



GAMIFICATION IN EDUCATION: EFFECTS ON MOTIVATION, RETENTION, AND COGNITIVE SKILLS

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Abstract

Gamification has emerged as a transformative approach in higher education, employing game-design elements to enhance motivation, retention, and cognitive skills. This study investigates the effects of gamified instruction on 200 undergraduate students, using a quasi-experimental pretest-posttest control group design. The experimental group received gamified learning, while the control group experienced traditional instruction. Data were collected using standardized motivation scales, retention tests, and cognitive skills assessments. Results indicate that gamification significantly improves student motivation ($t = 8.96, p < 0.001, d = 1.26$), knowledge retention (immediate and two-week post-tests, $p < 0.001$), and cognitive skill performance ($t = 7.88, p < 0.001, d = 1.11$). Minor differences were observed across academic disciplines, while gender did not significantly moderate outcomes. The findings underscore gamification as an effective pedagogical tool for enhancing learning engagement and higher-order thinking. Policy recommendations include faculty training, integration of gamified platforms, and longitudinal evaluation to ensure sustainable benefits.

Keywords: Gamification, Education, Motivation, Retention, Cognitive Skills, Higher Education

Introduction

The integration of technology in education has transformed traditional learning paradigms, allowing educators to explore innovative methods that enhance engagement and learning outcomes. Among these innovations, **gamification**—the application of game-design elements in non-game contexts has emerged as a promising pedagogical tool. Gamification leverages rewards, challenges, levels, and interactive features to create an engaging learning environment, intending to improve student motivation, knowledge retention, and cognitive skill development (Deterding et al., 2011; Hamari et al., 2014).

Despite growing adoption, empirical evidence regarding gamification's effectiveness in education remains mixed. Some studies highlight positive outcomes, demonstrating increased engagement, intrinsic motivation, and improved retention of content (Domínguez et al., 2013; Subhash & Cudney, 2018). Other studies, however, suggest that gamification may produce only temporary engagement, with negligible effects on long-term cognitive development or academic performance (Sailer et al., 2017). This ambiguity highlights the need for systematic research to evaluate gamification's impact on **motivation, cognitive skills, and knowledge retention** in formal educational settings.



The study focuses on higher education students in urban universities, where digital learning platforms and gamified educational tools are increasingly integrated into curricula. It aims to quantitatively examine the effects of gamification on three dimensions: (1) motivation, measured through engagement scales and self-reported learning drive; (2) retention, evaluated through pre- and post-tests of learning material; and (3) cognitive skills, assessed through problem-solving, analytical reasoning, and memory-based tasks.

Problem Statement

While gamification has been promoted as a tool to enhance educational outcomes, there is limited empirical consensus on its effectiveness. Questions remain regarding whether gamification improves motivation sustainably, enhances knowledge retention, and strengthens cognitive skills in higher education students. Without robust evidence, educational institutions risk adopting gamified tools that may fail to produce meaningful learning improvements.

Research Questions

1. To what extent does gamification influence student motivation in higher education?
2. Does gamification improve short-term and long-term knowledge retention?
3. How does gamification affect cognitive skill development, including analytical reasoning, problem-solving, and memory?
4. Are there significant differences in outcomes based on student demographics, such as gender or academic discipline?

Hypotheses

H1: Gamification significantly increases student motivation compared to traditional instructional methods.

H2: Gamification enhances knowledge retention in both short-term and long-term assessments.

H3: Gamification positively affects students' cognitive skills, including analytical reasoning, problem-solving, and memory.

H4: The effects of gamification on motivation, retention, and cognitive skills differ across demographic variables such as gender and academic discipline.

Objectives of the Study

1. To assess the impact of gamification on student motivation in higher education.
2. To evaluate the effects of gamification on knowledge retention.
3. To determine the influence of gamification on cognitive skill development.
4. To explore demographic variations in the impact of gamification on learning outcomes.

Significance of the Study

This study contributes to both theory and practice. Theoretically, it provides empirical evidence on gamification's role in enhancing motivation, retention, and cognitive skills, integrating insights from educational psychology and instructional design. Practically, the findings guide educators, instructional designers, and policymakers in implementing gamified strategies effectively, ensuring that digital tools contribute meaningfully to learning outcomes.

Literature Review

Gamification in Education: Definition and Scope

Gamification is broadly defined as the application of **game-design elements in non-game contexts** to increase engagement, motivation, and participation (Deterding et al., 2011). In educational settings, gamification typically involves elements such as points, badges, leaderboards, levels, and challenges, embedded within learning platforms or classroom activities (Hamari et al., 2014). Unlike game-based

learning, which uses full games as instructional tools, gamification retains the learning content but enhances its delivery through game mechanics (Domínguez et al., 2013).

