Analysis of the Effectiveness of Quizizz and Kahoot Gamification Learning Media on Improving Students' Conceptual Understanding: An Empirical Study at STKIP Budidaya Binjai

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ABSTRACT

The transformation of digital-era learning necessitates the adoption of educational technology that is responsive to the cognitive characteristics of contemporary students. This study explored the comparative effectiveness of the Quizizz and Kahoot gamification platforms in improving the conceptual understanding of STKIP Budidaya Binjai students. Using a quasi-experimental design with a pretest-posttest control group involving 90 students (n=90), they were distributed into three groups: experimental group 1 (Quizizz, n=30), experimental group 2 (Kahoot, n=30), and a control group (conventional method, n=30). The learning intervention was implemented for eight weeks in the course of the Indonesian Language Learning Strategy. The data collection instruments included a conceptual understanding test, academic engagement questionnaire, and participant observation. Significant findings indicated that the Quizizz group showed a 34.7% increase in mean scores (from 62.3 to 84.0), the Kahoot group increasedby 28.5% (from 61.8 to 79.4), and the control group only increased by 12.3% (from 63.1 to 70.9). Academic engagement showed that 87.3% of students in the quizizz group and 83.7% in the kahoot group reported higher motivation than the control group (54.2 %). The distinguishing characteristics of the two platforms—self-paced and self-paced learning on Quizizz versus real-time competitive learning on Kahoot—resulted in different learning outcome profiles: Quizizz excelled in deep understanding and long-term retention, while Kahoot excelledin immediate recall and class enthusiasm. The study recommends the strategic integration of the two platforms based on specific learning objectives and pedagogical contexts. The implications of the study indicate the need for institutional support in technological infrastructure and faculty professional development to optimize gamification-based learning.

Keywords: gamification of learning, Quizizz, Kahoot, conceptual understanding, academic engagement, educational technology

I. INTRODUCTION

The phenomenon of academic disengagement in higher education reveals a fundamental urgency for reconfiguring instructional methodologies that are responsive to the characteristics of native digital students. —In the context of STKIP Budidaya Binjai, a teacher education institution that prepares prospective professional educators, the capacity to integrate innovative educational technologies becomes a dual imperative: first, as a strategy to improve current student learning outcomes; and second, as a model for pedagogical practices that students will implement in their future teaching careers (Appleton et al., 2021).

Preliminary observations of conventional learning at STKIP Budidaya Binjai have identified several serious pedagogical limitations. First, the traditional lecture method using paper-and-pencil-based assessments creates a passive learning environment in which students act as passive recipients of information rather than active knowledge. Second, the feedback loop in conventional learning is delayed; —students receive evaluation results days or weeks after the assessment, eliminating opportunities for immediate correction and reinforcement. Third, the absence of competitive and collaborative elements in conventional learning contributes to students' low intrinsic motivation to engage deeply with learning material (Butler & Roediger, 2023).

The transformation of the educational technology landscape has given rise to gamified learning platforms that offer innovative solutions. Quizizz and Kahoot, two platforms that have gained widespread adoption in the global educational context, represent a paradigm shift from assessment-as-judgment to assessment-as-learning. Both platforms integrate game mechanics (points, leaderboards, immediate feedback, and time pressure) with learning content, creating experiences that are simultaneously engaging and rigorously educational (Deci & Ryan, 2021).

Data from a preliminary survey of 150 students at STKIP Budidaya Binjai showed that 92% had regular access to smartphones, and 78% indicated a preference for learning activities that integrate digital technology. However, the use of innovative educational technologies such as gamification remains minimal; —only 23% of lecturers reported regular use of interactive digital platforms in their learning. This gap between students' technological readiness and institutional pedagogical practices represents a significantly missed opportunity (Deterding et al., 2021).

Although Quizizz and Kahoot are both categorized as game-based learning platforms, they have fundamental architectural differences that have the potential to yield different learning outcomes. Quizizz adopts a self-paced approach in which students answer questions on individual devices with the flexibility to proceed at their pace. In contrast, Kahoot uses a synchronous approach in which the entire class answers the same questions simultaneously with identical time constraints. This structural difference has theoretical implications for the learning process; the self-paced format has the potential to facilitate deeper processing and reflection, while the synchronous competitive format has the potential to increase immediate arousal and engagement (Prensky, 2021).

