



Exploring the Impact of Gamification in E-learning Environments in Levelling Up Tolerance of Ambiguity

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ABSTRACT

Gamification significantly enhances students' capabilities in addressing challenges. E-learning environments encompass various learning scenarios that present considerable challenges for learners, including competitions and conflicts that may influence their capacity to navigate these situations. Tolerance of ambiguity refers to an individual's capacity to navigate situations characterized by conflicts and uncertainty regarding achievable outcomes. The present study investigates the impact of gamification on enhancing learners' ambiguity tolerance, as it serves as a mechanism to improve their capacity to confront challenges and foster motivation in educational contexts. A quasi-experimental design was employed to compare the experimental group utilizing a gamification-based e-learning environment with the control group that engaged with the same environment devoid of gamification. The research sample comprised 60 tenth-grade students from the Jeddah Educational Department, who were randomly assigned to two research groups. A scale for measuring tolerance of ambiguity was employed following the verification of its reliability and stability, comprising (60) items. The findings indicated that a gamification-based e-learning environment is superior to a non-gamified e-learning environment in enhancing tolerance for ambiguity. Employing gamification to enhance cognitive styles is essential at this time, as it is likely to yield positive effects on learning outcomes.

Keywords: Tolerance of Ambiguity, Gamification, E-learning Environments.

1- Introduction

Learners may struggle to engage with specific tasks in e-learning environments due to the challenges in tolerance of ambiguity inherent in these new learning contexts (Sazalli, Adnan, & Fakhrudin, 2021). Tolerance of ambiguity refers to an individual's capacity to confront conflicting or complex situations without experiencing psychological distress, as well as to manage and accept various interpretations and equivalent outcomes (Khodabandeh, 2024). Tolerance of ambiguity refers to the inclination to view ambiguous situations positively, in contrast to tolerance of ambiguity, which involves perceiving such situations as threatening (Sobal & DeForge, 1992). It is defined as a series of responses to stimuli that are unfamiliar, complex, uncertain, or open to multiple interpretations (Arquero & Tejero, 2009). Tolerance of ambiguity refers to an individual's capacity to navigate ambiguous situations. Specifically, individuals with high ambiguity tolerance can make decisions in environments marked by insufficient information (Katsaros, Tsirikas, & Nicolaidis, 2014). It is essential to create e-learning environments that effectively enhance learners' tolerance of ambiguity and facilitate deeper immersion in learning processes. Tolerance of ambiguity is a significant personality variable, reflecting an individual's ability to adapt to and process their environment, alongside their self-perception and motivation (Khodabandeh, 2024).

This research aims to investigate the influence of gamification in specific e-learning contexts to determine its effect on enhancing tolerance of ambiguity levels. Gamification refers to the integration of game features and elements into educational settings that are not inherently game-oriented (Deterding, Dixon, Khaled, & Nacke, 2011, p. 9). Its purpose is to enhance enjoyment and motivation within educational contexts, thereby alleviating monotony and stereotypes, and fostering a sense of happiness and engagement in the learning environment (Hammedi, Leclercq, Poncin, & Alkire, 2021). Gamification involves the incorporation of certain elements or principles derived from games, including badges, points, rewards, and leaderboards, rather than relying on a specific game (Al-Hafdi & Alhalafawy, 2024; Alhalafawy & Zaki, 2022; Alhalafawy & Zaki, 2019; Alzahrani & Alhalafawy, 2023; Alzahrani & Alhalafawy, 2022; Alzahrani, Alshammari, & Alhalafawy, 2022). The gamification of educational environments involves the integration of challenges, tasks for users to complete, point accumulation based on task performance, progression through levels contingent on accumulated points, achievement badges as rewards for task completion, and a ranking system for students based on their achievement rates (Perryer, Celestine, Scott-Ladd, & Leighton, 2016).

