not statistically significant. Leitao's *et al.* (2022) study delves into the influence of game elements on recycling motivation among secondary school students in Portugal and the UK, revealing a notable trend toward autonomous motivation. Together, these studies underscore the varied and impactful outcomes of gamification in diverse educational contexts, offering valuable insights into its potential to enhance engagement, motivation and academic performance.

In the evolving landscape of education, Alsubhi *et al.* (2021) proposes a comprehensive engagement framework for gamification in education software development. By amalgamating game elements, learning activities and various factors, their framework has proven efficacious in not only enhancing student engagement and performance but also addressing the challenges posed by the COVID-19 pandemic on online learning. The study emphasizes the pivotal role of gamification, specifically using Quizziz, in mitigating the impact on students' critical thinking skills, highlighting the crucial role of teachers in this process. Kang and Recard (2023) contribute further insights by investigating the implementation of a gamification approach to enhance students' learning engagement. Their study identifies key game elements for enhancing engagement in e-learning platforms.

It proposes a conceptual engagement framework, informed by literature analysis and a comprehensive questionnaire survey, serving as a valuable guide for developers and academics in crafting engaging educational systems. Additionally, Alsubhi's *et al.* (2020) research into learners' engagement in gamified learning environments, unveils distinct achievement-oriented and perfection-oriented engagement types, each influencing motivation and providing valuable insights into gamification design and adaptation. Lavoué *et al.* (2021) shed light on the effectiveness of game-based learning, demonstrating its efficacy in planning education and fostering motivation, emotional involvement and teamwork among students, thereby enhancing overall engagement. Hartt *et al.* (2020) explores the dynamics of e-learning platforms, gamification and adaptive gamification, revealing that while both improve engagement, adaptive gamification, tailored to learning styles, exhibits a notable 25% increase in motivation and a 26% reduction in dropout rates. Hassan *et al.* (2021) advocate for incorporating interactive activities like games and gamification in education to not only enhance learning but also promote sustainable life skills and increase engagement, challenging traditional teaching methods. Duggal *et al.* (2021) emphasizes the positive impact of a reward-based gamification system on the educational experience during the COVID-19 pandemic, particularly in two gamified undergraduate courses. Rincon-Flores and Santos Guevara (2021) study on gamification in higher education reveals that challenge and enjoyment significantly influence engagement and satisfaction, suggesting that gamification can enhance educational quality. Nguyen-Viet and Nguyen-Viet (2023) delve into enhancing satisfaction among Vietnamese students through gamification, emphasizing its mediating role in engagement and learning effectiveness. Collectively, these studies provide a comprehensive understanding of the multifaceted impact of gamification on education, offering valuable insights for educators, developers and policymakers alike.

2. Review of literature

Errol Scott Rivera (2021) has contributed a unique perspective on integrating gamification in education. Their proposed framework, called the Gamification for Student Engagement Framework, is designed to provide a systematic guide for practitioners to create gamified learning experiences customized for specific student outcomes. This can help enhance student satisfaction and well-being across different educational settings. The framework emphasizes the importance of aligning gamification strategies with individual student experiences, taking into account the nuanced nature of their preferences and learning environments.

Numerous studies have provided valuable insights into the multifaceted impact of gamification in education. Alsawaier's (2017) meta-analysis highlights the positive impact of gamification on motivation and engagement and identifies design elements and moderators influencing its effectiveness. Other studies, such as those by Huang *et al.* (2020) and García-López *et al.* (2023), examine the motivational aspects of gamified platforms, emphasizing their impact on behavioral dissatisfaction, cognition and metacognition in university students. The integration of gamification in specific subjects, such as chemistry (Chans and Portuguez Castro, 2021) and industrial psychology (Eltahir *et al.*, 2021), showcases its effectiveness in various academic domains. Research by Qiao *et al.* (2023) investigates the effects of mixed and non-digital gamification, emphasizing improvements in learning achievement, cognitive engagement and course satisfaction. Camacho-Sánchez *et al.* (2023) conducted a systematic review on game-based learning and gamification in physical education, providing insights into enhancing student engagement. Luo's analysis (2022) using HistCite software identifies crucial factors contributing to the varied effectiveness of educational gamification. The incorporation of flipped classrooms and gamification in postgraduate business education programs in China during the pandemic, as studied by Ng and Lo (2022), further highlights