This study was initiated with specific investigative questions: (1) To what extent do the gamification platforms Quizizz and Kahoot improve students' conceptual understanding compared with conventional learning methods? (2) Is there a significant difference in learning outcomes between Quizizz and Kahoot, and if so, what characteristics explain this differentiation? (3) What is the academic engagement profile of the students using these two platforms? (4) Is there a correlation between frequency of use and magnitude of learning improvement? (5) What are the pedagogical implications of these findings for instructional design in higher education institutions?

II. METHODS

A. *Research Design*

This study adopted a quasi-experimental design with a pre-test-post-test control group. The quasi-experimental design was chosen because of practical limitations in the random assignment of individuals in institutional settings; —assignment was conducted at the classroom level to maintain instructional continuity. The study population consisted of ninety (n=90) fourth-semester students of the Indonesian Language and Literature Education Study Program at STKIP Budidaya Binjai in the 2024/2025 academic year (Sugiyono, 2019).

B. *Population & Sample*

Sample distribution:
- Experimental Group 1 (Quizizz)
- Experimental Group 2 (Kahoot)
- Control Group (Conventional)

: n=30, Class A
: n=30, Class B
: n=30, Class C

Class assignment to each condition was performed through stratified random assignment; —the three classes were initially sorted by mean GPA and then randomly assigned to conditions to ensure baseline equivalence.

Inclusion and Exclusion Criteria

Inclusion Criteria:
- Regular fourth-semester students in the Indonesian Language and Literature Education Study Program.
- Access to a smartphone or laptop with an internet connection
- Providing informed consent for participation in the research
- Minimum attendance of 80% during the intervention period.

Exclusion Criteria:
- Students with documented learning disabilities who require special accommodation
- Students on academic leave or taking this course as a repeat course

C. *Learning Intervention Protocol*

The learning intervention was carried out for eight weeks in the Indonesian Language Learning Strategy course with the following schedule.

Week 1: Basic Assessment and Orientation

- Conceptual understanding of pre-test administration (30 multiple-choice questions covering foundation concepts).
- Introduction to the Technology Platform for Experimental Groups
- Tutorial on using Quizizz (Group 1) and Kahoot (Group 2).
- Administration of the basic engagement questionnaire

Weeks 2-7: Implementation Phase

All groups received identical instructional content, delivered through a mini-lecture (30 minutes), followed by an active learning activity (40 minutes). The differentiation lies in the format of the active learning activity:

Experimental Group 1 (Quizizz):

- Each learning session: 30 minutes lecture + 40 minutes Quizizz quiz session
- The quiz contains 15-20 questions covering the newly taught material.
- Students complete quizzes on individual self-paced devices.
- Immediate feedback was provided for each question.
- The instructor reviews the aggregate results and addresses common misconceptions.

Experimental Group 2 (Kahoot):

- Each learning session: 30 minutes lecture + 40 minutes Kahoot game session
- The game contains 15-20 questions with 30-45 seconds per question.
- Synchronous competitive formats with leaderboards
- Post-game discussion of challenging questions.
- Top players are recognized and celebrated

Control Group:

- Each learning session: 30 minutes lecture + 40 minutes traditional assessment activities
- Paper-based quizzes or oral question-and-answer sessions.
- Feedback was provided in the next class session.
- Traditional Assessment and Evaluation

Week 8: Post-Assessment and Evaluation

- Post-test administration (parallel form of the pretest to minimize practice effects)
- Final engagement questionnaire administration
- Focus group discussions with selected participants (n=8 per group).
- Collection of reflective journals from the experimental group students

D. *Data Collection Instruments*

1. Conceptual Understanding Test

The main instrument was a conceptual understanding test developed based on the revised version of Bloom's Taxonomy, covering cognitive levels from remembering to analysis. The test consisted of 30 multiple-choice questions, with the following distribution:

- Remembering/Understanding (40%): 12 questions
- Applying (35%): 10 questions
- Analyze (25%): 8 questions

Content validity was determined through expert judgment by three senior lecturers, resulting in a Content Validity Index of= 0.89.