The application of gamification to enhance tolerance of ambiguity in e-learning settings is grounded in self-determination theory. This theory posits that certain factors contribute to the enjoyment and stimulation of activities driven by internal motivations. Key factors include autonomy, competence, and relatedness, all of which are facilitated by gamification elements. These elements promote autonomy by providing students with a sense of agency and freedom in task execution, enhance

competence by instilling a sense of effectiveness in task completion and environmental influence, and foster relatedness through the development of social relationships among peers and a sense of belonging within groups formed during task engagement (Bakhanova, Garcia, Raffae, & Voinov, 2020; Sailer, Hense, Mayr, & Mandl, 2017; Suh, Wagner, & Liu, 2015; van Roy & Zaman, 2019).

The research gap identified a significant lack of studies investigating the effects of gamification on enhancing tolerance of ambiguity. Numerous studies have investigated the effectiveness of gamification in relation to various dependent variables, including well-being (Alhalafawy & Zaki, 2019), engagement (Alzahrani et al., 2022), motivation (Li, Hew, & Du, 2024), and self-regulated learning (Alhalafawy & Zaki, 2022). However, many of these studies have overlooked the degree of ambiguity that students may encounter in e-learning environments. The researcher noted that certain students in e-learning environments may struggle to tolerate the ambiguity present in some learning situations within these contexts. Some learning situations in e-learning environments are designed without elements that promote tolerance of ambiguity or encourage immersion and enjoyment in the learning experience.

The researcher conducted an exploratory study involving secondary school teachers of tenth grade students in a digital technology course to assess students' abilities to tolerate ambiguity in various educational situations presented via digital platforms. The teachers concurred that a significant number of students may lack the capacity to tolerate ambiguity. The researcher assessed indicators of tolerance of ambiguity among tenth grade students and determined that their level of tolerance of ambiguity in e-learning contexts was low. Gamification serves as a significant tool for optimising e-learning environments. Gamification serves as a tool that can transform educational contexts and enhance learners' capacity to navigate ambiguous situations. Therefore, it is pertinent to investigate the impact of gamification in e-learning environments on improving students' levels of tolerance of ambiguity. The research seeks to address the following primary question: This study investigates the effectiveness of gamification in enhancing tolerance of ambiguity among tenth-grade students in Jeddah. This research seeks to validate the hypothesis regarding the effect of gamification on tolerance of ambiguity, addressing the limited studies in this area. No statistically significant difference exists in the level of tolerance of ambiguity.

No statistically significant difference exists at the 0.05 level between the mean scores of the experimental group, which utilised gamification in e-learning environments, and the mean scores of the control group, which employed an e-learning environment without gamification, regarding the improvement of tolerance of ambiguity.

2-Literature Review

2-1 Gamification

Sari et al. (2019) emphasized the significance of gamification in educational contexts, particularly in challenging scenarios, as it fosters strong motivation and equips students with effective tools to navigate educational obstacles. A substantial body of research has demonstrated that gamification effectively aids learners in overcoming educational challenges. Zainuddin et al. (2020) conducted a study to compare regular testing systems with gamification-based testing systems. The findings indicated that gamification-based electronic testing systems effectively enhance student engagement in the learning process and foster creative thinking. Chen et al. (2020) developed a gamification-based participatory reading annotation system to encourage student engagement in annotating texts. The results demonstrated the effectiveness of gamification in improving students' performance concerning the quality of their participation in the annotation process, linked to reading comprehension. A study conducted by Zainuddin, Chu, Shujahat, and Perera (2020) analyzed 46 research papers published between 2016 and 2019 on gamification. The findings highlighted the necessity of reassessing motivational elements across various digital applications and platforms to establish their effectiveness and varied impacts on learning outcomes. A study by Legaki et al. (2020) examined the effectiveness of gamification in addressing challenges in statistical education through the implementation of points, levels, and leaderboards. Analyzing quantitative data from 365 students, the findings indicated that gamification significantly enhanced learning processes compared to traditional methods. Tan and Cheah (2021) proposed a model for gamification applications aimed at enhancing cognitive perception anxiety in specific educational contexts related to physics. This model utilized gamification elements such as points, badges, levels, and leaderboards, integrated within an artificial intelligence framework. The results indicated the effectiveness of the proposed application in improving low cognitive perceptions. XU et al. (2021) conducted a systematic review of 35 studies examining the use of gamification elements, such as dots, badges, and leaderboards, to improve psychological variables. The study's results indicate that prior research has demonstrated the efficacy of gamification elements in improving various factors, including psychological aspects and those associated with productivity and self-efficacy. Furthermore, it was found that motivational processes rely on the capacity of digital stimuli to affect internal motivations via external incentives. Litvin et al. (2020) developed a mobile application named eQuoo, which employs gamification techniques to engage users with its content and instructions. The findings indicated that gamification effectively enhances psychological resilience. Additionally, the study confirmed that gamification contributes to improved mental well-being, as digital incentives foster social relationships and significantly support personal growth. This complements the findings of Alhalafawy and Zaki (2019), which demonstrated that gamification could enhance psychological well-being. Alzahrani et al. (2022) demonstrated that gamification enhances engagement in