the positive impact on learner achievement and engagement. Different audiences and types of material may have different reactions to the educational and learning benefits of gamification. According to research, students who take gamified classes do better academically because they are better able to focus on their coursework. For instance, college students who participated in a gamified cell biology class outperformed their peers who attended a lecture-based session by a factor of forty percent (Kim *et al.*, 2018).

One strategy for incorporating gamification into a system involves beginning with unsatisfied needs and using a simple, superficial reward-based layer as an introduction to the system. These advantages need to be quickly replaced with others that are more meaningful, such as a narrative, the option to choose which routes to study, engaging activities and opportunities to reflect (Nicholson, 2015). Using educational games as learning aids is a feasible technique because of the games' inherent ability to teach as well as facilitate the development of important skills such as problem-solving, collaboration and communication. According to Dicheva *et al.* (2015), games possess an incredible driving force; they utilize a range of appeals, sometimes without obtaining anything in return, merely for the joy of it and the potential to win. Games also provide the possibility of winning.

Hamari *et al.* (2014) gamification can be effective in enhancing engagement and motivation, but its impact on performance is more nuanced and context-dependent. Dicheva *et al.* (2015) have found that gamification has a positive impact on student engagement and motivation. However, the effectiveness of gamification depends on various factors, such as the design of gamified activities, the context of implementation and the individual characteristics of students. Landers *et al.* (2017) has discussed the role of rewards, motivation and engagement in gamified learning environments. As per the findings, gamification can enhance student motivation and engagement by leveraging psychological principles, such as intrinsic and extrinsic motivation, self-determination theory and flow theory.

Seaborn and Fels (2015), the benefits of the digital gaming medium stimulate its use in fields that are not related to entertainment. Gamification is a term that has been used in the field of education to describe both video games in general and digital game-based learning (DGBL) in particular (Kim *et al.*, 2018). Education has a significant potential for application since its goal is to raise the level of enthusiasm and involvement among students. The use of game mechanics to solve challenges in learning and education is referred to as gamification, and it relates to a variety of activities and processes (Rapp *et al.*, 2019). Gamification may be broken down into many categories. Over the last several years, gamification has been an increasingly popular tactic. However, further work has to be done in the field of academic research on gamification in education to cover certain significant gaps.

3. Research objective

The principal objective of this study is to comprehensively examine the factors associated with gamification and their consequences, particularly by investigating how these factors affect student engagement and, subsequently, how student engagement influences student performance.

4. Research questions

The effectiveness of integrating gamification in education remains a subject of debate, with varying outcomes reported in different studies. To address this, the growing body of literature on this topic has enabled us to conduct a meta-analysis to better understand the overall success of implementing gamification in educational settings. The primary research question guiding this analysis is, "What is the influence of gamification on student performance?" This central question has led to the following subsidiary questions: (1) Does

the adoption of a gamified learning system (or elements of gamification) impact student engagement? (2) Does increased student engagement through gamification translate into improved student performance?

5. Hypothesis

H1. Instructor involvement does not exert a notable influence on student engagement in gamification.

H2. Effective time management does not seem to significantly affect student engagement in gamification.

H3. Peer interaction appears to have minimal impact on student engagement.

H4. Student engagement does not appear to be a strong predictor of student performance.

6. Methodology

The research methodology involved analyzing data using various tools and techniques. Data cleaning was done to remove missing data, and 93.3% of cases were considered valid for analysis. The reliability analysis showed strong internal consistency among the measurement scale items. The scale had 30 items, with an average mean score of 3.368. The inter-item correlation was moderate, indicating a reasonable degree of association among items. Descriptive statistics were provided for the overall scale.