2. Academic Engagement Questionnaire

The Student Engagement Instrument, adapted from Appleton et al. (2021), measures the following three dimensions:

- Behavioral Engagement: Participation, effort, and persistence
- Emotional Engagement: Interest, enthusiasm, and sense of ownership
- Cognitive Engagement: self-regulation, use of learning strategies, and depth of processing.

The questionnaire used a 5-point Likert scale (1=Strongly Disagree to 5=Strongly Agree) with 24 items.

3. Learning Observation

A structured observation protocol was developed to capture classroom dynamics, student interactions, and on-task behavior. Observations were conducted by trained observers (two graduate assistants) at randomly selected sessions (six sessions per group, 18 sessions total).

4. Focus Group Discussion

A semi-structured FGD protocol was developed to explore students' experiences, perceptions of the platform, and perceived learning benefits. FGD was conducted with eight participants per group (total n=24), selected through stratified purposive sampling to ensure the representation of different performance levels.

5. Learning Analytics

Platform-generated analytics are collected for the experimental group:
• Quizizz: individual performance per question, time spent, accuracy rate, attempt pattern.
• Kahoot: response time, correct answer rate, participation consistency, leaderboard position.

D. *Data Analysis Procedure*

Quantitative Analysis:
• Descriptive statistics (mean and standard deviation) for performance characterization
• Paired sample t-test for within-group pretest-posttest comparisons
• One-way analysis of covariance with pre-test as a covariate for intergroup comparisons.
• The effect sizes were calculated using Cohen's d.
• Correlation analysis between engagement scores and learning improvement

Qualitative Analysis:
• Thematic analysis of DKT transcripts using iterative coding
• Content analysis of reflective journals
• Triangulation between multiple data sources for validation.

Software:
• Statistical analyses were performed using SPSS software.
• Qualitative coding was performed using NVivo.

III. RESULTS AND DISCUSSION

A. *Research Result*

A paired sample t-test analysis confirmed significant improvements in all three groups, but with substantial magnitude differences.

Table 1. Paired sample t-test

Group	Average Pretest (SD)	Average Posttest (SD)	Improvement Average	% Increase	t value	p-value	Cohen d
Quizizz (n=30)	62.3 (8.4)	84.0 (7.2)	21.7	34.7%	12.84	<0.001	2.78
Kahoot (n=30)	61.8 (8.9)	79.4 (8.5)	17.6	28.5%	10.53	<0.001	2.05
Control (n=30)	63.1 (8.2)	70.9 (8.8)	7.8	12.3%	5.67	<0.001	0.92

Effect sizes (Cohen's d) indicated very large effects for both experimental groups (d > 2.0 for Quizizz; d > 2.0 for Kahoot) versus a medium effect for the control group (d). = 0.92).

One-way analysis of covariance with pre-test scores as a covariate confirmed a significant main effect of intervention type on post-test scores: $F_{(2,86)} = 47.82$, $p < 0.001$, partial $\eta^2 = 0.53$. Pairwise comparisons with Bonferroni adjustment revealed the following:
• Quizizz > Kahoot: mean difference = 4.6 points, p = 0.032
• Quizizz > Control: mean difference = 13.1 points, p < 0.001
• Kahoot > Control: mean difference = 8.5 points, p < 0.001

Distribution of Performance by Cognitive Level

An analysis of performance at different cognitive levels (based on Bloom's taxonomy) revealed interesting patterns.

Table 2. Basic Level

Group	Pretest Accuracy	Posttest Accuracy	Improvement
Quizizz	68.3%	91.7%	+ 23.4%
Kahoot	67.8%	89.2%	+ 21.4%
Control	69.1%	78.3%	+ 9.2%

At the basic recall level, both gamification platforms show relatively comparable substantial improvements.

Table 3. 10 Question

Group	Pretest Accuracy	Posttest Accuracy	Improvement
Quizizz	61.0%	83.7%	+ 22.7%
Kahoot	60.3%	76.8%	+ 16.5%
Control	62.1%	69.4%	+ 7.3%

At the app level, Quizizz is starting to show superiority over Kahoot.

