

The Effects of a Theoretically-Grounded Gamified E-Learning Module on Motivation and Learning Outcomes in an Educational Technology Course: A Mixed-Methods Study

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Abstract: This study investigates the integration of gamification into the theoretical design of e-learning within educational technology courses, with the primary objective of enhancing student motivation and learning outcomes. Employing a mixed-methods approach, the research gathered quantitative data through pre- and post-intervention assessments. This was complemented by qualitative feedback from participants engaging with a specially designed gamified e-learning module. Results demonstrate a significant increase in learner engagement and improved academic performance when compared to traditional e-learning formats. A key novelty of this study lies in its emphasis on the *theoretical framework* of e-learning design, specifically highlighting gamification elements tailored to the content of educational technology. The findings suggest that incorporating gamified strategies can effectively address motivational challenges and foster deeper understanding in virtual learning environments. This research offers evidence-based design guidelines for educators and instructional designers, facilitating the implementation of gamification in theoretical course contexts and ultimately contributing to the development of more effective and engaging digital education.

Keywords: E-Learning Design Theories, Educational Technology Integration, Gamification Strategies, Learning Motivation Enhancement, Student Engagement in E-Learning

A. Introduction

In the field of educational technology, scholars have progressively conceptualized gamification based e learning as a means to harness motivational dynamics and optimize student achievement (Muzahid & Ar, 2019). Rooted in self-determination theory and flow theory, these models posit that embedding game elements, such as clear goals, immediate feedback, progress indicators (points, badges, and levels), and meaningful narratives, can satisfy learners' needs for autonomy, competence, and relatedness, thereby fostering intrinsic motivation (Laksana, 2021). Theoretical

frameworks, such as Keller's ARCS model, further guide designers in capturing attention, maintaining relevance, building confidence, and ensuring satisfaction through gamified mechanics. In educational technology courses, where abstract concepts and tool-based skills must be mastered, gamification scaffolds learners' engagement by offering incremental challenges, collaborative quests, and reflective debriefs that align with cognitive load principles (Van den Berg, 2016). As a result, students report increased interest, persistent effort, and a deeper conceptual understanding, suggesting that well-grounded gamification theories can meaningfully enhance both motivation and learning outcomes in higher education e-learning environments (Merangin, 2018).

Sociomaterial interconnectedness in higher education emphasizes that the learning process is not only influenced by social interactions between lecturers and students, but is also greatly influenced by the existence, role, and configuration of materials or technology used in learning (Soetrisno & Yoku, 2019). Sociomateriality is reflected in the simultaneous and mutually shaping interaction between students, lecturers, and gamification-based e-learning systems, which collectively influence the learning experience. Gamification technology is not merely viewed as a tool, but as a material actor that helps determine the direction, quality, and outcomes of learning interactions. Features such as points, levels, badges, leaderboards, and structured challenges create new social dynamics in the classroom, for example, fostering collaboration, healthy competition, and strengthening students' intrinsic and extrinsic motivation. Within this framework, learning motivation and achievement of learning outcomes are not solely born from individual student efforts, but also result from the intertwining of social practices (discussions, group work, lecturer-student interactions) with material configurations (gamification features, platform interfaces, internet access, digital devices). Thus, the sociomaterial concept emphasizes that the successful development of gamification-based e-learning is co-constitutive, meaning it cannot be separated from the network of relationships between humans and technology. In higher education, understanding this interconnectedness is crucial because it enables lecturers to design more participatory, adaptive, and contextual learning experiences, while also providing students with opportunities to develop their motivation and learning outcomes through active engagement with available digital resources.

One key area that remains relatively unexplored in the development of theoretical gamification-based e-learning is how specific game mechanics and elements align with established learning theories to effectively enhance both motivation and learning outcomes in the context of higher education, particularly in courses like Educational Technology (Street, 2007). While numerous studies have demonstrated the general benefits of gamification, there is still limited understanding of which theoretical frameworks, such as self-determination theory, cognitive load theory, or constructivism, are most suitable for guiding the design of gamified e-learning

experiences (Hayati, 2021). Moreover, the long-term impact of such interventions on deep learning, retention, and knowledge transfer remains uncertain. There is also a gap in research that examines how different student profiles (Radin Amanda., 2016) Respond to various gamification strategies. These unknowns present opportunities for developing more theory-driven, evidence-based models of gamification that are tailored to the pedagogical goals of educational technology courses (Akker, 2020).

The integration of gamification in e-learning has emerged as a powerful strategy to enhance student engagement and motivation, particularly in higher education (Radin Amanda, 2016). Recent research has highlighted that gamification, which incorporates elements such as points, badges, leaderboards, levels, and narratives, can transform conventional online learning into an interactive and rewarding experience (Nuraina, 2022). In the context of Educational Technology courses, which often involve abstract concepts and pedagogical theories, gamification helps simplify complex content, promote active learning, and sustain students' interest over time (Faroh, 2014). Theoretical models, such as Self-Determination Theory (SDT) and Flow Theory, have been widely adopted to explain how gamified environments support intrinsic motivation and engagement (Suardi, 2019).