The data was well-suited for factor analysis due to the high correlation between variables. A statistically significant chi-square value supported the factorability of the correlation matrix. Factor identification was done, and Pearson correlation coefficients were calculated to determine the strength and direction of relationships between variables.

7. Data analysis

This research examines the relationship between gamification, student engagement and academic performance in educational contexts. It uses factor analysis, KMO, Bartlett's test, component transformation matrix, correlation and regression analysis, descriptive statistics, ANOVA, coefficients and coefficient correlations, residual statistics and confirmatory factor analysis (CFA). The findings highlight the potential of gamification in enhancing student motivation, participation and achievement, but emphasize the need for thoughtful design, alignment with learning objectives and individual differences.

8. Results

The test results in Table 1 shows the majority of participants identified as male, constituting 64.3% of the sample, while females accounted for 26.1%. The gender distribution indicates a notable gender imbalance in the study, with males being the more dominant group. Only 9.5% of the data had missing or unspecified gender information.

The test results in Table 2 shows the age distribution of participants demonstrates that the majority fall within the age range of 18–20, comprising 71.9% of the sample. Participants aged 15–18 represent 10.1%, while those between 21–25 make up 7.5%. Participants above the age of 25 constitute a smaller percentage at 1.0%. The data suggests a concentration of participants in the late adolescence to early adulthood range, with limited representation from older age groups.

The test results in Table 3 shows the majority of participants hold a degree, accounting for 78.9% of the sample. Higher Secondary education is the next most common category, making up 8.5%, followed by Diploma at 1.0% and Postgraduate at 2.0%. There are also 9.5% of cases where education-level information is missing or unspecified. The analysis suggests a diverse educational background among participants, with a significant portion having attained at least a degree.

The test results in Table 4 shows the Kaiser–Meyer–Olkin (KMO) Measure of Sampling Adequacy for the dataset is 0.872, indicating a high level of adequacy for factor analysis. Additionally, Bartlett's Test of Sphericity reached statistical significance (Chi-Square = 2165.437, df = 210, Sig. = 0.000), suggesting that the correlation matrix is not an identity matrix, supporting the suitability of the data for factor analysis.

The test results in Table 5 shows the rotated factor matrix, obtained through Maximum Likelihood extraction and Varimax rotation with Kaiser Normalization, reveals distinct factor loadings for different variables. In Factor 1, significant loadings are observed for variables related to time management, indicating a cohesive factor associated with effective time management skills. Factor 2 captures variables related to student engagement, with strong

Table 1. Demographics profile of the respondents

		Gender Frequency	Percent	Valid percent	Cumulative percent
Valid	Male	128	64.3	71.1	71.1
	Female	52	26.1	28.9	100.0
	Total	180	90.5	100.0	
Missing	System	19	9.5		
Total		199	100.0		

Source(s): Authors' own construct from validation 2024

Table 2. Age distribution summary of the respondents

		Age Frequency	Percent	Valid percent	Cumulative percent
Valid		19	9.5	9.5	9.5
	15–18	20	10.1	10.1	19.6
	18–20	143	71.9	71.9	91.5
	21–25	15	7.5	7.5	99.0
	above 25	2	1.0	1.0	100.0
	Total	199	100.0	100.0	

Source(s): Authors' own construct from validation 2024

Table 3. Educational level distribution summary of the respondents

		Education level Frequency	Percent	Valid percent	Cumulative percent
Valid		19	9.5	9.5	9.5
	Degree	157	78.9	78.9	88.4
	Diploma	2	1.0	1.0	89.4
	Higher Secondary	17	8.5	8.5	98.0
	Postgraduate	4	2.0	2.0	100.0
	Total	199	100.0	100.0	

Source(s): Authors' own construct from validation 2024

loadings on Student_Egmt1 and Student_Egmt2. Factor 3 represents instructor involvement, as evidenced by substantial loadings on Inst_Invol2 and Inst_Invol3. Factor 4, with prominent loadings on Peer_Int1 and Peer_Int3, seems to encapsulate peer interaction. Lastly, Factor 5 is associated with variables related to student performance, as indicated by loadings on Student_Perf2 and Student_Perf3. The rotation method converged after 7 iterations, solidifying the stability of the factor solution. This rotated factor matrix provides a clearer interpretation of the underlying factors influencing the observed variables, facilitating a more nuanced understanding of the relationships within the dataset.

