



## The impact of gamification on undergraduate students' performance in a physical education distance learning course

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### Abstract

The purpose of this study was to examine the impact of gamification on online undergraduate students' performance at the Democritus University of Thrace. Sixty-two (n=62) third-year undergraduate Physical Education students, aged between 20-21 years old, were randomly assigned into two teaching method groups: a badges group consisting of 32 students and a no-badges group comprising 30 students. To assess students' cognitive learning achievements, four quizzes and a final performance test were utilized. An independent sample t-test analysis was performed to investigate whether online students who received gamification with badges would experience higher performance than their counterparts in the no badges (control) group. The analysis indicated that the incorporation of badges during distance learning courses did not significantly impact the course performance among undergraduate students. Online students who utilized the training program with badges demonstrated similar performance to online students who did not use badges. In conclusion, the results suggest that gamifications tools like badges might not necessarily contribute to an improvement in students' performance.

**Keywords:** Gamification, performance, physical education, distance learning

### Introduction

Gamification involves integrating game-like elements into non-game environments such as education, business, or sports, aiming to provide users with a more engaging and immersive experience (Deterding, Khaled, Nacke & Dixon 2011<sup>[1]</sup>; Seaborn & Fels, 2015)<sup>[2]</sup>. In the realm of education, particularly distance education, the purpose of employing gamification tools is to boost student motivation and involvement without fully immersing them in a gaming context (Hakulinen, Auvinen & Korhonen, 2015)<sup>[3]</sup>.

Despite being a relatively recent development in educational practices, the effectiveness of gamification tools in this context has sparked controversy among scholars (Faiella & Ricciardi, 2015)<sup>[4]</sup>. The outcomes of implementing gamification tools in educational settings have yielded conflicting results concerning behavioral, cognitive, and psychological outcomes. While there is no consensus on the positive or negative impact of gamification on learners, scholars collectively acknowledge the necessity for additional research to shed light on these effects (Dicheva, Dichev, Agre & Angelova, 2015)<sup>[5]</sup>; Hung, 2017<sup>[6]</sup>).

Numerous studies have explored the impact of gamification on student performance within educational settings. However, the overall conclusion remains inconclusive due to varying outcomes (Dichev & Dicheva, 2017)<sup>[7]</sup>; Seaborn & Fels, 2015)<sup>[2]</sup>. The definition of performance in gamification studies varied based on their respective designs. Some studies measured performance as participants' achievement in specific tasks, such as generating tags for an image annotation task (Mekler, Brühlmann, Tuch, Opwis, 2017)<sup>[8]</sup> or engaging in a short simulation game (Sailer, Hense, Mayr, Mandl, 2017)<sup>[9]</sup>. Others focused on academic accomplishments, including quiz, assignment, or exam scores (Balci, Secaur, Morris,

2022<sup>[10]</sup>; Kyewski & Krämer, 2018<sup>[11]</sup>; Morris, Dragovich, Todaro, Balci & Dalton, 2019)<sup>[10, 12]</sup>.

To illustrate the mixed findings on the impact of gamification on performance, several results are discussed below. One study gamified a Massive Open Online Course (MOOC) in conjunction with social media, leading to increased student participation and a rise in course completion rates from 7% to 39.9% (Borras-Gene, Martinez-Nunez & Fidalgo-Blanco, 2016)<sup>[13]</sup>. Another study revealed that the incorporation of leaderboards into course design significantly enhanced student interaction and project engagement compared to non-leaderboard-exposed students (Landers & Landers, 2014)<sup>[14]</sup>. Additionally, the introduction of points, badges, and leaderboards in a hybrid course boosted students' involvement in discussion boards, encouraged them to tackle more challenging projects, and ultimately improved the quality of their performances compared to a control group (Tan & Hew, 2016)<sup>[15]</sup>.

Conversely, Domínguez *et al.* (2013)<sup>[16]</sup> implemented badges, leaderboards, and trophies to gamify certain course activities, resulting in the gamified group achieving higher scores on practical assignments but scoring lower on written assignments and displaying reduced course participation compared to the control group. Despite these mixed effects, students in the gamified group maintained positive attitudes toward the implementation of gamification tools (Domínguez *et al.*, 2013)<sup>[16]</sup>. In contrast, Hanus and Fox (2015)<sup>[17]</sup> reported a negative impact on student performance (final exam score) when badges, leaderboards, and coins were integrated into their course design compared to students in a non-gamified class. In conclusion, the conflicting results regarding the effects of gamification on performance underscore the need for further research (Dichev & Dicheva, 2017)<sup>[7]</sup>.