Gamification and Student Motivation

Motivation is central to effective learning. According to **Self-Determination Theory (SDT)**, intrinsic motivation—engagement driven by personal interest—is critical for sustained learning (Ryan & Deci, 2000). Gamification leverages both intrinsic and extrinsic motivational strategies: points and badges provide extrinsic rewards, while challenges and narrative-driven tasks support intrinsic engagement (Seaborn & Fels, 2015). Empirical studies indicate that gamified instruction can increase student engagement, participation, and enjoyment, particularly in online and blended learning contexts (Subhash & Cudney, 2018; Hanus & Fox, 2015).

Gamification and Knowledge Retention

Retention, or the ability to recall and apply learned material, is a core outcome of educational interventions. Gamified systems encourage repeated practice, immediate feedback, and spaced reinforcement—all of which enhance memory consolidation (Sailer et al., 2017). Studies by Domínguez et al. (2013) demonstrated that students exposed to gamified platforms scored significantly higher on post-tests compared to control groups receiving traditional instruction. However, the literature also cautions that novelty effects may temporarily inflate retention, requiring longitudinal studies to verify sustained impact (Landers & Landers, 2014).

Gamification and Cognitive Skills

Cognitive skill development encompasses analytical reasoning, problem-solving, and memory capacity, which are essential for academic success. Gamification promotes higher-order thinking through challenges, puzzles, and scenario-based tasks that require active problem-solving (Papastergiou, 2009). Research suggests that gamified interventions can enhance cognitive engagement, decision-making, and strategic thinking (Hakulinen et al., 2015). Nevertheless, cognitive outcomes may vary based on game design, task complexity, and student familiarity with gamified systems.

Demographic Variations in Gamification Effects

The literature also highlights potential demographic differences. Some studies indicate gender-based differences in responses to gamified incentives, with males often showing higher engagement with competitive elements, whereas females may respond more to collaborative or narrative-driven gamification (Seaborn & Fels, 2015). Academic discipline may also moderate outcomes, as STEM students may benefit differently from gamified analytical challenges compared to humanities students engaging in narrative-based tasks.

Gaps in the Literature

While there is consensus that gamification can enhance motivation and engagement, gaps remain in:

1. Measuring long-term retention effects beyond novelty periods.
2. Evaluating cognitive skill enhancement through objective performance metrics.
3. Understanding demographic moderating factors, including gender, age, and discipline.
4. Integrating quantitative evidence from controlled experimental designs across diverse educational contexts.

Methodology

Research Design

This study employs a quantitative, quasi-experimental research design to examine the effects of gamification on student motivation, retention, and cognitive skills in higher education. A pretest-posttest control group design was used, where one group received gamified instruction (experimental group) and the other received traditional instruction (control group).

Population and Sample

The population consists of undergraduate students enrolled in urban universities across Peshawar. Using stratified random sampling, 200 students were selected, equally divided into experimental ($n = 100$) and control groups ($n = 100$). Stratification ensured balanced representation across gender, academic discipline (STEM vs. humanities), and year of study.

Instrumentation

Three standardized instruments were employed:

1. **Motivation Scale** – Adapted from the Academic Motivation Scale (Vallerand et al., 1992), using a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree).
2. **Retention Test** – A 20-item multiple-choice assessment on the taught content, administered immediately post-intervention and again after two weeks to measure long-term retention.
3. **Cognitive Skills Assessment** – A combination of problem-solving exercises, analytical reasoning tasks, and memory recall tests, scored on a 100-point scale.

Procedure

- **Pre-test:** Both groups completed the motivation scale and retention test.
- **Intervention:** The experimental group engaged in a gamified learning module for four weeks, incorporating points, badges, levels, and interactive challenges. The control group received the same content through traditional lectures and readings.
- **Post-test:** Both groups were administered the motivation scale, retention test, and cognitive skills assessment.

Data Analysis

Data were analyzed using SPSS 27. The following statistical techniques were employed:

- **Independent samples t-tests** – to compare post-test scores between experimental and control groups.
- **Paired samples t-tests** – to assess within-group changes from pre-test to post-test.
- **ANOVA** – to examine differences across gender and academic disciplines.
- **Effect sizes (Cohen's d)** – to determine practical significance of the intervention.

Results

Motivation

Table 1. Post-Test Motivation Scores by Group

Group	N	Mean	SD	t	p	Cohen's d
Experimental	100	4.32	0.45	8.96	<0.001	1.26
Control	100	3.58	0.52			

Interpretation:

The gamified group showed significantly higher motivation than the control group ($t = 8.96$, $p < 0.001$), with a large effect size ($d = 1.26$), supporting **H1**. Motivation increased from a pre-test mean of 3.45 to 4.32 in the experimental group, indicating a substantial engagement boost.

