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Examining the predictive role of weekly game-based online quiz performance on academic achievement and engagement

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Abstract: This pilot study explores the predictive role of weekly game-based online quizzes on academic achievement and engagement in a 15-week foundation of education course at a university. The purpose was to assess how quiz performance relates to midterm and final exam outcomes and student engagement, leveraging Quizizz as a formative assessment tool. Conducted with 24 third-year students selected via convenience sampling, the methodology involved collecting quiz scores and completions from Quizizz, alongside attendance and exam scores from university records. Descriptive statistics, Pearson's correlation, and linear regression were analyzed using Statistical Package for the Social Sciences (SPSS) version 27. Findings revealed that there is a statistically significant correlation between quiz performance, attendance, and the number of quiz completions. Simple regression analysis further revealed that students' midterm exam scores and final exam scores were predicted by quiz performance. The result from this study suggested integrating game-based quiz tools as a formative assessment into education to enhance learning outcomes, with a call for larger-scale research to validate and refine this approach.

Keywords: Game-based learning, formative assessment, academic achievement, Quizizz, gamification, student engagement, higher education, quiz performance, self-determination theory, predictive role

Highlights

What is already known about this topic:

- Game-based tools like Quizizz enhance engagement and motivation in education.
- Formative assessments improve learning outcomes via feedback.
- Gamification's impact varies by design and context.

What this paper contributes:

- Weekly quiz performance predicts midterm (47.4%) and final exam (42.8%) success.
- Quiz scores link to engagement (attendance, completion) in a 15-week course.
- Pilot study tests gamification in a foundational education context.

Implications for theory, practice and/or policy:

- Supports self-determination theory in gamified learning environments.
- Advocates for regular, challenging quizzes to boost achievement in higher education.
- Suggests refining quiz design for broader pedagogical impact.

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Introduction

The rapid integration of technology in education has transformed traditional teaching methods, introducing innovative tools such as game-based learning platforms to increase student engagement and learning outcomes. Quizizz stands out as the preferred online quiz platform for interactive formative assessments that integrate gamification with live feedback capabilities (Anak Yunus & Hua, 2021). Formative assessments hold a critical position in education because they offer continuous information about student advancement while supporting necessary teaching modifications. The specific use of Quizizz as a weekly formative assessment, along with its effects on student achievement in higher education, has not yet been extensively studied, even though this tool has become widely used in educational environments (Göksün & Gürsoy, 2019; Pujiati et al., 2024).

The concept of gamification involves integrating elements of game design, such as scores and rewards, into environments to change the way teaching is done to increase participation (Deterding et al., 2011). Self-determination theory draws on drive (such as curiosity) and external rewards (such as incentives) (Deci & Ryan, 2000). Ryan and Deci (2000) emphasized that intrinsic motivation leads to deeper engagement. The gamified features of Quizizz, such as leaderboards and instant feedback, may support these psychological needs, suggesting that gamification can effectively enhance engagement and the reliability of assessments (Salas-Morera et al., 2012). While research indicates that gamification increases classroom participation, it also highlights the importance of performance design (Hamari et al., 2014). Previous studies have shown that online quiz tools improve grammar learning for ESL students, who appreciate motivational aspects (Segaran & Hashim, 2022). Similarly, game-based learning in Arabic grammar courses has increased both motivation and academic performance (Eltahir et al., 2021). Additionally, gamified digital tools have shown promise in enhancing academic outcomes and motivation in higher education (Camacho-Sánchez et al., 2022). However, poorly aligned gamification can lead to distractions, underscoring the need for educators to align gamification strategies with learning objectives (Domínguez et al., 2013).