The presence of mixed research findings, as indicated by studies such as Hanus and Fox (2015)<sup>[17]</sup> and Mekler *et al.* (2017)<sup>[8]</sup>, suggests that a more in-depth investigation is necessary to conclusively identify the effects of gamification

on performance. Thus, the purpose of this research was to examine the impact of gamification on online undergraduate students' performance at the Democritus University of Thrace. The research question guiding this study was the following:

1. How does a distance learning environment gamified with badges affect online undergraduate students' performance?

## Methods

### Participants

This research involved 62 third-year students from the Department of Physical Education and Sport Science at Democritus University of Thrace. The participants, with an age range of 20 to 21 years ( $M=20.5$ ,  $SD=1.05$ ), comprised 33 males (53.2%) and 29 females (46.8%). These students were undertaking the 334–New Technology in Health course during the spring semester of 2021. The students were randomly divided into two teaching method groups: the badges group, consisting of 32 students (17 males and 15 females), and the no-badges group, comprising 30 students (16 males and 14 females). Before the commencement of assignments, participants were briefed on the study's objectives, their assigned experimental group, the teaching method, and their participation obligations. While all students in the two classes were invited to take part, the procedures varied for the two course delivery formats. Each student provided voluntary consent, understanding that participation would not impact their grades.

### Instruments

To assess students' cognitive learning achievements related to the objectives of the N334 - New Technology in Health course, four quizzes and a final performance test were created. A table of specifications was developed to illustrate the connections between the identified course content and the levels of learning. In alignment with these specifications, four modules with 10 items each were constructed, along with a final quiz consisting of 20 items. All tests were designed as multiple-choice, with each test item offering five options to minimize the likelihood of guessing.

The construction of the tests adhered to the linear model, where test scores were determined by summing the number of correct answers, assigning equal weight to each item. This approach ensures a straightforward calculation of scores based on the total number of correct responses across the items.

### Open eClass distance course

A streamlined distance learning framework, incorporating a badges tool, was implemented on Open eClass, an asynchronous learning management system. The course structure included a welcome module, four learning modules with quizzes, a survey module, and a final module for all participant groups. The welcome module provided group-specific information and guidance on navigating the Open eClass system.

Distinct course designs were crafted for each group, integrating the badges gamification tool. Badges in Open eClass are digital images awarded upon achieving specific milestones. The two groups formed were the "badges" group, earning badges during the study, and the "no-badges" group (control group) without any badge rewards. Badge types were configured to align with different activities in Open eClass, with increasing difficulty as users progressed. The study incorporated four badge categories: learning badges for completing modules, test badges for passing module tests, perfectionism badges for achieving scores of 90% or higher, and survey badges awarded upon completing a single survey administered throughout the study.

### Procedure

In the spring semester of 2021, undergraduate students enrolled in the N334 – New Technology in Health course were invited to take part in the study. After securing their informed consent through Google Forms, participants were randomly assigned to one of two study groups. Additionally, participants voluntarily registered on the Open eClass platform.

Upon logging into Open eClass, participants initiated their journey with the welcome module. The badges group participants were informed in the welcome module that they would receive badges upon completing specific activities, such as module completion or surveys. Conversely, the no-badges group did not receive any badges during the study, as the badge system was deactivated for this group.

After completing the welcome module, participants advanced to Step 2, where they had to finish the four learning modules. Each learning module included educational content and a quiz. Participants were instructed to read the provided content and then take a quiz consisting of ten multiple-choice questions. Successful completion of both the learning content and the associated test marked the conclusion of a learning module.

Following Step 2, participants moved on to subsequent steps. Step 3 involved the final quiz test, comprising twenty multiple-choice questions to gather participants' performance data. In Step 4, the final module conveyed to participants that they had completed the study. Participants were expected to finish the study within four weeks of enrolling in Open eClass. In case of non-completion, reminder emails were sent by the researcher through the system. Upon completing the study, participants were awarded a grade by the researcher.

### Statistical analysis

The experiment followed a factorial design, with the teaching method group (badges, no-badges) serving as the independent variable, and performance as the dependent variable. Independent samples t-test analysis was conducted to investigate the differences of performance among the teaching method groups (badges, no-badges) of the participants. The hypothesis of this study was:

H01. Online students who receive badges will have higher performance than online students in the no badges (control) group.