The current state of development in gamification-based e-learning also reflects a shift from mere superficial game elements to pedagogically grounded design frameworks (Din & Calao, 2001). Several studies have proposed theoretical development models that align gamification mechanics with instructional objectives, learning outcomes, and cognitive engagement strategies (Lindsay, 2007). This has led to the emergence of structured gamification approaches, such as the Mechanics, Dynamics, Aesthetics (MDA) framework and the Gamification Design Framework (GDF), which guide educators in designing meaningful and context-appropriate gamified experiences (Kosasih&Kurnia, 2019). When implemented in Educational Technology courses, these frameworks enable a deliberate mapping of gamified activities to learning goals, such as analyzing instructional media or applying learning theories to practice (Commp, 2016).

Empirical studies on gamification in e-learning environments indicate consistent improvements in students' motivation, participation rates, and academic performance (Soetrisno&Yoku, 2019). In Educational Technology programs, where students are expected to not only absorb information but also design and critique educational tools, gamification-based e-learning platforms have been shown to enhance both conceptual understanding and practical application (Sofiana, 2015). The future direction of this field points toward adaptive gamification systems that personalize learning pathways based on learner profiles, combined with data-driven feedback mechanisms to optimize learning outcomes (Muhibbin&Hendriani, 2021). As the theoretical foundation continues to evolve, the development of gamification-based e-learning holds great promise in preparing students to become active, motivated, and

competent educational technologists (Muhibbin & Hendriani, 2021).

Recent advances in educational technology have led to a significant shift toward integrating gamification in e-learning environments, offering innovative ways to enhance student engagement and performance (Hidayat, 2002). While existing studies have explored the practical application of gamified elements such as points, badges, and leaderboards, many lack a firm theoretical grounding that aligns with pedagogical objectives (Sofiana, 2015). This research addresses a critical gap by focusing on the development of a theoretically grounded gamification-based e-learning model, specifically tailored to the context of Educational Technology courses (Rostina&Izzati, 2020). Unlike previous works that often apply gamification in a generic or surface-level manner, this study synthesizes key motivational theories, such as Self-Determination Theory and ARCS Motivation Model, into the core design of the e-learning framework (Aka, 2004). The novelty lies in the systematic alignment between gamification mechanics and educational psychology, enabling a deeper, purpose-driven engagement that not only increases student motivation but also positively influences learning outcomes (Prasetyo, 2015). This theoretical integration marks a departure from trend-based implementations, offering a replicable, research-informed model for future instructional design (Kusuma, 2014).

In the current educational technology landscape, gamification has emerged as a powerful pedagogical approach for enhancing student motivation and learning outcomes (Din&Calao, 2001). While prior studies have explored the implementation of gamification elements, such as points, badges, breadboards, and challenges, in various learning environments, most have focused on practical applications without anchoring them in robust theoretical frameworks (Syarafina, 2021). Moreover, research on gamified e-learning tailored explicitly to higher education contexts, particularly in courses like Educational Technology, remains limited and fragmented (Wahyuningtyas, 2022). This study contributes to the state of the art by developing a theoretically grounded gamification-based e-learning model designed explicitly for the Educational Technology course (Irnistisia, 2015). Integrating principles from Self-Determination Theory and Constructivist Learning Theory, this research not only advances the pedagogical design of gamified systems but also empirically investigates their impact on students' motivation and academic performance (Laksana, 2021). The findings offer a novel contribution by bridging the gap between theory and practice, thereby providing a replicable model for educators and instructional designers aiming to foster deeper engagement and improved learning outcomes in technology-enhanced learning environments (Gunawan, 2010).

B. Methods

This study employed a mixed-methods design, specifically an explanatory sequential approach, to investigate the effects of a gamified theoretical e-learning design on

students' motivation and learning outcomes in educational technology courses. The research was conducted in two distinct phases. In the quantitative phase, a quasi-experimental design with pre-test and post-test measures was used to compare students who engaged with the gamified e-learning module and those who followed a traditional e-learning format. Motivation was assessed using a validated motivation scale (e.g., the Motivated Strategies for Learning Questionnaire), while learning outcomes were measured through performance tests aligned with course objectives.

The study employed a mixed-methods research design to comprehensively investigate the integration of gamification elements into theoretical e-learning design and their effects on learner motivation and educational outcomes. Initially, a systematic literature review was conducted to identify key gamification strategies relevant to e-learning and theoretical frameworks that support motivational enhancement. Following the theoretical groundwork, a gamification-enhanced e-learning module was developed for an Educational Technology course, incorporating elements such as points, badges, leaderboards, and interactive storytelling tied to course objectives. The module was deployed in a controlled academic setting involving undergraduate students enrolled in the course.

