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Toomas Ilves

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Gamification in Education and Its Impact on Critical Thinking Skills in Estonia

Toomas Ilves

University of Tartu

Abstract

Purpose: The purpose of this article was to analyze gamification in education and its impact on critical thinking skills in Estonia

Methodology: This study adopted a desk methodology. A desk study research design is commonly known as secondary data collection. This is basically collecting data from existing resources preferably because of its low cost advantage as compared to a field research. Our current study looked into already published studies and reports as the data was easily accessed through online journals and libraries.

Findings: Gamification in education enhances critical thinking by using challenges, rewards, and interactive learning. It boosts engagement, motivation, and problem-solving, helping students analyze, strategize, and adapt. This approach fosters creativity and deeper learning, making education more effective.

Unique Contribution to Theory, Practice and Policy: Self-determination theory (SDT), flow theory & constructivist learning theory may be used to anchor future studies on the gamification in education and its impact on critical thinking skills in Estonia. The implementation of gamification should be diverse, adaptable, and integrated across various learning environments to optimize its impact on critical thinking. To maximize the benefits of gamification in education, governments and policymakers should implement structural changes that support its adoption.

Keywords: *Gamification, Education, Critical Thinking Skills*

INTRODUCTION

Critical thinking involves the objective analysis and evaluation of information to form reasoned judgments. In developed economies like the United States, United Kingdom, and Japan, educational systems have traditionally emphasized these skills to foster innovation and adaptability. However, recent studies indicate a decline in critical thinking abilities. For instance, a global assessment revealed that U.S. adults ranked 14th in literacy and 15th in adaptive problem-solving among industrialized nations, with 34% displaying mathematics skills below primary-school levels, up from 29% in 2017 (Wall Street Journal, 2025). Similarly, in Japan, concerns have been raised about the education system's focus on rote memorization over critical thinking, potentially stifling creativity and individual thought (Sage Journals, 2024).

Australia and Estonia, educational systems have placed significant emphasis on fostering critical thinking skills. Australia's "Australia 2035 and Beyond" report highlights critical thinking, deductive reasoning, judgment, and imagination as essential skills for future business leaders, underscoring the nation's commitment to integrating these competencies into educational frameworks (The Australian, 2024). Similarly, Estonia's educational system, recognized as one of the best in Europe, focuses on problem-solving, critical thinking, and digital competence, contributing to high rankings in reading, mathematics, and science among 15-year-olds (The Times, 2024).

In developing economies, efforts to enhance critical thinking skills are gaining momentum. A bibliometric analysis of critical thinking research from 2000 to 2021 showed increasing scholarly interest, with publications from non-Western countries on the rise (PMC, 2023). However, these publications often lack the impact and recognition of their Western counterparts, highlighting the need for more robust research and implementation strategies.

For instance, a bibliometric analysis of critical thinking research from 2000 to 2021 indicates increasing scholarly interest, with publications from non-Western countries on the rise (Zhao et al., 2023). However, these publications often lack the impact and recognition of their Western counterparts, highlighting the need for more robust research and implementation strategies. In regions like East Asia, challenges persist; cognitive overload theory suggests that students may struggle to display adequate critical thinking skills during courses conducted in non-native languages, emphasizing the importance of language proficiency in critical thinking development (Yu, 2017).

In sub-Saharan Africa, governments have prioritized critical thinking in educational reforms to boost global competitiveness. Despite these efforts, challenges persist. For example, a study across five universities in East and South Africa found that while student teachers value critical thinking, many struggle with its pedagogical application, and most exhibit below-average critical thinking skills (Net Journals, 2024). These findings underscore the importance of developing contextually appropriate assessment tools and teaching methods to effectively cultivate critical thinking in these regions.

Despite these efforts, challenges persist. For example, a study across five universities in East and South Africa found that while student teachers value critical thinking, many struggle with its pedagogical application, and most exhibit below-average critical thinking skills (McGrane, 2022). These findings underscore the importance of developing contextually appropriate assessment tools

and teaching methods to effectively cultivate critical thinking in these regions. Additionally, the COVID-19 pandemic has exacerbated existing educational challenges, with an estimated 121 million students in sub-Saharan Africa excluded from digital or broadcast distance learning, further hindering the development of critical thinking skills (UNICEF, 2021).