Most existing studies focus on specific subjects, such as science or languages (Mdlalose et al., 2022; Muna et al., 2023), whereas some cover broader disciplines (Morris et al., 2021; Mackintosh-Franklin, 2021). However, the relationship between engagement (such as attendance and quiz completion) and performance in gamified assessments has not been thoroughly investigated. While some research highlights the motivational benefits of these tools (Segaran & Hashim, 2022; Eltahir et al., 2021), fewer studies (e.g., Lin et al., 2023) have examined how the quality of performance mediates outcomes. Furthermore, while quantitative data dominates the field, there is a lack of qualitative insights into student experiences (Landers & Callan, 2014). Calls for mixed-method approaches have been made by Cosi et al. (2020) and Zhyhadlo (2022), and small-scale pilot studies remain underrepresented. Most research has focused on larger sample sizes (Sotola & Crede, 2021; Figueroa-Cañas & Sancho-Vinuesa, 2021), while this study aims to test feasibility in a specific context. Previous studies on game-based quizzes have been widely studied in Western and tech-rich settings. However, there is a lack of studies of game-based quizzes' predictive role in resource-limited contexts like Cambodian higher education—particularly over a semester's progression. So, this study will offer a fresh perspective on gamification's adaptability.

Evaluation and interaction techniques in higher learning institutions are very important for achieving academic excellence. Quizzes, as a method of formative assessment, serve as learning aids all the time, whereas attendance mirrors students' engagement in their learning. This research aims to explore the effects of implementing weekly quizzes as a formative assessment tool over a 15-week foundation of education course, with academic achievement as the key outcome measure. As a pilot study with a small sample (N = 24), it aims to generate initial findings on the tool's efficacy in this context. This finding is exploratory and requires validation with a larger and more diverse sample. The significance of this study lies in its potential to offer educators evidence-based insights into the use of quizzes for formative assessment, particularly in foundational higher education courses where establishing strong academic foundations is critical. With digital tools increasingly shaping pedagogy, understanding their impact is

vital for optimizing teaching strategies (Pujiati et al., 2024). This research is guided by the following two research questions:

1. How do students' average quiz scores and attendance relate to their academic performance on midterm and final exams in a game-based formative assessment context?
2. To what extent do average quiz scores uniquely predict students' midterm and final exam performance beyond attendance and quiz completion frequency?

Literature review

Introduction

This literature review attempts to address the gaps in gamification as a formative assessment in higher education and its effects on academic performance and student participation. It shows how students' learning motivation stems from the use of game-like features in gamification and other online activities. Together, these approaches frame the use of weekly game-based online quizzes as a formative tool in a Foundations of Education course. Through the synthesis of theoretical foundations, empirical evidence, and research gaps, this review contextualizes a pilot study within the evolving landscape of innovative assessment practices in education.

Theoretical foundations of formative assessment

Formative assessment is a process in which instructors and students utilize feedback to improve teaching and learning (Black & Wiliam, 1998). The summative assessment comes after a learning unit has been completed, whereas the formative assessment addresses inadequacies and aids movement through the stages of learning (Sadler, 1989). Formative assessment enables self-regulation (Zimmerman, 2000), as it provides self-adjusting learners with sufficient feedback enabling them to achieve profound learning outcomes (Black & Wiliam, 1998; Mackintosh-Franklin, 2021). For foundation courses in higher education, where fundamental skills are ingrained, formative assessment is very important. Regular low-stakes tasks, such as quizzes, promote self-assessment and exam readiness (Nicol & Macfarlane-Dick, 2006) and improve learning outcomes across disciplines through formative feedback (Morris et al., 2021). Teachers and educators can scale this formative assessment at universities through digital tools (Cosi et al., 2020).

Intersection of formative assessment and gamification

The combination of formative assessment and gamification creates an effective learning approach. Gamified formative tools, such as online quizzes, blend structured feedback with motivational elements, supporting autonomy and competence (Nicholson, 2015; Deci & Ryan, 2000). Research has shown that gamified quizzes (e.g., Quizizz, Kahoot) increase participation and self-efficacy in language courses (Wang & Tahir, 2020), a finding confirmed in science teacher education (Mdlalose et al., 2022). Sotola and Crede's (2021) meta-analysis linked frequent low-stakes testing to improved class performance and exam preparation (DeSouza & Fleming, 2003), which predicted final exam success (Figueroa-Cañas & Sancho-Vinuesa, 2021). Lin et al. (2023) compared computer-based and game-based formative assessments and reported that the latter sustained engagement and performance over time. Digital game-based tools such as Kahoot and Quizizz enhance formative assessment in language lessons (Zhyhadlo, 2022), and teachers view these tools positively as performance indicators (Muna et al., 2023). Research has also revealed that gamified quizzes increase engagement but not always grades, emphasizing performance quality (Cheong et al., 2013) and increasing attendance without consistent score gains (Barata et al., 2013), whereas gamified feedback drives deeper learning (Camacho-Sánchez et al., 2022; Eltahir et al., 2021).

