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The effect of gamification on psychological needs for competence of undergraduate physical education students in a distance learning course

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Abstract
The purpose of this research was to investigate the impact of gamification using badges on the psychological needs for competence of online undergraduate students 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. At the end of this study, students participated in the data collection process by filling out the online perceived competence subscale of the intrinsic motivation inventory. An independent sample t-test analysis was performed to investigate whether online students who received badges would experience higher competence need satisfaction 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 psychological needs for competence among undergraduate students. Online students who utilized the training program with badges demonstrated comparable competence need satisfaction to online students who did not use badges. Conclusively, the findings suggest that badges might not necessarily contribute to an improvement in students' competence need satisfaction.

Keywords: Gamification, badges; psychological needs for competence; physical education; students; distance learning

Introduction

Understanding what motivates individuals to engage in games is crucial for comprehending how gamification tools can motivate learners. According to Ryan, Rigby & Przybylski (2006) [1] within the Self-Determination Theory (SDT) framework, intrinsic motivation is considered the primary motivation for play, sports, and computer games. People voluntarily play games due to the intrinsic satisfaction and enjoyable experience they provide. Several studies support the idea that games, by satisfying the needs for autonomy, competence, and relatedness, can intrinsically motivate individuals (Burgers, Eden, Van Engelenburg & Buningh, 2015 [2]; Peng, Lin, Pfeiffer & Winn, 2012) [3].

Competence, within this context, is defined as the feeling of mastery and effectiveness in interacting with the environment (Ryan & Deci, 2020 [4]; Vansteenkiste, Ryan & Soenens, 2020) [5]. Competence is influenced by factors such as positive informational feedback, optimal challenge, opportunities for skill growth, and expertise (Riley, 2016 [6]; Ryan & Deci, 2020 [4]; Vansteenkiste *et al*., 2020) [5]. Learners' competence tends to increase when they can monitor their progress and witness improvements during skill development. Conversely, factors like unclear guidelines, insufficient guidance, overly challenging tasks, and a perceived lack of usefulness can undermine the sense of competence (Xi & Hamari, 2019) [7].

As mention before, gamification tools, similar to games, have the potential to fulfill psychological needs, and studies suggest that autonomy and competence needs can be addressed through various gamification elements (Dichev & Dicheva, 2017 [8]; Mekler, Brühlmann, Tuch & Opwis, 2017) [9]. Elements such as points, badges, leaderboards, and customizable features can satisfy autonomy and competence needs (Peng *et al*., 2012 [3]; Sailer, Hense, Mayr & Mandl, 2017 [10]; Xi & Hamari, 2019) [7]. However, the effectiveness of gamification tools in fulfilling these needs in educational settings varies across studies.

Research in educational contexts has explored the impact of gamification on fulfilling psychological needs, especially autonomy and competence. Results have been mixed, with some studies showing positive effects on need fulfillment, while others report inconclusive or negligible results (Frost, Matta & MacIvor, 2015; Sailer *et al*., 2017 [10]; Mekler *et al*., 2017 [9]; van Roy & Zaman, 2018) [12]. For instance, gamification tools like badges, leaderboards, and levels had positive effects on competence need satisfaction but yielded mixed results for autonomy needs (Sailer *et al*., 2017). The findings from different studies underscore the importance of considering various factors such as motivation types, personalities, and contextual elements in the relationship between gamification, motivation, and need satisfaction (van Roy & Zaman, 2018; van Roy & Zaman, 2019) [13].

Given the inconclusive findings, this study aims to contribute additional evidence on the fulfillment of competence needs through gamification. The gamification tool, badges for competence was selected based on existing literature (Frost *et al*., 2015 [11]; Peng *et al*., 2012 [3]; Sailer *et al*., 2017 [10]; van Roy & Zaman, 2018 [12]; Xi & Hamari, 2019) [7]. Specifically, the purpose of this research was to investigate the impact of gamification using badges on the psychological needs for competence of online undergraduate students 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' psychological needs for competence?

Methods

Participants

This study involved 62 third-year students from the Department of Physical Education and Sport Science at Democritus University of Thrace. The participants, aged between 20 and 21 years old (M=20.5, SD=1.05), included 33 males (53.2%) and 29 females (46.8%). These students were enrolled in the 334–New Technology in Health course during the spring semester of 2021. They were randomly assigned to 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 assignments, participants received information about the study's purpose, their experimental group, the teaching method, and participation obligations. All students in the two classes were invited to participate, but the procedures differed for the two course delivery formats. Each student provided consent to participate, and they were informed that participation was voluntary and would not affect their grades.

Instruments

The participants' need for competence was assessed using the perceived competence subscale of the Intrinsic Motivation Inventory (Ryan, Mims & Koestner, 1983) [14]. This subscale consists of six items, and responses are recorded on a 7-point Likert scale ranging from 1 (Not at all true) to 7 (Very true). The subscale demonstrates good internal consistency, with a Cronbach's alpha of 0.80 (McAuley, Duncan & Tammen, 1989) [15].