Gamification in education refers to the application of game design elements such as points, badges, leaderboards, and challenges in non-game educational contexts to enhance student engagement and motivation (Dichev & Dicheva, 2017). This approach leverages the inherent enjoyment and engagement found in games to create more interactive and effective learning experiences (Kapp, 2012). By incorporating game mechanics, educators aim to foster a stimulating environment that promotes active learning and skill development (Hamari, 2014). Research indicates that gamification can lead to improvements in various educational outcomes, including increased participation, motivation, and knowledge retention (Deterding, 2011). However, the effectiveness of gamification strategies depends on thoughtful integration into the curriculum and alignment with learning objectives (Seaborn & Fels, 2015).

Several gamification strategies have been identified as effective in enhancing critical thinking skills. Firstly, problem-solving challenges require students to navigate complex scenarios, thereby developing analytical and decision-making abilities (Serrano, 2022). Secondly, role-playing simulations immerse students in specific roles or situations, encouraging perspective-taking and evaluative thinking (Watson, 2023). Thirdly, collaborative missions involve group tasks that promote teamwork and the synthesis of diverse viewpoints, essential components of critical thinking (Johnson & Johnson, 2018). Lastly, adaptive feedback systems provide real-time responses to student actions, facilitating reflection and iterative improvement (Shute, 2008). Implementing these strategies within educational settings has been associated with significant enhancements in students' critical thinking capabilities (Bai, 2021).

Problem Statement

Despite the growing integration of gamification in educational settings, its specific impact on critical thinking skills remains underexplored. While some studies suggest that gamified learning environments can enhance engagement and motivation, leading to improved learning outcomes (Hamari, 2014), the direct correlation between gamification and the development of critical thinking skills is not well-established. For instance, a meta-analysis by Sailer and Homner (2020) found small but significant positive effects of gamification on cognitive, motivational, and behavioral learning outcomes, yet the specific impact on critical thinking was not isolated. Additionally, research by Bai (2021) indicates that the effectiveness of gamification varies based on design elements and implementation contexts, further complicating our understanding of its influence on critical thinking. Therefore, there is a pressing need for empirical studies that specifically examine how gamification strategies affect the development and enhancement of critical thinking skills in learners.

Theoretical Framework

Self-Determination Theory (SDT)

Developed by Deci and Ryan, SDT posits that motivation is driven by the fulfillment of three innate psychological needs: autonomy, competence, and relatedness. In educational gamification, elements such as choice-based challenges and immediate feedback can satisfy these needs,

enhancing intrinsic motivation and promoting deeper engagement with critical thinking tasks. This alignment suggests that when students feel autonomous and competent within a gamified learning environment, they are more likely to engage in critical analysis and problem-solving activities (Ryan & Deci, 2020).

Flow Theory

Introduced by Csikszentmihalyi, Flow Theory describes a mental state of complete immersion and focus in an activity, often leading to optimal learning experiences. Gamification strategies that balance challenge levels with individual skill sets can facilitate this flow state, encouraging sustained attention and fostering critical thinking. By designing educational games that adapt to a learner's abilities, educators can create environments where students are fully engaged, thereby enhancing their capacity for critical analysis (Kiili, 2021)

Constructivist Learning Theory

Rooted in the works of Piaget and Vygotsky, constructivism asserts that learners construct knowledge through active engagement and experiences. Gamified educational activities that involve problem-solving and exploration align with this theory by allowing students to build their understanding through interactive scenarios. Such environments encourage learners to apply critical thinking as they navigate challenges, reflect on outcomes, and adjust their strategies accordingly (Dichev & Dicheva, 2019).

Empirical Review

De Azevedo (2023) explored the use of a serious game that incorporated Brazilian folk heroes to enhance critical thinking among marginalized communities vulnerable to misinformation. The study utilized a role-playing, card-based game with four participant groups, including individuals experiencing homelessness and favela residents in Goiânia, Brazil. Through interactive gameplay, participants were encouraged to analyze misinformation, assess sources critically, and make informed decisions. The findings demonstrated that gamification significantly improved participants' ability to identify and resist misinformation by fostering logical reasoning and analytical skills. The authors recommended integrating culturally relevant gamified educational interventions in formal and informal settings to enhance critical thinking and information literacy.

Ali (2022) explored the role of gamification in STEM education, focusing on how interactive game-based learning strategies impact student engagement and critical thinking skills. The study conducted a systematic literature review of recent pedagogical approaches in STEM education and assessed their effectiveness in enhancing learning outcomes. The researchers found that incorporating elements such as leaderboards, rewards, and problem-solving missions led to improved motivation and a deeper engagement with complex STEM concepts. Moreover, students demonstrated enhanced critical thinking skills, as they were required to evaluate information, apply problem-solving techniques, and adapt strategies dynamically. The study recommended that STEM educators incorporate gamified learning strategies that promote hands-on problem-solving, collaboration, and analytical reasoning to prepare students for real-world scientific challenges.