Gamification in education

Combining game features with a classroom setting continues to be an effective way to engage and motivate learners in different academic contexts. A variety of studies have shown that outcomes are beneficial for academic performance. Janković and Lambić (2022) reported that third-grade primary school students using Kahoot and Quizizz outperformed peers in traditional settings on science assessments, suggesting that gamified quizzes enhance content mastery. Similarly, Janković et al. (2024) compared Kahoot and Quizizz in a primary school science context and reported improved success rates, with Quizizz slightly edging out Kahoot because of its asynchronous flexibility. In higher education, Pujiati et al. (2024) reported that Quizizz significantly improved student performance in a university course, attributing gains to immediate feedback and interactive elements, given that both Kahoot and Quizizz increased academic achievement across multiple subjects, with effect sizes varying by quiz frequency and subject complexity (Maraza-Quispe et al., 2024). Furthermore, compared with nongamified methods, Quizizz significantly increased EFL students' engagement, as measured through participation rates and self-reported interest (Munawir & Hasbi, 2021). Quizizz can also foster active participation and reduce anxiety, enhancing learning interactions (Anak & Hua, 2021), resulting in a marked increase in students' learning interest, particularly among secondary learners, owing to its competitive and user-friendly design (Rulismi et al., 2024). Research has shown that engagement in higher education has been sustained over time with Quizizz, which is linked to the adaptability of higher education to individual pacing (Pujiati et al., 2024).

Caboblanco Manzanares (2022) compared Quizizz to traditional methods in an EFL classroom and reported that it significantly increased motivation, although its direct effect on academic performance was moderate and context-dependent. This finding aligns with the literature review that synthesized teacher and student perspectives, highlighting Quizizz's motivational appeal through immediate feedback and game-like competition, although teachers noted logistical challenges such as preparation time (Degirmenci, 2021). Both Kahoot and Quizizz enhance intrinsic motivation, with Kahoot excelling in real-time settings and Quizizz in self-paced environments, suggesting tool-specific strengths (Maraza-Quispe et al., 2024). Janković et al. (2024) and Janković and Lambić (2022) suggested that while both tools improve achievement, Quizizz's asynchronous nature may better support diverse learners, whereas Kahoot's synchronous format fosters classroom dynamics. Munawir and Hasbi (2021) and Anak Yunus and Hua (2021) noted that engagement gains were strongest among language learners, possibly because of gamification's alignment with iterative skill practice. However, Caboblanco Manzanares (2022) and Pujiati et al. (2024) reported that motivation and performance increase without strategic integration, such as by aligning quizzes with learning objectives or varying difficulty levels. Qualitative insights complement these quantitative findings. Degirmenci (2021) reported that students valued the fun and competitive aspects of Quizizz, whereas teachers appreciated its diagnostic potential, although some reported technical barriers. Rulismi et al. (2024) highlighted students' enthusiasm for Quizizz's visual and interactive features, which increased interest in traditional methods. These arguments propose that the success of gamified instruments relies on the design and implementation of the tools themselves.

Furthermore, in online education, gamification is the use of elements, such as points, leaderboards, badges, and levels, which have been found to enhance engagement, foster motivation, and boost interaction (Saleem et al., 2022). Gamification's experiential and motivational elements support students in overcoming complex academic challenges, enhance task completion, and reduce procrastination, while also helping online learners manage their busy schedules and maintain organization (Kaufmann, 2018). Kaufmann (2018) further found that applications of gamification improve fun, engagement, motivation, and academic performance, while also increasing course satisfaction. In addition, the meta-analysis of 27 studies found that gamified online learning (GOL) has a medium positive effect on student learning, particularly on academic achievement. Its effectiveness is strongest in university or in-service settings, with class sizes of 31–50, shorter durations (≤ 3 months), cooperative or mixed learning modes, and when a limited number of impactful game elements are used (Yu, Yu, & Li, 2024).