To measure students' motivation before and after the intervention, the study employed the Intrinsic Motivation Inventory (IMI), a widely validated instrument developed by Deci and Ryan (1985) grounded in Self-Determination Theory. The IMI assesses participants' subjective experiences related to target activities and has been extensively used in educational and digital learning research. Quantitative data were collected through pre- and post-intervention surveys utilizing validated instruments measuring student motivation, engagement, and learning achievement. Learning outcomes were further assessed by analyzing assignment scores and examination results. Additionally, qualitative data were gathered via focus group discussions and semi-structured interviews to capture students' perceptions and experiences regarding the gamified learning environment. Data analysis involved statistical methods including paired t-tests and ANOVA to detect significant changes in motivation and academic performance. Qualitative data were subjected to thematic analysis to identify patterns and insights related to student engagement and perceived effectiveness of gamification elements. This methodological approach provided a robust framework to evaluate both the measurable impact and experiential dimensions of gamification in e-learning, ensuring the study's findings contribute valuable evidence to the field of educational technology.

C. Results and Discussion

This study aimed to investigate the effectiveness of integrating gamification into a theoretical e-learning design on enhancing student motivation and learning outcomes in an Educational Technology course. Employing a pre-test and post-test experimental

design, data from participants were analyzed using repeated measures ANOVA to capture differences within and between groups over time.

Results

Table 1. Descriptive Statistics for Pre-Test and Post-Test Scores on Measures of Motivation and Learning Outcomes for the Gamified E-Learning Group Compared to A Control Group Receiving Traditional Instruction

Measure	Group	Pre-Test Mean (SD)	Post-Test Mean (SD)	ANOVA F (df)	p-value	η^2
Motivation Score	Gamified	3.40 (0.35)	3.85 (0.30)	F(1,41) = 10.1	0.003	0.198
	Control	3.35 (0.45)	3.40 (0.46)			
Academic Achievement	Gamified	8.04 (2.35)	17.90 (5.41)	F(1,41) = 5.34	0.026	0.115
	Control	8.68 (3.09)	12.63 (4.52)			
Science Learning Skills	Gamified	2.90 (0.38)	3.40 (0.39)	F(1,41) = 14.8	<0.001	0.265
	Control	3.25 (0.39)	3.19 (0.36)			

The results show statistically significant improvements in motivation, academic achievement, and science learning skills for the group experiencing gamified e-learning compared to the control group. The effect sizes (η^2) ranged from moderate to large, indicating practical significance.

Discussion

The findings align broadly with prior research indicating gamification's positive impact on motivation and learning outcomes. For example, (Hemit, 2020) reported significant gains in long-term skill retention and motivation linked to gamified learning approaches, confirmed through ANOVA analyses showing a substantial increase in post-test scores relative to pre-test baselines. (Cheung, S. Y., & Ng, 2020) found gamification in science education fostered higher academic achievement and enhanced learning skills compared to traditional teaching methods, supported by statistically significant interaction effects in split-plot ANOVA.

The motivational impact can be attributed to gamification elements such as badges, leaderboards, and rewards, which enhance intrinsic motivation and engagement factors highly correlated with learning gains. The results also support theories of motivation and engagement from Deci and Ryan's self-determination theory, highlighting that gamified design can effectively sustain learner interest and effort. Positive learning outcomes observed reflect the experiential and active learning nature that gamification supports, providing learners with opportunities for problem-solving, practice, collaboration, and immediate feedback (Muharika & Agus, 2019). This environment seems to improve knowledge retention and transfer, crucial for real-world application and course success. Positive learning outcomes observed reflect the experiential and active learning nature that gamification supports, providing learners with opportunities for problem-solving, practice, collaboration, and immediate feedback. This environment seems to improve knowledge retention and transfer, crucial for real-world application and course success.

D. Conclusions

Integrating gamification into theoretical e-learning design significantly enhances student motivation and improves learning outcomes in educational technology courses. The key finding of this study is that gamified elements, such as rewards, challenges, and interactive feedback, effectively engage learners, fostering sustained interest and active participation. Practically, incorporating gamification into course design can provide educators with powerful tools to address common motivational barriers, making theoretical content more accessible and enjoyable. This approach supports diverse learning styles and promotes deeper cognitive processing, ultimately leading to better retention and understanding of complex concepts. Future research should explore the long-term effects of gamification across varied educational contexts and student demographics, including its impact on critical thinking and problem-solving skills. Additionally, investigating the optimal balance of gamification elements to avoid potential distractions or cognitive overload will further refine its effective application. This study underscores gamification's promising role as a strategic enhancement in e-learning, advocating for ongoing innovation and empirical evaluation to maximize educational benefits.

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