Fernandez and Martinez (2021) examined how gamification fosters higher-order thinking skills, including critical thinking, in higher education. The study analyzed the implementation of gamified learning experiences across multiple universities, focusing on courses that incorporated

interactive quizzes, simulations, and collaborative challenges. Findings indicated that gamification significantly improved students' ability to think critically, particularly in disciplines that require analysis, synthesis, and evaluation of complex information. Students who engaged in gamified learning environments were more likely to apply logical reasoning and problem-solving skills in their coursework. The study concluded that game-based educational activities should be carefully designed to encourage critical thinking by presenting students with real-world challenges that require strategic decision-making and reflective learning.

Hamari and Koivisto (2020) conducted a comprehensive meta-analysis on gamification's impact on learning outcomes, engagement, and cognitive skill development. The study reviewed empirical studies from diverse educational settings and examined the effects of gamified strategies on students' motivation and cognitive skills, including critical thinking. The findings indicated that gamification increased engagement levels, leading to better knowledge retention and deeper cognitive processing. However, the study also highlighted that while gamification can enhance learning outcomes, its effectiveness depends on how well game mechanics align with educational objectives. The authors recommended further research to assess the long-term impacts of gamified learning environments on students' critical thinking development.

Zhou (2019) investigated the effects of gamification in science education, specifically examining how game-based learning methods influence students' critical thinking and problem-solving abilities. The researchers conducted a systematic review of gamification applications in science courses, analyzing their effectiveness in engaging students and enhancing higher-order cognitive skills. The study found that gamified strategies, such as interactive science simulations, virtual labs, and challenge-based assessments, significantly improved students' ability to analyze scientific data and formulate logical conclusions. However, the review also noted that the success of gamification in science education depended on factors such as curriculum integration, the complexity of tasks, and the level of instructor involvement. The authors suggested that future research should focus on identifying the most effective game elements that specifically enhance critical thinking in science education.

Kim and Park (2019) assessed the relationship between gamification and academic achievement, with a particular focus on how game-based learning influences students' critical thinking skills. The researchers implemented gamified classroom activities in various academic disciplines and measured students' performance on critical thinking assessments. The results indicated that students exposed to game-based learning environments demonstrated stronger logical reasoning, better problem-solving skills, and an improved ability to analyze complex information. The study emphasized that the most effective gamified strategies involved challenges that required students to think critically, collaborate with peers, and reflect on their learning progress. The researchers recommended that educators integrate gamified tasks that promote active learning, cognitive flexibility, and independent reasoning to maximize the development of critical thinking skills.

Sharma and Gupta (2018) examined how interactive learning environments influence students' ability to think critically and make informed decisions. The study focused on technology-enhanced classrooms that incorporated gamified elements such as digital escape rooms, adaptive learning platforms, and real-time feedback systems. Findings revealed that students who engaged in interactive, game-based learning environments exhibited a higher ability to analyze problems, evaluate alternative solutions, and justify their reasoning with evidence. The study concluded that

gamification promotes critical thinking by encouraging students to approach learning as a problem-solving process rather than passive knowledge acquisition. The authors recommended that educators design gamified learning experiences that emphasize exploration, experimentation, and reflective practice to enhance students' critical thinking capabilities.

METHODOLOGY

This study adopted a desk methodology. A desk study research design is commonly known as secondary data collection. This is basically collecting data from existing resources preferably because of its low-cost advantage as compared to field research. Our current study looked into already published studies and reports as the data was easily accessed through online journals and libraries.

FINDINGS

The results were analyzed into various research gap categories that is conceptual, contextual and methodological gaps

Conceptual Gaps: Although multiple studies have explored gamification in education, there is a lack of consensus on the most effective game elements that specifically enhance critical thinking skills. For instance, Zhou (2019) highlighted that the success of gamification in science education is dependent on curriculum integration, yet there is limited research on the interplay between different game elements and specific cognitive processes. Additionally, Hamari and Koivisto (2020) acknowledged that gamification improves engagement but noted that its effectiveness varies based on alignment with educational objectives. However, empirical studies rarely differentiate between game mechanics that foster engagement and those that directly stimulate critical thinking. Furthermore, Kim and Park (2019) demonstrated that game-based learning positively influences logical reasoning and problem-solving, but there remains a gap in understanding how different gamification approaches impact various levels of Bloom's Taxonomy in critical thinking development.