As a whole, many researchers have stated that the game-based tools Kahoot and Quizizz, in particular, as well as others, are strongly positively correlated with academic achievement, involvement, and motivation, regardless of educational level, the subject area of training, or even the lesson delivery approach. Their advantages include providing instant feedback and challenges and, in many cases, their appeal to motivational factors; however, for the best results, their use must be well planned in the curriculum. These results provide a comparative background for exploring similar tools in specific contexts, such as the foundation of education courses. The literature affirms formative assessment efficacy (Black & Wiliam, 1998; Morris et al., 2021) and gamification engagement potential (Hamari et al., 2014; Eltahir et al., 2021). Studies such as those of Sotola and Crede (2021), Lin et al. (2023), and Mdlalose et al. (2022) underscore the value of quizzes, yet their predictive role and engagement dynamics at specific classroom-based levels remain underexamined. Previous studies have found that game-based online quizzes improve knowledge retention and academic achievement (Ahmed et al., 2022; Tavares, 2022). In addition, gamified features, such as points and leaderboards, have been found to enhance student engagement and motivation (Hellín et al., 2023; Wang & Tahir, 2020). However, the predictive role of students' weekly quiz performance on their achievement and engagement has been little discussed. This study addresses that gap by examining the predictive role of weekly game-based quiz results in shaping learning outcomes. A pilot study advances this field by testing weekly game-based quizzes in a Foundations of Education course, contributing to innovative assessment practices.

Research method

Participants

This pilot study included 24 third-year university students enrolled in a 15-week Foundations of Education course at a university, where weekly quizzes were administered via a game-based learning application. Participants were recruited from a single cohort, with no specific inclusion or exclusion criteria beyond course enrollment, reflecting a convenience sample typical of exploratory research.

Data collection

Data were gathered from two sources. The quiz scores and number of quiz completions were extracted automatically from *Quizizz*, a game-based learning platform used for weekly assessments (quiz items were designed to cover foundational concepts, which may explain the high scores). Attendance percentages, midterm exam scores, and final exam scores were obtained from the university's official record system via secure administrative access. These variables were collected to evaluate students' academic performance and engagement across the 15-week course, ensuring comprehensive tracking of both formative and summative outcomes.

Data analysis

Descriptive statistics were computed via SPSS (version 27) to characterize the data, including means, standard deviations, ranges, skewness, and kurtosis, with skewness and kurtosis values examined against thresholds of |1| to assess normality (Bulmer, 1979). Pearson's correlation analysis was conducted to explore the relationships among average quiz scores, number of quiz completions, attendance, midterm exam scores, and final exam scores. Simple linear regression was employed to test the predictive effect of average quiz scores on midterm exam scores and final exam scores in separate models, with attendance and number of quiz completions tested as covariates. All analyses were performed at a significant level of $\alpha = 0.05$.

Ethical considerations

This study followed ethical principles for research with human participants. The participants were informed about the study's purpose—examining game-based learning engagement and academic

performance—during a course briefing. Due to the pilot nature of the study and the use of existing educational data, formal written consent was not obtained; however, verbal consent was secured, and students could opt out without consequences. This approach suited the exploratory design and convenience sampling. To ensure confidentiality, quiz scores, attendance, and exam results were sourced securely from Quizizz and university records. Only aggregated or deidentified data were analyzed, with no personally identifiable information linked. Data were stored on a password-protected computer accessible solely to the researcher, minimizing privacy risks. The study presented a minimal risk, relying on standard educational data (e.g., quizzes, exams) without experimental interventions. The game-based platform Quizizz was already part of the course, avoiding additional burdens. Potential benefits included insights into enhancing learning outcomes for future instructional design. Finally, approval was obtained from the university's administrative office, which was aligned with institutional policies. While a formal ethics review was not required for this pilot, the study followed APA (2017) guidelines, ensuring fairness, transparency, and responsible data use.