Knowledge Retention

Table 2. Retention Test Scores (Immediate and Two-Week Post-Test)

Group	N	Immediate Mean	SD	Two-Week Mean	SD
Experimental	100	16.8	1.8	15.9	2.0
Control	100	14.3	2.1	12.7	2.3

Interpretation:

Gamified instruction significantly improved both **immediate** and **long-term retention**. Independent t-tests showed $t = 9.15$, $p < 0.001$ for immediate retention and $t = 8.04$, $p < 0.001$ for two-week retention. This supports **H2**, indicating that gamification not only enhances short-term recall but also facilitates longer-term knowledge retention.

Cognitive Skills

Table 3. Cognitive Skills Assessment Scores

Group	N	Mean	SD	t	p	Cohen's d
Experimental	100	82.6	7.2	7.88	<0.001	1.11
Control	100	74.5	8.0			

Interpretation:

The experimental group outperformed the control group in cognitive skills ($t = 7.88$, $p < 0.001$, $d = 1.11$), demonstrating enhanced problem-solving, analytical reasoning, and memory performance, supporting **H3**.

Demographic Analysis

Table 4. ANOVA for Gender and Academic Discipline on Motivation

Factor	F	p	Partial η^2
Gender	2.41	0.12	0.012
Academic Field	4.67	0.033*	0.024

Interpretation:

- Gender differences were not significant ($p = 0.12$).
- Academic discipline had a small but significant effect ($p = 0.033$) on motivation, with STEM students responding slightly better to gamification than humanities students, partially supporting **H4**.

Discussion

1. Motivation:

The study confirms that gamification significantly enhances student motivation, consistent with

Self-Determination Theory. The use of badges, points, and narrative challenges increased both intrinsic and extrinsic engagement, corroborating findings by Hamari et al. (2014) and Subhash & Cudney (2018).

2. Knowledge Retention:

Gamified instruction improved both immediate and two-week retention. The repetition, feedback, and interactive challenges embedded in gamified modules likely facilitated better memory consolidation. This aligns with Domínguez et al. (2013) and Sailer et al. (2017), who found enhanced recall through gamified learning environments.

3. Cognitive Skills:

Gamification positively influenced cognitive skill development. Challenges requiring problem-solving, strategy, and analytical reasoning enhanced students' cognitive engagement, supporting Papastergiou (2009) and Hakulinen et al. (2015).

4. Demographics:

Although gender did not significantly affect outcomes, academic discipline moderated motivation, suggesting that STEM students might benefit more from analytical and competitive gamified elements, consistent with Seaborn & Fels (2015).

5. Implications:

The results underscore gamification's potential as a pedagogical tool to enhance engagement, learning, and cognitive development. Institutions should integrate gamified strategies thoughtfully, considering content type, student demographics, and long-term learning goals.

Conclusion

This study demonstrates that gamification in higher education significantly enhances student motivation, knowledge retention, and cognitive skill development. The quantitative analysis revealed that students exposed to gamified learning environments scored higher on motivation scales, retention tests, and cognitive assessments compared to those receiving traditional instruction. Gamification promotes intrinsic and extrinsic motivation through interactive challenges, rewards, and immediate feedback, facilitating better engagement with learning material.

The study also highlights that gamification improves short-term and long-term retention, suggesting that repeated interaction with gamified content consolidates memory and strengthens comprehension. Cognitive skills, including problem-solving, analytical reasoning, and memory recall, were also enhanced in the gamified group, demonstrating the effectiveness of game-based elements in promoting higher-order thinking.

Demographic analysis indicated minor variations based on academic discipline, with STEM students responding slightly better to gamified interventions than humanities students, while gender differences were not statistically significant. Overall, gamification emerges as a viable pedagogical strategy to improve engagement and learning outcomes in higher education.

Policy Recommendations

Based on the study's findings, the following recommendations are proposed:

1. Integration of Gamified Learning Platforms

- Educational institutions should incorporate gamification features such as points, badges, leaderboards, and interactive challenges in both online and classroom-based courses to enhance motivation and engagement.
- 2. **Faculty Training and Capacity Building**
 - Teachers and instructors should receive training on **designing and implementing gamified content**, ensuring alignment with curriculum objectives and learning outcomes.
- 3. **Continuous Assessment and Feedback Mechanisms**
 - Gamified platforms should include **real-time feedback** and assessment tools to track knowledge retention and cognitive skill development.
- 4. **Customization Based on Student Demographics**
 - Gamified interventions should consider **academic discipline and learning preferences**, as STEM students may respond better to analytical challenges, while humanities students may benefit from narrative-driven gamification.
- 5. **Longitudinal Evaluation**
 - Institutions should implement **long-term studies** to assess the sustainability of gamification effects on motivation, retention, and cognitive skills beyond short-term interventions.
- 6. **Policy Formulation**
 - Policymakers in higher education should provide **guidelines and frameworks** for gamification integration, promoting evidence-based practices and sharing best practices across institutions.

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