Open eClass distance course

A concise distance learning framework utilizing a badges tool was implemented on Open eClass, an asynchronous learning management system. This condensed distance course included a welcome module, four learning modules, one survey module, and one final module for all participant groups. The welcome module was customized for each group, providing an overview of the study requirements and instructions on navigating the Open eClass system. Each of the four learning modules consisted of educational content and a quiz related to the content, and these modules were consistent across all participant groups.

Distinct course designs were created for each group within Open eClass, incorporating the badges gamification tool. In Open eClass, badges are digital images awarded upon reaching specific milestones in the system. Two groups were formed: the "badges" group, earning badges during the study, and the "no-badges" group (control group), which did not receive any badges. Various badge types were configured to correspond to different activities in Open eClass. While obtaining a badge is relatively straightforward initially, the difficulty increases as users progress in the system.

This study utilized four badge categories: learning badges, test badges, perfectionism badges, and survey badges. Learning badges were granted for completing modules, test badges for passing module tests, and perfectionism badges for achieving test scores of 90% or higher. Survey badges were awarded when participants completed the single survey administered throughout the study.

Procedure

During the spring semester of 2021, undergraduate students enrolled in the N334 – New Technology in Health course were invited to participate in the study. After obtaining their informed consent through Google Forms, participants were randomly assigned to either of the two study groups. Additionally, participants voluntarily enrolled themselves in the Open eClass platform.

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

Following the welcome module, participants progressed to Step 2, where they were required to complete the four learning modules. Each learning module included educational content and a quiz. Participants were instructed to read the provided content and then take the quiz. The quizzes, consisting of ten multiple-choice questions created by the researchers, required participants to answer at least seven questions correctly to pass. In case of failure, participants were allowed to retake the quizzes as many times as they wished. Successful completion of the learning content and the associated test deemed a learning module finished.

After finishing Step 2, participants progressed to subsequent steps. Step 3 involved the survey, where the psychological needs for competence survey was gathered. The final module, Step 4, conveyed to participants that they had concluded the study. Participants were expected to complete 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. Furthermore, 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 psychological needs for competence as the dependent variable. Independent samples t-test analysis was conducted to investigate the differences of psychological needs for competence 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 competence need satisfaction than online students in the no badges (control) group.

Results

The participants' need for competence was assessed using the perceived competence subscale of the Intrinsic Motivation Inventory (Ryan *et al*., 1983). To derive a composite score for each participant, the average of the items in the perceived competence subscale was calculated. The perceived competence subscale exhibited good internal consistency in this study, with a Cronbach's alpha of 0.86.

An independent samples t-test was employed to investigate the H01 hypothesis, which posited that online students receiving badges would demonstrate higher competence need satisfaction 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 psychological needs for competence among undergraduate students, $t_{(60)} = 0.384$, $p = 0.703$. Online students who participated in the training program with badges (M = 4.47, SD = 0.897) exhibited competence need satisfaction similar to that of online students who did not use badges (M = 4.38, SD = 0.853). Consequently, the utilization of badges in distance learning courses did not influence the psychological needs for competence 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 competence need satisfaction for the badges and no badges groups.

Variable	Badges (n=32)		No Badges (n=30)			
	M	S.D.	M	S.D.	t	p
Psychological needs for competence	4.47	.897	4.38	.853	.384	.703

Based on the results, the H01 hypothesis proposing that online students receiving badges would experience higher competence need satisfaction 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 competence need satisfaction from their involvement in the distance learning course compared to their counterparts who did not receive badges (Figure 1).