Results

Descriptive statistics

Table 1 presents descriptive statistics for the study variables. The average quiz score had a mean of 81.98 (SD = 11.74), ranging from 54.25–97.57 (skewness = -1.098, and kurtosis = 0.884), suggesting that the distribution shifted toward higher scores and slightly peaked relative to a normal curve. The number of quiz completions averaged 6.75 (SD = 2.15), with a range of 2–9 (skewness = -0.503) and kurtosis = -0.88), indicating a flatter-than-normal spread. Attendance averaged 77.42% (SD = 20.53), ranging from 36% to 100% (skewness = -0.539 and kurtosis = -0.998), reflecting a broad, flat distribution. The mean midterm exam score was 68.08 (SD = 19.57), ranging from 29–97 (skewness = -0.392 and kurtosis = -0.906). The final exam scores averaged 78.13 (SD = 13.53), ranging from 49–98 (skewness = -0.24 and kurtosis = -0.844), approximating a nearly normal, flat distribution. Across variables, distributions were generally left-skewed and flatter than normal, with quiz scores exhibiting the most pronounced skewness.

Table 1: Descriptive statistics for study variables (N = 24)

Variable	M	SD	Skewness	Kurtosis	Min	Max
Average quiz score	81.98	11.74	-1.098	0.884	54.25	97.57
Number of quiz completions	6.75	2.15	-0.503	-0.880	2	9
Attendance	77.42	20.53	-0.539	-0.998	36	100
Midterm exam score	68.08	19.57	-0.392	-0.906	29	97
Final exam score	78.13	13.53	-0.24	-0.844	49	98

Correlation analysis

Table 2 presents correlations among all the variables in the analysis. Pearson's product-moment correlations were carried out to examine the relationships among study variables. Most of these variables had moderate to strong correlation (from 0.46 to 0.79). The average quiz score was positively correlated with the final exam score ($r = 0.654$, $p < 0.001$), midterm exam score ($r = 0.688$, $p < 0.001$), attendance ($r = 0.486$, $p < 0.05$), and number of quiz completions ($r = 0.460$, $p < 0.05$). These findings indicate that higher quiz performance was associated with better exam outcomes, greater attendance, and greater quiz engagement. Moreover, the number of quiz completions was strongly correlated with attendance ($r = 0.776$, $p < 0.001$), suggesting that more frequent quiz participation aligned closely with class presence. However, no significant associations were found between the number of quiz completions and midterm exam score ($r = 0.366$, $p = 0.079$) or final exam scores ($r = 0.191$, $p = 0.369$). Attendance correlated significantly with midterm exam scores ($r = 0.471$, $p < 0.05$), but not with final exam scores ($r = 0.314$, p

= 0.135). The strongest overall correlation emerged between the midterm and final exam scores (r = 0.795, p < 0.001), indicating consistent student performance across these assessments.

Table 2*:* Pearson's correlations among study variables (N = 24)

Variable	AQS	NQC	Attendance	MES	FES
AQS	—				
NQC	0.460*	—			
Attendance	0.486*	0.776***	—		
MES	0.688***	0.366	0.471*	—	
FES	0.654***	0.191	0.314	0.795***	—

Note: * p < .05, ** p < .01, *** p < .001. AQS = average quiz score, NQC = number of quiz completions, MES = midterm exam score, FES = final exam score

Regression analysis

A simple linear regression was conducted to assess the predictive relationship between average quiz scores and midterm exam scores. Attendance and the number of quiz completions were tested as potential covariates but were excluded from the final model because of nonsignificant contributions (p > 0.05). The results in Table 3 indicate that average quiz scores explained 47.4% of the variance in midterm exam scores, $R^2 = 0.474$, F (1, 22) = 19.827, p < 0.001. This study suggests that the average quiz score has a significant and positive effect on the midterm exam score.

Table 3. Regression model predicting midterm exam scores (N = 24)

Model	Predictor	Unstandardized Coefficients		Standardized Coefficients	t	p
		B	SE	β		
M_0	(Intercept)	68.083	3.994		17.046	< 0.001
M_1	(Intercept)	-25.987	21.333		-1.218	0.236
	Average Quiz Score	1.147	0.258	0.688	4.453	< 0.001
	R^2					0.474
	F					19.827
	P					< 0.001

Note: Dependent variable: Midterm exam score. Predictor variables: Average quiz score. The following covariates were considered but not included: Attendance and the number of quiz completions.