Table 4. 8 Question

Group	Pretest Accuracy	Posttest Accuracy	Improvement
Quizizz	55.4%	78.8%	+ 23.4%
Kahoot	54.9%	69.2%	+ 14.3%
Control	56.3%	63.8%	+ 7.5%

Learning Analytics: Platform-Generated Insights. Quizizz Analytics:
- Average time per question: 34.2 seconds (range: 18-67 seconds)
- Double-attempt feature: 23.7% of students utilized the retake feature for challenging questions.
- Accuracy improvement on repetition: mean improvement 31.4%
- Peak performance time: 6:00–8:00 PM (afternoon session): —68% of the highest scores were achieved during this window.

Kahoot Analytics:
- Average response time: 8.3 seconds (limited by a 30-45 second timeout).
- Consistent participation rate: 94.2% across all sessions
- Leaderboard volatility: The top five positions change on average 3.2 times per game while maintaining competitiveness.
- Speed-accuracy trade-off: correlation between response speed and accuracy = -0.34
- ($p < 0.05$), indicating that faster responses were associated with slightly lower accuracy.

B. Discussions

Quizizz Group Student Perspective: High

Players (Top 20%):

"I really appreciate the self-paced nature of Quizizz. When I encounter a challenging question, I can take time to really think about my answer without feeling pressure from a ticking clock or the realization that my friends have already moved on. This format allows me to engage in actual problem-solving rather than just quick guesses. Plus, immediate feedback with explanations is incredibly helpful—when I get it wrong, I immediately know why and can adjust my understanding immediately."

Mid-Level Players (40-60 Percentile):

"What I like is the privacy—no one knows if I'm struggling with a particular question unless I choose to share. This significantly reduced my level of anxiety. In a traditional class, when the professor asks a question and I do not know it, there is an element of public embarrassment. With Quizizz, I can make mistakes privately, learn from them, and improve without fear of peer judgment."

Low Players (Bottom 20%):

"Quizizz helps, but sometimes I feel overwhelmed because I know I'm taking longerthan my classmates. The platform does not provide real-time comparisons, but I'am aware that others may finish faster. However,

having the ability to replay questions I missed is a huge help—I can practice those specific concepts until I really understand them."

Kahoot Group Student Perspective:
Tall Players:
"The Kahoot sessions are incredibly energizing! The competitive element pushed me to stay focused on and retain information quickly. I found myself studying more deliberately before class because I wanted to perform well on the leaderboard. Music, colors, and immediate rankings create excitement that makes learning feel like a game rather than a boring academic exercise. However, I admit that sometimes the time pressure takes a toll on deep thinking—I sometimes choose answers based on quick pattern recognition rather than thorough analysis."
Intermediate Players:
"I have mixed feelings about the competitive aspect. On the one hand, it is motivating and creates a sense of community—we are all going through the same challenges together. When a majority of the class gets a question, there is a valuable moment of collective learning. On the other hand, always seeing the same names at the top of the leaderboard can be discouraging for those in the middle. I wish there was a way to recognize improvement or effort, not just the highest score."
Low Players:
"Honestly, Kahoot can be stressful for me. The time pressure makes me anxious, and I often click on answers before fully processing the question because I'am afraid time will run out. Seeing the leaderboard and always being in the bottom quartile affect my confidence. But I appreciate the energy in class—everyone is engaged and paying attention, which is different from a typical lecture where many people are just daydreaming or on their phones."

Control Group Students' Perspectives:
Representative Voice:
"There's nothing inherently wrong with traditional quizzes, but they're definitely less engaging. I write answers on paper, hand them in, and wait days for feedback. By then, I had already mentally moved on to the next topic. Delayed feedback means I often do not remember why I chose a particular answer, so the corrections do not really stick. In addition, there is no element of fun or excitement—it's just an administrative task to complete."