In this study, we used structural equation modeling (SEM) and CFA tools for data analysis and testing relationships between variables. We performed SEM and CFA using SPSS (software for statistical data analysis) and AMOS (software that can be used to perform SEM). In brief, SEM is a family of multivariate statistical analysis methods used to model a network of complex structural relationships between one or more measured variables and latent constructs. CFA

KMO and Bartlett's test

Kaiser–Meyer–Olkin Measure of Sampling Adequacy		0.872
Bartlett's Test of Sphericity	Approx. Chi-Square	2165.437
	df	210
	Sig	0.000

Source(s): Authors' own construct from validation 2024

Table 4.
KMO and Bartlett's test summary

Rotated factor matrix[a]

	Factor				
	1	2	3	4	5
Time_Mgmt1	0.639				
Time_Mgmt2	0.765				
Time_Mgmt3	0.642				
Tme_Mgmt4	0.712				
Time_Mgmt5	0.770				
Student_Egmt1			0.813		
Student_Egmt2			0.725		
Student_Egmt3			0.673		
Student_Egmt4			0.657		
Inst_Invol1				0.660	
Inst_Invol2				0.710	
Inst_Invol3				0.774	
Inst_Invol4				0.568	
Peer_Int1		0.715			
Peer_Int2		0.645			
Peer_Int3		0.744			
Peer_Int4		0.558			
Peer_Int5		0.770			
Student_Perf1					0.585
Student_Perf2					0.618
Student_Perf3					0.642

Note(s): Extraction Method: Maximum Likelihood
Rotation Method: Varimax with Kaiser Normalization. [A]
[a]Rotation converged in 7 iterations
Source(s): Authors' own construct from validation 2024

Table 5.
Rotated factor matrix

method is used to verify the factor structure of a set of observed variables. The SEM estimation results provide valuable insights into the relationships among the key constructs in the context of Student Performance. The path coefficients, standard errors, critical ratios and *p*-values offer a comprehensive understanding of the associations between Time Management, Peer Interaction, Instructor Involvement, Student Engagement and Student Performance.

Figure 1 CFA path model reveals a positive correlation between teacher involvement and student engagement (0.47), time management (0.41) and academic performance (0.27).