A simple linear regression was conducted to assess the predictive relationship between average quiz scores and final exam scores. The number of quiz completions and attendance were tested as potential covariates but were excluded from the final model because of nonsignificant contributions (p > 0.05). The results in Table 4 indicate that average quiz scores explained 42.8% of the variance in final exam scores, $R^2 = 0.428$, F (1, 22) = 16.46, p < 0.001. This study indicates that the average quiz score has a significant and positive effect on final exam score.

Table 4. Regression model predicting final exam scores (N = 24)

Model	Predictor	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	SE	β		
M_0	(Intercept)	78.125	2.761		28.294	< 0.001
M_1	(Intercept)	16.335	15.381		1.062	0.300
	Average Quiz Score	0.754	0.186	0.654	4.057	< 0.001
	R^2					0.428
	F					16.46
	P					< 0.001

Note: Dependent variable: Final exam score. Predictor variables: Average quiz score. The following covariates were considered but not included: Number of quiz completions and attendance.

Discussion

This pilot study investigated the impact of weekly game-based online quizzes as a formative assessment tool on academic achievement in a 15-week Foundations of Education course with 24 third-year university students. The findings position quiz performance as a robust predictor of summative outcomes, explaining 47.4% of midterm exam variance and 42.8% of final exam variance (β = 0.688 and 0.654, respectively). These findings are consistent with Black and Wiliam's (1998) seminal work on formative assessment's role in enhancing achievement through ongoing feedback, as well as Sotola and Crede's (2021) meta-analysis linking frequent low-stakes testing to exam success. The significant correlations between quiz scores and both midterm and final exam scores suggest that game-based quizzes offer a reliable window into students' mastery of course content, supporting exam readiness, as noted by Nicol and Macfarlane-Dick (2006).

Beyond achievement, the study reveals a nuanced interplay between quiz performance and engagement. We found that students with higher quiz scores tended to exhibit greater attendance and quiz completion. This result is consistent with previous research, which indicated that gamification's motivational effects, specifically in language learning contexts (Munawir & Hasbi, 2021; Pujiati et al., 2024). This finding supports self-determination theory, where game-like elements foster autonomy and competence, encouraging self-regulated learning (Deci & Ryan, 2000; Zimmerman, 2000). However, neither attendance nor quiz completion directly predicted exam scores in the regression models. This result is consistent with the findings of Barata et al. (2013), who reported that gamified engagement increased attendance. Instead, quiz performance quality emerged as the key factor, which reinforces the study by Cheong et al.'s (2013) emphasis on performance depth over participation frequency. This suggests that well-designed quizzes aligned with learning objectives and challenging in scope are critical to translating engagement into achievement, a point underscored by Lin et al.'s (2023) comparison of game-based versus traditional formative tools.

In this study, a temporal shift further enriches these insights. As can be seen in the correlation analysis, students' in-class attendance correlated more strongly with midterm scores than with final scores. This result suggested that students may have relied less on in-class presence and more on quizzes or independent study as the course progressed. This result is consistent with the study by Pujiati et al. (2024), which found that with gamification's capacity, the engagement is sustained over time and formative assessment's role in fostering independent learning habits (Morris et al., 2021). The strong midterm-final correlation indicated stable performance, suggesting that quizzes provided consistent feedback to scaffold learning across the semester. This finding aligns with Figueroa-Cañas and Sancho-Vinuesa's (2021) work on quiz-exam predictive links.

These findings also suggest that game-based quizzes like Quizizz could enhance engagement in online settings, where student motivation is often a challenge. Using elements such as points, leaderboards, badges, and levels, gamification in online education enhances engagement, motivation, and interaction, according to Saleem et al. (2022). It also helps students overcome academic challenges, improve task completion, reduce procrastination, and manage busy schedules, leading to greater enjoyment, performance, and course satisfaction (Kaufmann, 2018). Supporting this, a meta-analysis found that gamified online learning has a medium positive effect on learning, particularly academic achievement, with optimal effects in moderate-sized classes, shorter interventions, cooperative or mixed learning, and when a limited number of game elements are used (Yu, Yu, & Li, 2024).