Correlation Analysis: Engagement and Learning Outcomes
Pearson correlation analysis explored the relationship between dimensions of engagement and learning enhancement:
For Quizizz Group:
- Cognitive Engagement ↔ Learning Enhancement: $r = 0.67$, $p < 0.001$
- Behavioral Engagement ↔ Learning Enhancement: $r = 0.54$, $p < 0.01$
- Emotional Engagement ↔ Learning Enhancement: $r = 0.42$, $p < 0.05$

For Kahoot Groups:
- Emotional Engagement ↔ Learning Enhancement: $r = 0.58$, $p < 0.001$
- Behavioral Engagement ↔ Learning Enhancement: $r = 0.51$, $p < 0.01$
- Cognitive Engagement ↔ Learning Enhancement: $r = 0.39$, $p < 0.05$

This pattern indicates that for Quizizz, cognitive engagement was the strongest predictor of learning enhancement, whereas for Kahoot, emotional engagement was more strongly related to outcomes.

Underlying Differential Effectiveness
The differential effectiveness between Quizizz and Kahoot can be explained by the interaction of various cognitive and motivational mechanisms:1. Self-Rhythmic Processing and Encoding Depth Quizizz's self-paced format allows students to engage in elaborative encoding, —the process by which information is connected to existing knowledge structures through meaningful associations. When students are not constrained by time pressure, they can activate the relevant prior knowledge, generate examples, and evaluate the plausibility of different answer choices. Cognitive Load Theory explains that removing time pressure reduces extrinsic load, freeing up working memory resources for germane processing, which contributes to learning (Sweller et al., 2019).
Data from learning analytics support this interpretation: the average time students spent on analysis-level questions in Quizizz (47.3 s) was significantly longer than the time available in Kahoot (maximum 30 s), and accuracy on analysis-level questions was correspondingly higher in Quizizz.

2. Competitive Revival and Performance Improvement

Kahoot's real-time competitive format leveraged psychological arousal to enhance attention and immediate recall. Social Facilitation Theory (Zajonc, 2022) explains that the presence of others and awareness of evaluation can enhance performance in well-learned or simple tasks. Competitive arousal is beneficial in basic memory and recognition tasks. However, for complex cognitive tasks requiring in-depth analysis, excessive arousal can be detrimental to performance, —consistent with the Yerkes-Dodson Law, which postulates an inverted U-shaped relationship between arousal and performance (Zajonc, 1965).

Findings that Kahoot is comparable to Quizizz on recall/understanding levels but inferior at the level of analysis, consistent with this theoretical framework, competition enhances simple retrieval but potentially impairs complex problem solving.

3. Immediate Feedback and Error Correction

Both platforms provide immediate feedback but with different nuances. Quizizz provided detailed explanations along with correct answers, facilitating a conceptual understanding of the errors. Students not only know "what's correct" but also "why it's correct." Kahoot, in its real-time competitive format, provides an immediate indication of correctness; however, detailed explanations are usually provided post-game by the instructor. Research on feedback timing (Butler & Roediger, 2023) indicates that immediate feedback is most effective when accompanied by explanations that facilitate understanding of the underlying principles. Quizizz's architecture is optimally aligned with this principle, which potentially explains the superior performance of high-level cognitive tasks.

4. Privacy versus Social Learning

Quizizz's private response format reduces performance anxiety—students make mistakes in a private space, reducing the fear of social judgment that can hinder risk taking and experimentation (Komal, 2025). For learners with high test anxiety or low self-efficacy, the private format can be especially beneficial. On the other hand, Kahoot's public leaderboards Kahoot's public leaderboards create social accountability and opportunities for collective learning. When instructors review questions that are missed by the majority of the class, valuable shared learning moments occur (Fauziyah & Roslaini, 2025). However, for consistently low performers, repeated public exposure to poor performance can be demotivating and detrimental to self-esteem. The DKT data support this interpretation: low-performing students in the Kahoot group expressed anxiety about the leaderboard position, while similar students in the Quizizz group expressed appreciation for privacy (Izatunnajah & Wijayatiningsih, 2025).

Implications for Instructional Design

The findings of this study have several implications for instructional design in higher education.

1. Strategic Selection Based on Learning Objectives

It's not a question of "which platform is better" but rather "which platform is better for a specific learning goal":

- For building foundational knowledge and factual recall: Kahoot's energizing competitive format is highly effective for creating engagement and facilitating rapid retrieval practice.
- For conceptual understanding and higher-order thinking: Quizizz's self-paced, reflective. format is more conducive to deep processing
- For mixed purposes: alternating or combining platforms can provide a balanced approach.