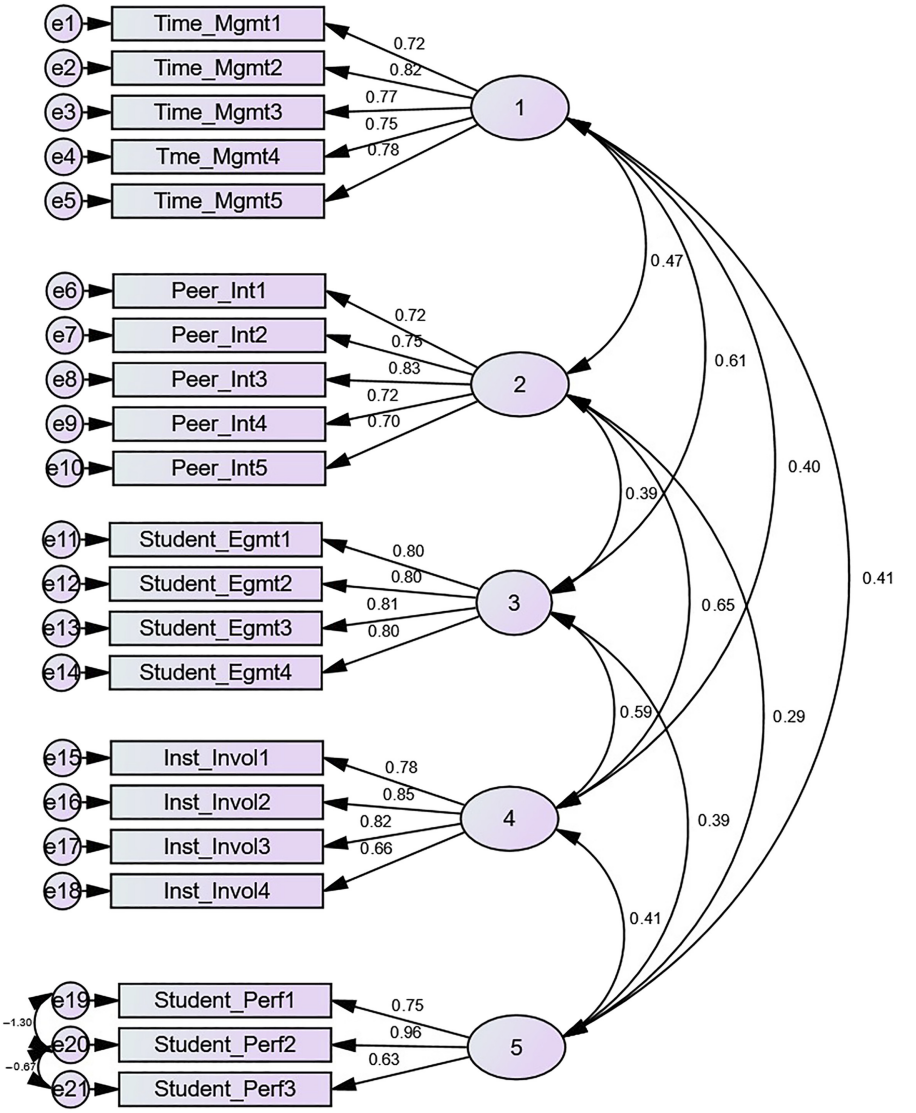


Figure 1.
Final CFA model

Source(s): Authors' own construct from Validation 2024

Students who are more engaged in class tend to have better teachers and time management leads to better academic performance. Student engagement is the most significant factor influencing performance.

The test results in Table 6 presents standardized factor loadings for items within five constructs: Time Management, Peer Interaction, Student Engagement, Instructor Involvement and Student Performance. The Time Management construct exhibits strong standardized factor loadings ranging from 0.723 to 0.816, contributing to a high Cronbach's Alpha of 0.77, indicating good internal consistency. The Peer Interaction construct demonstrates loadings between 0.699 and 0.829, resulting in a Cronbach's Alpha of 0.74. Student Engagement, with loadings from 0.798 to 0.808, shows a high Cronbach's Alpha of

Variables/ Constructs	Items	Standardized factor loadings	Cronbach's alpha	Composite reliability	Average variance extracted	Maximum shared variance
Time Management	Time_ Mgmt1	0.723	0.77	0.879	0.592	0.369
	Time_ Mgmt2	0.816				
	Time_ Mgmt3	0.774				
	Time_ Mgmt4	0.751				
	Time_ Mgmt5	0.780				
Peer Interaction	Peer_Int1	0.716	0.74	0.860	0.553	0.419
	Peer_Int2	0.746				
	Peer_Int3	0.829				
	Peer_Int4	0.722				
	Peer_Int5	0.699				
Student Engagement	Student_ Egmt1	0.804	0.80	0.879	0.645	0.369
	Student_ Egmt2	0.803				
	Student_ Egmt3	0.808				
	Student_ Egmt4	0.798				
Instructor Involvement	Inst_ Invol1	0.785	0.78	0.861	0.610	0.419
	Inst_ Invol2	0.852				
	Inst_ Invol3	0.818				
	Inst_ Invol4	0.656				
Student Performance	Student_ Perf1	0.747	0.78	0.831	0.628	0.168
	Student_ Perf2	0.963				
	Student_ Perf3	0.630				

Note(s): *Model fitness*: $X^2 = 413.201$, df = 177, $X^2/df = 2.344$, RMSEA = 0.082, CFI = 0.884
Source(s): Authors' own construct from validation 2024