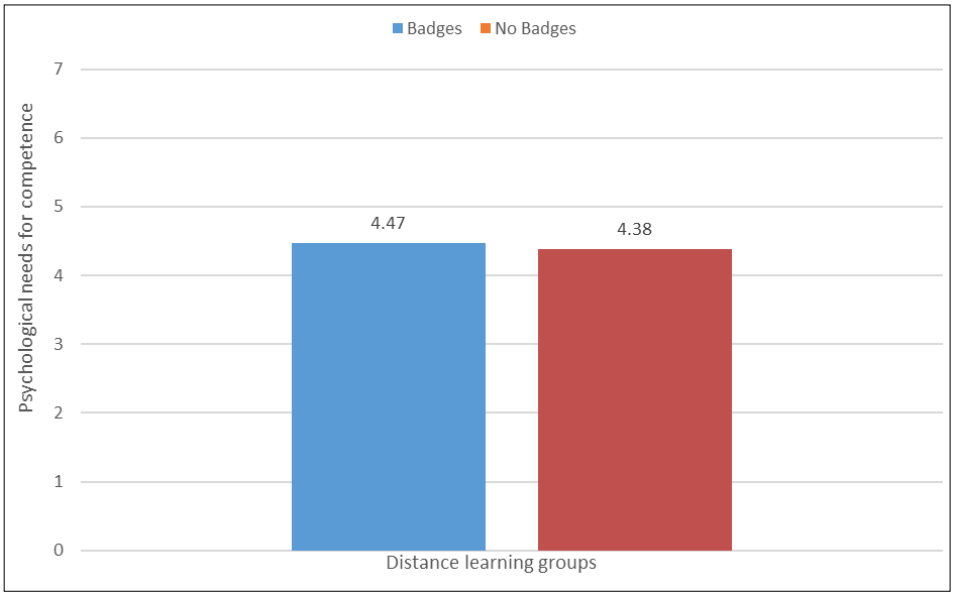

Fig 1: Mean scores of the distance learning groups (badges, no badges) in psychological needs for competence.

Discussion

The central research question of this study aimed to investigate whether badges could fulfill the psychological need for competence among online students. The initial hypothesis suggested that receiving badges would significantly satisfy students' competence needs compared to the no-badges condition. However, the collected data did not support this hypothesis, indicating that badges did not have a significant impact on increasing the need for competence among online learners. This lack of a significant effect of badges on competence need satisfaction aligns with findings from other studies, including those by Frost *et al*. (2015) [11], Hazan *et al*. (2018) [16], Mekler *et al*. (2017) [9], and van Roy & Zaman (2018) [12].

The need for competence, defined as the feeling of mastery and effectiveness in interacting with one's environment (Ryan & Deci, 2020 [4]; Vansteenkiste *et al*., 2020) [5], can be satisfied through inherently satisfying motivators or internalized extrinsic motivators that align with the need for competence (Deci & Ryan, 2015). Previous literature indicates that this need is fulfilled through various means, such as receiving positive informational feedback, engaging in optimal challenges, and having opportunities for skill development and expertise (Riley, 2016 [6]; Ryan & Deci, 2020; Vansteenkiste *et al*., 2020) [5]. Considering that badges are designed to acknowledge users' achievements (Da Rocha Seixas, Gomes & De Melo Filho, 2016) [18], it was hypothesized that they could offer positive feedback to learners regarding their performance and mastery levels, thus fulfilling their need for competence (McDaniel & Fanfarelli, 2015 [19]; van Roy & Zaman, 2017) [20]. However, the lack of competence fulfillment observed with badges in this study may be attributed to their inadequacy in providing meaningful positive feedback to learners regarding their performance and mastery while navigating the learning modules and completing quizzes in the Open eClass platform.

Several factors may contribute to the observed lack of effectiveness of badges in fulfilling the need for competence among learners. Firstly, badges may not have induced a sense of improved skills or expertise among participants, failing to satisfy their competence needs in the context of the created content of the short online course (Riley, 2016 [6]; Ryan & Deci, 2020; Vansteenkiste *et al*., 2020) [5].

Additionally, the lack of internalization of badges as external rewards could be a contributing factor. According

to Self-Determination Theory (SDT), extrinsic motivators need to be internalized to enhance intrinsic motivation by appealing to basic psychological needs (Deci & Ryan, 2015) [17]. If this internalization process fails, motivation remains purely extrinsic (Buckley & Doyle, 2016 [21]; van Roy & Zaman, 2018). In this case, badges may have been perceived by participants as controlling external rewards, potentially undermining the autonomous form of motivation and failing to fulfill the need for competence (van Roy & Zaman, 2018) [12].

It's worth noting that while some studies have reported that badges fulfill the competence needs of individuals (Peng *et al*., 2012 [3]; Sailer *et al*., 2017) [10], the contradictory result in this study may be attributed to differences in study design. To gain a comprehensive understanding of the impact of badges on the need for competence, further research is warranted.

Limitations

The study has several limitations that should be acknowledged. Firstly, the use of a short online course within a gamified learning management system (Open eClass) may not fully replicate the experience of an actual semester-long distance course. The distance course in Open eClass was designed as a simulation, lacking critical components of a real online course, such as the presence of an instructor or peers. The absence of these essential elements and the short duration of the course may compromise the authenticity of the online learning experience for participants, potentially impacting the study's validity (Dichev & Dicheva, 2017 [8]; Seaborn & Fels, 2015) [22].

This lack of a genuine distance course experience could influence online learners' competence need satisfaction, as participants may not have approached the distance course with the same level of seriousness or commitment as they would in a real educational setting. Moreover, the effects of badges might not have been fully realized within the short duration of the distance course (Hamari, 2017 [23]; Seaborn & Fels, 2015) [22]. To address these limitations, future studies could consider employing an actual online course setting and investigating the impact of badges on competence need satisfaction over a more extended period.

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