Practically, these results advocate integrating game-based quizzes into foundational courses. They blend engagement (via Quizizz's interactive design) with predictive diagnostics, offering instructors real-time insights into student progress. However, moderate R^2 values indicated that quiz scores do not fully account for exam outcomes. It means that other factors, such as prior knowledge, study strategies, or quiz difficulty, may also be significant for enhancing exam outcomes (Degirmenci, 2021). This study bridges formative assessment efficacy (Black & Wiliam, 1998) and gamification engagement potential (Nicholson, 2015), contributing to the literature on innovative assessment in higher education. However, the high average quiz score (M = 81.98, skew = -1.098) suggests that Quizizz assessments may have been relatively easy, potentially limiting variability in performance. Future iterations should align quiz difficulty more closely with learning outcomes, incorporating more challenging items to differentiate student performance.

Limitations

This pilot study offers valuable insights but faces constraints that warrant cautious interpretation. First, the small sample size (N = 24) from a single 15-week Foundations of Education course restricts statistical power and generalizability of the findings. Although significant effects emerged, these findings' robustness and applicability would benefit from a larger, more diverse sample across multiple courses or institutions. The moderate R^2 values leave over half the variance in exam scores unexplained, highlighting unmeasured factors and reinforcing the exploratory nature of this work.

Second, reliance on quantitative measures (quiz scores, attendance, exam performance) without qualitative data limits insight into students' experiences with game-based quizzes. Prior research has emphasized the role of educational technology outcomes; here, the absence of student feedback obscures how quizzes shaped motivation or strategies. Future studies could incorporate qualitative data, such as student interviews, to explore perceptions of engagement and motivation in game-based assessments.

Third, excluding attendance and quiz completion from regression models due to nonsignificant direct effects may mask subtler influences. Their strong correlation hints at collinearity or mediation, e.g., attendance facilitating quiz engagement, which a larger sample or advanced methods such as structural equation modeling could unpack (Kline, 2015). Other unexamined variables, such as quiz difficulty, time on task, or supplemental study resources, might also mediate the quiz-exam relationship, as noted in gamification studies (Degirmenci, 2021).

Finally, the study's focus on one course at a single university constrains its broader relevance. The variability in attendance (SD = 20.53) and midterm scores (SD = 19.57) may reflect course-specific dynamics (e.g., content, pedagogy), limiting extrapolation to other disciplines or levels. Replication across diverse contexts is needed to validate the predictive utility of game-based quizzes beyond this initial exploration.

Conclusion and practical implications

This pilot study advances the understanding of how weekly game-based online quizzes, as a formative assessment tool, influence academic achievement and engagement in a 15-week education course with 24 third-year university students. The results demonstrate that quiz performance strongly predicts summative outcomes, explaining 47.4% of midterm exam variance and 42.8% of final exam variance, underscoring quizzes as a reliable gauge of content mastery and exam readiness. Surprisingly, students' attendance influenced midterm scores more than final scores did. This suggests that students shifted toward quiz-driven or independent study later in the semester. In addition, quiz performance is linked to attendance, and quiz completion suggests that Quizizz's gamified format fosters self-regulated learning and participation. Collectively, these findings position game-based quizzes as a dual-purpose tool: monitoring progress while cultivating motivation and skill development. In addition, the findings indicate that quiz performance is a strong predictor of academic achievement, while engagement measures such as attendance and completion rates alone are not sufficient. For educators, this underscores the importance of integrating performance-based assessments alongside engagement indicators to gain a more accurate understanding of students' learning progress.

This study advocates integrating game-based quizzes into teacher education curricula to enhance formative assessment and students' overall academic outcomes. To maximize the potential integration of game-based quizzes as formative assessment in the classroom educators should: (a) administering regular quizzes aligned with clear learning objectives, providing immediate feedback to reinforce understanding; (b) designing engaging yet challenging tasks that mirror course goals, avoiding ceiling effects; (c) use the result from such tools to providing immediate feedback to reinforce students understanding; (d) leveraging gamification's motivational features (e.g., interactivity, leaderboards) to sustain student participation; (e) using insights from Quizizz's report to identify and support at-risk students early. Finally, instructors can harness this approach to nurture engagement, self-regulation, and achievement, preparing future educators for reflective practice.

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Data Accessibility Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Ethics and Consent

Ethical approval was not formally required for this pilot study using existing educational data. Verbal consent was obtained, data were deidentified, and stored securely, with university approval per APA (2017) guidelines.

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