learning. Alhalafawy and Zaki (2022) demonstrated that gamification enhances self-regulated learning skills in the context of educational emergencies.

2-2 Tolerance of Ambiguity

Tolerance/intolerance of ambiguity: Lack of tolerance of ambiguity is a significant cognitive style that pertains to individuals' tendencies and capacities to manage facts and information that may be incomplete or contradictory with their true nature (Buhr & Dugas, 2006). Tolerance of ambiguity denotes the capacity to accept unrealistic experiences, reflecting an individual's readiness to embrace cognitions or ideas that diverge from conventional experiences, in contrast to those lacking this ability (Messick, 1994). The term ambiguity refers to the tendency to perceive or interpret information as incomplete, irregular, or ill-defined, thereby serving as a source of threat or anxiety for the learner. Consequently, in ambiguous situations, learners may focus on a limited number of clearer elements or conceptualise ambiguous areas based on their guidance. Thus, the dimension of tolerance versus intolerance of ambiguity emerges as a significant personality variable (Sazalli et al., 2021). Raising the tolerance of ambiguity level of learners is crucial, as individuals with a higher tolerance are generally more adept at acquiring knowledge and skills (Khodabandeh, 2024).

When examining the traits that differentiate cognitively ambiguity-tolerant individuals from ambiguity-intolerant ones, the following observations can be stated (Kenny & Ginsberg, 1988; Ma & Kay, 2017; Wright, Clark, Clark, Rock, & Coventry, 2017):

- Individuals intolerant of ambiguity strive to evade the anxiety associated with uncertainty by distancing themselves from or swiftly circumventing ambiguous situations, thereby restricting their focus to a limited number of elements within ambiguous domains. Conversely, those tolerant of ambiguity actively pursue, relish, and excel in undertaking ambiguous tasks.
- Individuals intolerant of ambiguity are generally more attached to traditional elements than those who are tolerant of ambiguity, as they reject new concepts due to the uncertainties and mysteries they may embody. In contrast, ambiguity-tolerant individuals actively pursue and embrace novel experiences and knowledge.
- Individuals intolerant of ambiguity see ambiguous events as dangers rather than opportunities, leading them to avoid such circumstances. In contrast, ambiguity tolerant persons regard ambiguous situations as opportunities rather than threats and engage with them constructively.
- Individuals intolerant of ambiguity want unequivocal rejection or clear acceptance, while those tolerant of ambiguity embrace several potential answers for circumstances and problems.
- Individuals intolerant of ambiguity have less willingness to pursue information, in contrast to those tolerant of ambiguity, who demonstrate a strong motivation to seek knowledge.

- Tolerance of ambiguity correlates with students' academic achievement across all learning outcomes. Students with high academic achievement have a greater tolerance of ambiguity than their counterparts with lower academic success. Conversely, research has shown that learners have a greater tolerance of ambiguity in their educational activities than in their broader life experiences.

3-Methods

3-1 Approach

The present study employed a quasi-experimental design, deemed the most suitable for examining the causal relationship between the independent variable, gamification in e-learning environments, and the dependent variable, tolerance of ambiguity. Additionally, the research utilised a descriptive method during the study, analysis, and design phases, facilitating the analysis of gamification and the identification of indicators of tolerance of ambiguity.

3-2 Experimental design

An experimental design comprising two groups, namely an experimental group and a control group, was employed. The experimental group engaged with a gamification-based e-learning environment, while the control group utilised the same environment devoid of gamification elements. Figure 1 illustrates the research's experimental design.