Table 6.
Reliability and convergent validity

0.80. Instructor Involvement, characterized by loadings between 0.656 and 0.852, has a Cronbach's Alpha of 0.78. Lastly, Student Performance, featuring loadings from 0.630 to 0.963, displays a Cronbach's Alpha of 0.78. Composite reliability values are consistently high across all constructs, ranging from 0.831 to 0.879. The average variance extracted (AVE) is satisfactory for each construct, ranging from 0.553 to 0.645, indicating convergent validity. The Maximum Shared Variance values are within acceptable limits, further supporting construct validity. The model fitness indicators, including a chi-square of 413.201 with 177 degrees of freedom, a chi-square/df ratio of 2.344, an root mean square error approximation (RMSEA) of 0.082 and a comparative fit index (CFI) of 0.884, collectively suggest a reasonably good fit of the model to the data.

For establishing discriminant validity, we used the Fornell and Larcker (1981) criteria. The values in the diagonal bold are the square root of AVE and other values are inter-variable correlations. The requirement is that the diagonal bold values should be higher than other values in their respective rows and columns, which is met as can be seen in the table. Thus, we can say that our variables have good discriminant validity.

The test results in Table 7 reveals strong correlations between five factors influencing student performance: Time Management, Peer Interaction, Student Engagement, Instructor Involvement and Student Performance. Student engagement is the most significant factor influencing academic success, with active involvement in learning leading to better performance. Time management skills are highly correlated with student performance, with effective time management skills resulting in better grades. Instructor involvement positively impacts student engagement, with positive peer interactions contributing to motivation and interest in learning. However, the direct impact of peer interaction on performance is weaker. The data suggests that educators should focus on fostering student engagement, promoting good time management skills and creating a positive learning environment with active instructor involvement for improved student performance.

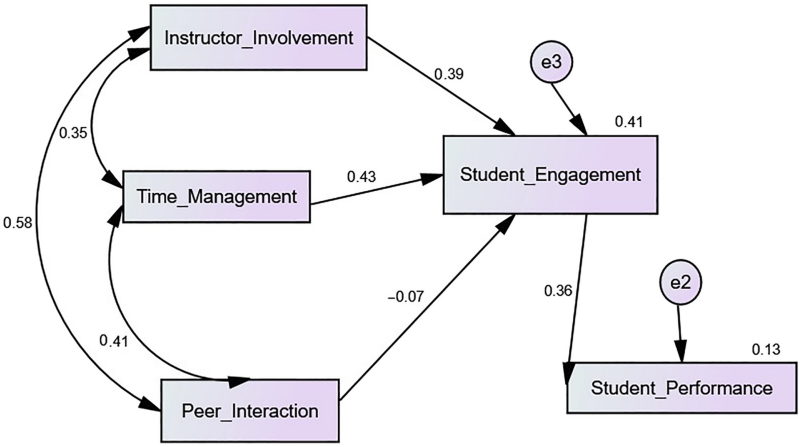
Figure 2 Structural Measure Model indicates that the path model reveals a positive correlation between teacher involvement and student engagement (0.47), time management (0.41) and academic performance (0.27). However, it does not show causality, suggesting that increasing teacher involvement does not necessarily lead to increased student engagement.

The test results in Table 8 reveals significant pathways between key constructs. Student Engagement is positively influenced by both Instructor Involvement ($\beta = 0.380$, $p < 0.001$) and Time Management ($\beta = 0.433$, $p < 0.001$), suggesting that students with more involved instructors and effective time management skills are likely to be more engaged. However, Peer Interaction does not significantly predict Student Engagement ($\beta = -0.068$, $p = 0.352$).