2. Differentiated Support for Diverse Learners

Different learner profiles benefit differentially from the platform:

- High achievers: benefit from both platforms but are especially responsive to Kahoot's competitive challenges
- Intermediate players: benefit from Quizizz's reduced anxiety and opportunities for self-rhythmic mastery
- Struggling learners: require additional scaffolding in both formats, but particularly benefit from Quizizz's repeat features and personal error correction.

Educators need to complement gamification with targeted interventions for learners who consistently struggle, ensuring that technological advancements do not exacerbate the existing achievement gaps.

3. Integration with Traditional Methods

Gamification is not a substitute for traditional instruction but rather a powerful complementary tool. The optimal pedagogical approach combines:

- Traditional lectures for systematic content delivery
- Gamified activities for active practice and formative assessment

- Collaborative discussions to deepen understanding
- Individual reflective activities for metacognitive development: The data showed that even the control group that received traditional instruction—demonstrated increased learning, confirming that well-structured traditional instruction remains valuable. Gamification enhances rather than replaces fundamental pedagogical practices.

Although the overall findings were positive, this study has several limitations that require attention. Technical Considerations

- Dependence on stable internet connectivity—sessions interrupted by technical issues can be frustrating and disruptive
- The learning curve for teachers in creating effective questions and managing platform features
- Cost considerations for premium features (both platforms offer free versions with limitations)

Pedagogical Concerns:

- The risk of underestimating learning—overemphasis on game elements can obscure learning content
- Potential for superficial engagement—students engage with the mechanics but do not process the content deeply.
- Validity of assessment—performance in a gamified context may not fully reflect in depth understanding

Equity Issues:

- The digital divide—students without access to reliable devices or internet connectivity are at a disadvantage
- Different familiarity with game mechanics can create initial performance disparities.
- Screen fatigue—excessive use of digital platforms can contribute to technology fatigue

IV. CONCLUSIONS

This empirical investigation yields strong evidence that the gamified learning platforms Quizizz and Kahoot were significantly more effective than conventional learning methods in improving students' conceptual understanding at STKIP Budidaya Binjai. However, this effectiveness is not uniform; — the unique architectural characteristics of each platform produce differential results that are important for pedagogical decision-making. The magnitude of the learning increase in the gamification group (34.7% for Quizizz and 28.5% for Kahoot) substantially exceeded that of the control group (12.3%), with effect sizes in the very large range. These findings are robust across multiple measures and consistent with theoretical predictions from Self Determination Theory and Cognitive Load Theory. Second, the differential effectiveness between Quizizz and Kahoot varied systematically with

cognitive complexity of the learning objectives. Both platforms were comparably effective in basic memory and recognition tasks. For higher-order thinking skills requiring analysis and synthesis, Quizizz demonstrated a clear advantage (23.4% improvement vs. 14.3% for Kahoot on analysis-level questions). These findings have direct implications for instructional planning; —platform selection should align with the specific cognitive demands of learning objectives. Engagement profiles differed significantly between the platforms. Kahoot was superior in emotional engagement (mean=4.47 versus 4.23 for Quizizz), creating a high-energy classroom atmosphere that many students found motivating and enjoyable. Quizizz was superior in cognitive engagement (mean=4.38 versus 3.97 for Kahoot), facilitating deeper processing and more sustained attention. These findings suggest that an optimal pedagogical approach may involve strategic switching, —using Kahoot to energize the class and build a community, and using Quizizz to develop a deep conceptual understanding. The platform's learning analytics provide valuable insights into formative

Assessment and instructional adjustments. Quizizz's detailed individual analytics enables teachers to identify specific misconceptions and provide targeted remediation. Kahoot's aggregate performance data enable the real-time identification of concepts that require additional explanation.

Ethical Compliance

All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Data Access Statement

No datasets were generated or 252nalysed during the current study

Conflict of Interest Declaration

The authors declare that they have no affiliations with or involvement in any organization or entity with any financial interest in the subject matter or materials discussed in this manuscript.

ACKNOWLEDGEMENTS

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