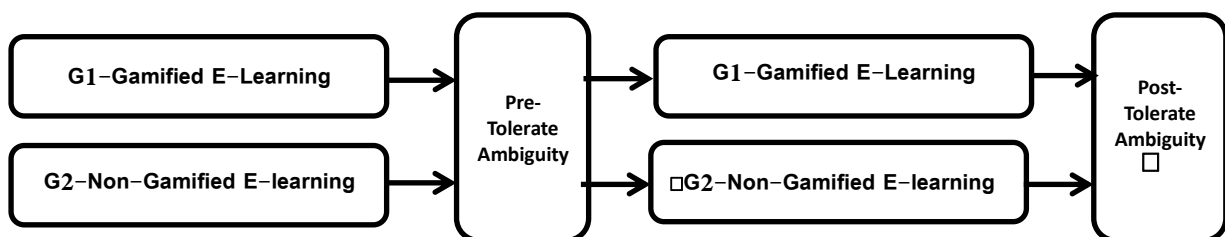


Figure 1. The experimental design of the research variables

The present study employed a quasi-experimental approach to elucidate the relationship between the independent variable, namely gamification platforms, and the dependent variable, which was the level of tolerance of ambiguity.

3-3 Sample

The research sample comprised (60) students from the Jeddah Educational Department, randomly selected from tenth grade participants in the digital skills course. These students were allocated into two experimental groups: one group consisting of (30) students engaged in a gamification-based e-learning environment,

and another group of (30) students utilising a non-gamification-based e-learning environment.

3-4 Tolerance of Ambiguity scale

The basic tolerance of ambiguity scale was created by Norton (1975) and then modified into Arabic by several research to assess ambiguity tolerance/intolerance. The scale has 60 questions, to which the respondent selects from 7 alternatives: strongly agree (7), agree (6), tend to agree (5), neutral (4), prefer to disagree (3), disagree (2), and strongly disagree (1). The student replies using the previously specified seven-point scale, resulting in a total score of 420 degrees. The scale's stability was confirmed using the re-measurement technique in circumstances similar to the first application, with a two-week gap, resulting in a stability coefficient of 0.86. The scale's reliability was confirmed through the internal consistency of its items, with correlation coefficients computed between individual item scores and the total scale score. These coefficients, ranging from 0.81 to 0.88, were all statistically significant at the 0.01 level.

3-5 Procedures

To achieve the current research objective of utilizing gamification in an e-learning context to enhance tolerance of ambiguity, the Talent LMS platform has been chosen due to its extensive features, including the capability to enable or disable competitive gamification elements. It is regarded as one of the most robust learning platforms, distinguished by its implementation of various gamification components and equipped with essential tools for the gamification system, such as points, levels, badges, leaderboards, and other gamification elements.

The e-learning environment was created using the research platform to facilitate specific learning objectives for the second lesson on artificial intelligence from the second unit focused on technology and living in the digital technology course. The curriculum included eight learning goals across four topics: machine learning, applications of machine learning, examples of artificial intelligence, and applications of artificial intelligence. A total of three tasks were assigned for each educational subject, resulting in twelve tasks throughout the four themes. Every student was mandated to perform the assignments within designated time limits to get gamification rewards. The assignments were assessments, writing reports on each subject matter, and submitting multimedia created by the students.

Gamification components were used in the following manner:

- Points: Students get points for each login, completion of subtasks, completion of main tasks, passing quizzes (with each quiz score doubled by 5 points), submission of assignments, participation in discussions or comments, and casting votes. The points allocated for each job are standardized at five points.

- Badges: A diverse array of badges is established to provide students access to activity badges, learning badges, test badges, task badges, survey badges, and communication badges.
- Leaderboards: Two leaderboards have been established, one for points and another for badges.

Consequently, the first experimental group engaged in educational activities via the platform, which incorporated elements of gamification. The experimental control group engaged with identical content and tasks via the same platform, Talent LMS, albeit with the gamification feature deactivated.