### Results

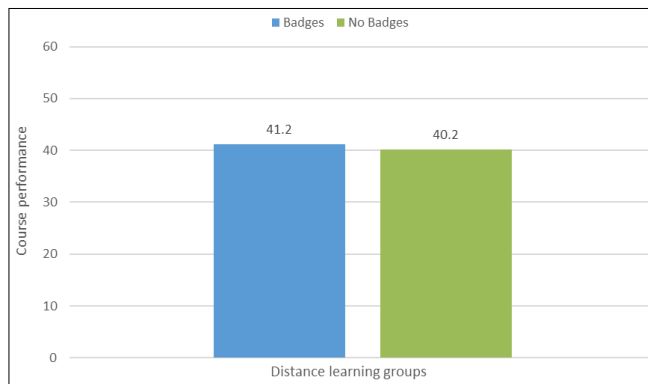
An independent samples t-test was employed to investigate the H01 hypothesis, which posited that online students receiving badges would demonstrate higher performance than online students in the no-badge group. Prior to

conducting the t-test, Levene's test was used to assess the homogeneity of variance, and the Shapiro-Wilk test was employed to evaluate the normality of the sample. The significance level for all measurements was set at  $p < 0.05$ . The analysis indicated that the inclusion of badges in distance learning courses did not have a significant impact on the performance among undergraduate students,  $t_{(60)} = 1.5, p = .14$ . Online students who participated in the training program with badges ( $M = 41.2, SD = 2.53$ ) exhibited performance similar to that of online students who did not use badges ( $M = 40.2, SD = 2.58$ ). Consequently, the utilization of badges in distance learning courses did not influence the performance among online students. Detailed information, including mean values (M), standard deviations (SD), and  $t$ -values with corresponding levels of significance, is presented in Table 1.

**Table 1:** Mean scores and standard deviations of performance for the badges and no badges groups.

Variable	Badges (n=32)		No Badges (n=30)		t	p
	M	S.D.	M	S.D.		
Course performance	41.2	2.53	40.2	2.58	1.5	.14

Based on the results, the H01 hypothesis proposing that online students receiving badges would experience higher performance than those in the no badges (control) group is not supported. Consequently, undergraduate students who were awarded badges during the intervention did not experience greater performance from their involvement in the distance learning course compared to their counterparts who did not receive badges (Figure 1).



**Fig 1:** Mean scores of the distance learning groups (badges, no badges) on course performance.

**Discussion**

The central research question of this study aimed to explore whether gamification using badges could enhance the performance of online students. The initial hypothesis posited that receiving badges would significantly improve performance compared to the no-badges condition. However, the collected data did not support this hypothesis, suggesting that badges did not have a significant impact on increasing performance among online learners. This lack of a significant effect of gamification on course performance aligns with findings from other studies, including those conducted by Balci *et al.* (2022) [10], Kyewski & Krämer (2018) [11], and Morris *et al.* (2019) [12]. To assess students' cognitive learning achievements in the N334 - New Technology in Health course, four quizzes and a final performance test were utilized. However, none of

these performance measures yielded significant results among the groups, indicating that neither of the gamification tools significantly enhanced the performance of online learners.

As mentioned earlier, the non-significant impact of badges on performance in this study aligns with previous research findings (Balci *et al.*, 2022 [10]; Hanus & Fox, 2015 [17]; Kyewski & Krämer, 2018 [11]; Morris *et al.*, 2019) [12]. In contrast, other studies have shown that gamified learning environments can lead to either partial (Denny, 2013 [18]; Domínguez *et al.*, 2013) [16] or full (Borras-Gene *et al.*, 2016 [13]; Landers & Landers, 2014 [14]; Tan & Hew, 2016) performance enhancements in learners. Existing literature suggests that gamified learning environments designed with clear learning objectives may foster an engaging, motivating, and meaningful learning experience, thereby enhancing performance in learners (Sailer & Homner, 2020).

The lack of significant results in performance measures in this study may be attributed to the gamification implementation design. It is possible that the design failed to sufficiently encourage learners to engage more with the Open eClass course, such as spending more time in the system or achieving higher quiz scores.

**Conclusions**

In conclusion, despite employing various measures such as quiz results and a final test to evaluate the performance of online students, this study did not observe a significant impact of gamification with badges on these outcomes. Consequently, if practitioners aim to enhance students' performance in a gamified online learning environment, caution should be exercised regarding the potential lack of effectiveness of these gamification tools.

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