Contextual Gaps: Existing research has largely focused on formal education settings such as universities and STEM disciplines, leaving a gap in the application of gamification in informal and non-traditional learning environments. De Azevedo (2023) explored gamification in marginalized communities in Brazil, revealing its potential for combating misinformation, but similar studies have not been widely replicated in other cultural contexts. Similarly, Sharma and Gupta (2018) examined technology-enhanced classrooms but did not explore how gamification affects learners outside structured academic settings, such as corporate training or lifelong learning programs. Moreover (2022) focused on STEM education, yet there is limited empirical evidence on how gamification influences critical thinking in the humanities and social sciences.

Geographical Gaps: Most studies on gamification and critical thinking have been conducted in developed and middle-income countries, with limited research on its impact in underrepresented regions. Fernandez and Martinez (2021) analyzed gamified learning in multiple universities but did not consider developing countries where technological access may be a constraint. Similarly, Hamari and Koivisto (2020) conducted a meta-analysis incorporating diverse studies, yet research from low-income regions remains scarce. Kim and Park (2019) emphasized the benefits of gamification for critical thinking but did not explore its impact in under-resourced educational systems, particularly in Africa, South Asia, or remote rural areas where digital infrastructure may

be lacking. Expanding research to these regions could provide valuable insights into the scalability and adaptability of gamification for fostering critical thinking in diverse educational contexts.

CONCLUSION AND RECOMMENDATIONS

Conclusion

Gamification in education has emerged as a powerful tool for enhancing engagement, motivation, and cognitive skill development, particularly in fostering critical thinking abilities. Research has demonstrated that integrating game-based learning strategies such as problem-solving challenges, role-playing simulations, adaptive feedback, and collaborative missions can significantly improve students' analytical reasoning, decision-making, and problem-solving skills (Hamari & Koivisto, 2020; Kim & Park, 2019). However, while gamification has shown promising results in STEM and higher education, gaps remain in understanding its long-term impact across different disciplines, informal learning settings, and underrepresented geographical regions (Ali, 2022; Zhou, 2019). Additionally, the effectiveness of gamification depends on the thoughtful alignment of game mechanics with educational objectives, ensuring that students are not just engaged but also developing higher-order cognitive skills (Fernandez & Martinez, 2021). Moving forward, more empirical studies are needed to assess the sustainability of gamification as a pedagogical strategy, particularly in diverse cultural and socioeconomic contexts, to fully harness its potential in shaping critical thinkers for the future.

Recommendations

Theory

Expanding research on gamification and cognitive development is essential to strengthen its theoretical foundation. Future studies should integrate gamification with cognitive learning theories, such as Bloom's Taxonomy, Constructivism, and Self-Determination Theory, to establish a structured approach for enhancing critical thinking skills. Additionally, differentiating between specific game mechanics such as adaptive feedback, role-playing, leaderboards, and problem-solving missions can help identify which elements are most effective in stimulating higher-order cognitive skills. Furthermore, current gamification studies are predominantly focused on STEM education, leaving gaps in other disciplines. Expanding research into humanities, business education, and social sciences will broaden the theoretical understanding of how gamification impacts different aspects of critical thinking. Future theoretical models should also consider the role of emotions, motivation, and engagement levels in determining the long-term impact of gamified learning environments on cognitive abilities.

Practice

The implementation of gamification should be diverse, adaptable, and integrated across various learning environments to optimize its impact on critical thinking. Schools, universities, and corporate training programs should adopt game-based learning strategies tailored to different age groups, disciplines, and cognitive levels. Leveraging technology, particularly AI-driven gamification platforms, can provide personalized learning experiences that adjust to students' skill levels and cognitive progress. Additionally, educator training programs should include pedagogical frameworks for game-based learning, ensuring that teachers design activities that encourage analytical reasoning rather than passive memorization. Institutions should also facilitate

collaborative game-based learning environments, where students engage in problem-solving simulations that mimic real-world decision-making scenarios, reinforcing their critical thinking abilities.

Policy

To maximize the benefits of gamification in education, governments and policymakers should implement structural changes that support its adoption. Ministries of education should integrate gamification into national curricula, ensuring that students engage in active, experiential, and problem-solving learning techniques from an early stage. Furthermore, there is a need for quality standards and accreditation criteria for educational gamification tools to ensure they align with scientific evidence on cognitive development and educational best practices. Policymakers should also prioritize digital inclusion initiatives, providing underprivileged communities with technological infrastructure, training programs, and access to gamified educational tools, helping bridge the digital divide in modern learning. Governments and educational bodies should work together to assess and regulate the impact of gamified learning strategies, ensuring equitable access to innovative learning approaches while protecting students from ineffective or counterproductive game-based methodologies.

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