4-Result

To address the primary research question and to substantiate the hypothesis concerning the comparison between the first experimental group utilising the gamified e-learning environment and the control group engaging with the same e-learning environment devoid of gamification, a t-test was employed to ascertain the significance of the differences observed between the experimental and control groups. The results of the t-test for the participants in both research groups are presented in Table 1.

Table 1 Mean, SD, and t-value pertaining to the levels of tolerance of ambiguity observed in both the experimental and control groups.

Group	N	Mean	SD	t	df	sig
G1-Gamified E-Learning	30	392.30	5.42	50.29	58	0.000
G2-Non-Gamified E-learning	30	307.83	7.56			

Analysis of the data from Table 1 indicates that the experimental group using the gamified e-learning environment outperformed the control group employing the non-gamified e-learning environment. Figure 2 illustrates the comparison of average total tolerance of ambiguity level scores between the experimental and control groups.

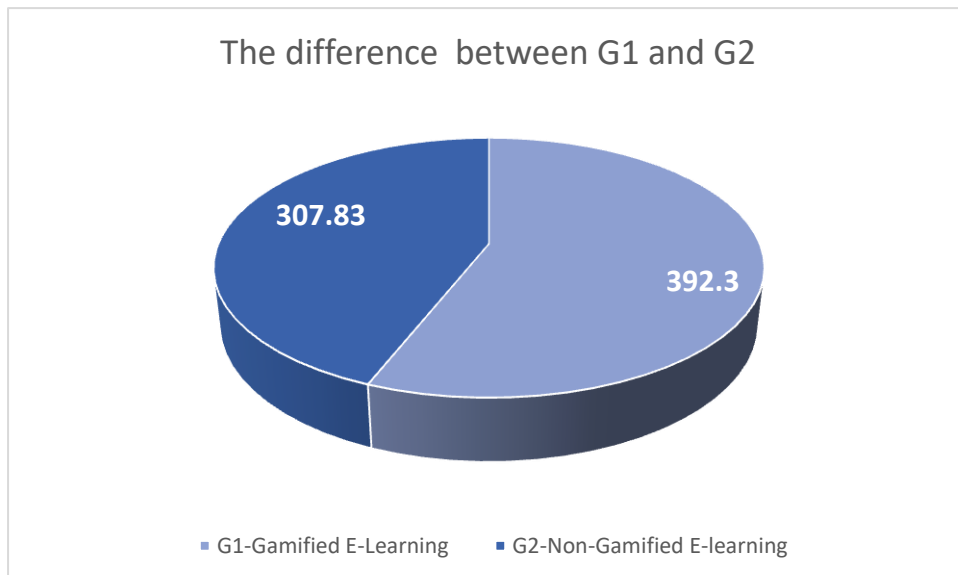


Figure 2. The difference between the experimental and control groups in the level of tolerance of ambiguity

5-Disscutions

The present finding regarding the efficacy of a gamification-based e-learning environment in fostering tolerance of ambiguity can be ascribed to the notion that gamification equips students with a range of motivations that enable them to endure pressure and navigate educational contexts with proficiency. Gamification fosters robust motivations via the implementation of points and badges, enabling learners to navigate contexts that may present ambiguity for certain individuals and serve as potential sources of threat. The incorporation of gamification, along with its components such as points and badges, encourages learners to engage in cognitive activities that facilitate the development of learning schemas, all while minimising cognitive strain during their pursuit of digital rewards. Gamification has been shown to motivate students to persist in their educational endeavours, thereby expanding their repertoire of cognitive style. This enhancement in cognitive capabilities facilitates a more effective structuring of their learning processes, which in turn positively influences cognitive load. As learners become more adept at structuring their learning, they are better equipped to store and retrieve acquired information with minimal cognitive strain. This outcome can likewise be ascribed to the capacity of gamification to enhance and stimulate learners in their engagement with intricate information, which often necessitates exploration and the establishment of connections among various components of the content. As learners navigate gamification-based educational platforms, they strive to accumulate the maximum number of points and badges, thereby elevating their status on the leaderboards. (Alhalafawy & Zaki, 2019). Gamification has enhanced learners' capacity to engage with educational processes, regardless of their complexity or the level of detail

involved. This approach allows individuals to undertake a range of activities without adversely affecting the efficiency of their working memory in processing the information presented to them. Consequently, gamification facilitates the absorption of the stresses arising from the ambiguity inherent in various aspects of learning contexts within the e-learning environment, while preserving the capacity of working memory.