	Time management	Peer interaction	Student engagement	Instructor involvement	Student performance
Time Management	*0.770*				0.409***
Peer Interaction	0.472***	*0.744*			0.293**
Student Engagement	0.608***	0.385***	*0.803*		0.391***
Instructor Involvement	0.398***	0.647***	0.587***	*0.781*	0.406***
Student Performance					*0.792*

Table 7.
Discriminant validity

Note(s): ***$p < 0.001$
Source(s): Authors' own construct from validation 2024



Source(s): Authors' own construct from Validation 2024

Figure 2.
Structural measure model results

	Estimate	S.E.	C.R.	*p*
Student_Engagement ← Instructor_Involvement	0.380	0.068	5.560	***
Student_Engagement ← Time_Management	0.433	0.064	6.773	***
Student_Engagement ← Peer_Interaction	−0.068	0.073	−0.930	0.352
Student_Performance ← Student_Engagement	0.280	0.054	5.191	***

Note(s): **, * Significant at 1%, 5% level
S.E – An estimate of the standard error of the covariance
C.R – critical ratio obtained by covariance estimate by its standard error
Source(s): Authors' own construct from validation 2024

Table 8.
Direct effect of research model: standardized regression weights

Moreover, Student Performance is positively associated with Student Engagement ($\beta = 0.280$, $p < 0.001$), indicating that more engaged students tend to have better academic performance. These findings underscore the importance of instructor involvement and time management in fostering student engagement, with subsequent positive implications for academic performance. The significance levels are denoted as ** (1%) and * (5%), providing confidence in the observed relationships. The standard error (S.E.) and critical ratio (C.R.) values further support the reliability and significance of the estimated covariance in the structural model.

The hypotheses test results in Table 9 shows the outcomes of the structural relationships investigated in the study. Hypothesis H1, asserting an influence of Instructor Involvement on Student Engagement in Gamification, is supported, indicating that students with more

H#	Study hypotheses	Result
H1	There is an influence of Instructor Involvement towards Student Engagement in Gamification	Supported
H2	There is an influence of Time Management on Student Engagement in Gamification	Supported
H3	There is an influence of Peer Interaction on Student Engagement in Gamification	Rejected
H4	There is an influence of Student Engagement in Gamification on Student Performance	Supported

Source(s): Authors' own construct from validation 2024

Table 9.
Outline of structural relationship results of the study

involved instructors tend to exhibit higher levels of engagement. H2, which posits an influence of Time Management on Student Engagement in Gamification, is also supported, suggesting that effective time management contributes positively to student engagement. However, H3, proposing an influence of Peer Interaction on Student Engagement in Gamification, is rejected, indicating that the study did not find a significant impact of peer interaction on student engagement in the context of gamification. Finally, H4, suggesting an influence of Student Engagement in Gamification on Student Performance, is supported, indicating that higher levels of student engagement are associated with better academic performance in the gamified learning environment. These results provide valuable insights into the factors influencing student engagement and performance in gamified educational settings.

9. Discussion and implications

The study's findings, as outlined in Table 7, provide a foundation for a comprehensive discussion on the relationships between key constructs in the context of gamified education.

Instructor Involvement on Student Engagement aligns with existing literature emphasizing the crucial role of instructors in facilitating engaging learning experiences. This result underscores the importance of instructor support, guidance and active involvement in gamified educational environments, contributing to enhanced student engagement.

Similarly, the confirmed influence of Time Management on Student Engagement highlights the significance of effective time management skills in fostering student engagement within gamification. Students who can efficiently manage their time are more likely to engage actively with the gamified elements, reinforcing the idea that time-related skills play a vital role in the success of gamified educational interventions.

Contrary to expectations, the study did not find a significant influence of Peer Interaction on Student Engagement in the gamified context. This unexpected result may prompt further exploration into the nature of peer interactions within gamification, considering factors such as group dynamics, individual preferences and the design of gamified activities that promote collaborative engagement.

The positive impact of Student Engagement in Gamification on Student Performance validates the notion that actively engaged students are more likely to achieve better academic outcomes. This result underscores the potential of gamification not only in enhancing engagement but also in positively influencing students' overall performance.