The present findings can be elucidated through the lens of motivation theory, which characterises gamification digital incentives as an array of external motivators that may bridge the gap between intrinsic motivations and the learner's actual capabilities. It is conceivable that a learner possesses an inherent aspiration for excellence, yet their academic and cognitive competencies may not suffice; thus, in such instances, external incentives play a significant role in propelling the learner towards the attainment of the desired proficiency (Zichermann & Cunningham, 2011). This serves to elucidate the capacity of gamification to enhance learners' tolerance of ambiguity when navigating educational contexts within e-learning environments (Zichermann & Cunningham, 2011).

The findings of the present study align with a substantial body of research that has demonstrated the efficacy of gamification in the enhancement of dependent variables. In this context, Restivo and Van De Rijdt (2012) investigated the impact of digital incentives on students' productivity. The findings indicated that the productivity rate of the experimental group utilising digital incentives was 60% greater, and they were six times more likely to obtain digital incentives in comparison to the control group. Turan, Avinc, Kara, and Goktas (2016) investigated the impact of various gamification elements on student achievement within an IT course. The findings indicated that participants in the experimental group achieved higher grades than their counterparts who engaged in traditional learning methods. Hew and his colleagues (Hew, Huang, Chu, & Chiu, 2016) investigated the correlation between gamification elements and achievement motivation. The findings from their study, derived from a series of experiments, demonstrated the efficacy of gamification in fostering achievement motivation. Kayımbaşoğlu, Oktekin, and Hacı (2016) sought to incorporate various elements of gamification into digital platforms and to illustrate their efficacy. The findings of the study indicated that platforms utilising gamification are superior to alternative styles in their capacity to diminish student distraction and to bolster students' motivation to engage in learning events and activities. In a systematic review conducted by Johnson et al. (2016), a comprehensive analysis was performed on a selection of prior studies examining the effects of gamification on well-being. This review encompassed 19 research studies that offered empirical evidence regarding the influence of gamification on well-being. The findings of the research indicated that 59% of the studies documented favourable outcomes associated with gamification in relation to well-being, and that digital incentives play a supportive role in promoting behaviours linked to mental health. This complements the research conducted by Alhalafawy and Zaki (2019), which demonstrated the potential of gamification to enhance psychological well-being. Alzahrani et al. (2022)

demonstrated that the implementation of gamification enhances engagement in the learning process. Alhalafawy and Zaki (2022) demonstrated that the implementation of gamification enhances self-regulated learning skills in the context of educational emergencies.

6-Limitations

The impact of gamification on the degree of tolerance of ambiguity was examined within the framework of the implemented platform, wherein three components of gamification were engaged: points, badges, and leaderboards. The capacity of gamification to enhance tolerance of ambiguity appears to be confined to the e-learning context rather than the broader learning environment. Expanding this phenomenon necessitates comprehensive application processes and the advancement of measurement techniques through factor analyses. The research was conducted exclusively with male participants, as the educational framework precluded the inclusion of females. In this context, females are instructed solely by female educators, thereby necessitating the pursuit of additional studies to address this gap in the research.

7-Conclusions

The current research intended to investigate the impact of gamification in e-learning settings on enhancing learners' tolerance for ambiguity in various learning contexts within e-learning environments. The findings have demonstrated the efficacy of gamification in enhancing learners' tolerance of ambiguity within e-learning contexts. The study identified an effective design for e-learning settings that may enhance students' tolerance of ambiguity levels. Other targeted users might use the findings of the present research to enhance e-learning resources, hence boosting students' abilities to navigate educational scenarios marked by ambiguity. Further research may investigate the influence of the interplay between gamification components and learners' degrees of tolerance of ambiguity on educational results. It may also be pertinent to undertake bibliometric analyses and a systematic review of research that has focused on the application of gamification in enhancing cognitive styles.

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