Overall, these findings contribute valuable insights to the literature on gamification in education. Educators and instructional designers can leverage these results to inform the development and implementation of gamified learning experiences, emphasizing the pivotal roles of instructor involvement, effective time management and individual student engagement for optimal educational outcomes. Future research could delve deeper into the dynamics of peer interaction in gamified settings and explore additional factors that may further enhance the effectiveness of gamification in education.

The confirmed relationships between key constructs underscore the potential of gamification as a pedagogical tool to enhance student engagement and, consequently, improve academic performance. These findings have practical implications for educators, instructional designers and policymakers seeking to optimize the effectiveness of gamified educational interventions. However, it is important to note the limitations of this study, such as the potential for response biases in self-reported data and the specific context in which the study was conducted. Future research could explore these relationships across diverse educational settings and demographic groups to enhance the generalizability of the findings. This study contributes to the growing body of literature on gamification in education and

provides actionable insights for educators aiming to leverage gamified approaches for enhanced student outcomes. The results invite further exploration and refinement of gamification strategies, emphasizing the need for continued research in this evolving field.

10. Theoretical implications

Gamification is a transformative approach to education, combining play and learning to engage modern learners. It is rooted in psychological principles such as self-determination theory, flow theory and narrative psychology. It enhances cognitive engagement by promoting deeper understanding and retention of information, stimulating critical thinking and problem-solving. Gamification also fosters intrinsic motivation, improving academic performance by increasing engagement and enhancing focus, retention and resilience. It also promotes social interaction, fostering collaboration and competition. Gamification's shift towards intrinsic motivation can instill a lifelong love for learning, transcending immediate academic goals. However, its impact on education is context-dependent and requires further research to adapt to evolving learning preferences. Understanding the theoretical foundations of gamification is crucial for educators, policymakers and researchers to optimize teaching methods, enhance student outcomes and ensure the relevance of education in an ever-evolving landscape.

11. Practical implications

The study provides a reliable measurement tool for assessing student engagement and performance in educational settings, with a high Cronbach's Alpha and robust reliability. The instrument's quality data collection and structural insights offer valuable insights for designing effective gamified educational interventions. The regression model reveals that Instructor Involvement and Time Management positively impact student engagement, while peer interaction doesn't. Both factors positively impact academic performance. The CFA confirms the instrument's validity and the parsimony-adjusted measures balance model fit and complexity. The study also emphasizes the need for innovative design to harness gamification's full potential. Future research should explore optimal conditions for gamification implementation, considering design, user characteristics and educational context. The findings can guide informed decisions about implementing gamification in educational settings, fostering intrinsic motivation and aligning with learning objectives.

12. Limitations and scope for future research

This study focuses on the impact of gamification on student engagement and academic performance in a specific context. The results are based on cross-sectional data, which may introduce preferences or inaccuracies in terms of geographical conditions. The model indicates that Instructor Involvement and Time Management positively influence student engagement, while peer interaction doesn't, both of which positively impact academic performance. Other factors like individual differences, teaching methods and external factors are not extensively explored. The effectiveness of gamification can be influenced by context-specific factors, which are not comprehensively considered in this study. Future research should include longitudinal investigations, diverse samples, objective measures, multifactorial analyses, comparative analyses, qualitative investigations, external validity, advanced analytics, optimal conditions and intervention studies. By addressing these limitations, scholars and practitioners can advance our understanding of gamification's impact on education and refine its implementation for the benefit of students and educational institutions.

13. Discussion and conclusion

This study provides valuable insights into gamified educational environments, highlighting factors that influence student engagement and performance. The findings support the hypotheses that Instructor Involvement and Time Management have a positive influence on Student Engagement, which in turn has a positive impact on Student Performance.

The results emphasize the important role of instructors in facilitating engaging learning experiences and the significance of effective time management skills for students participating in gamified activities.

Interestingly, the study found no significant influence of Peer Interaction on Student Engagement, which challenges assumptions about the role of peer collaboration in gamified learning environments. This unexpected result calls for further research to explore the dynamics of peer interactions within the context of gamification and to identify factors that may mediate or moderate these relationships.

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