International Journal of Serious Games

ISSN: 2384-8766
https://journal.seriousgamessociety.org/

Article

Leaderboards or badges in two gamified forums: motivational and engagement differences

Joel Manuel Prieto-Andreu[1] and Pablo Moreno-Ger[1]

[1]*Faculty of Education, Universidad Internacional de La Rioja, Logroño, Spain*
{Joel Manuel Prieto-Andreu} joelmanuel.prieto@unir.net ; {Pablo Moreno-Ger} pablo.moreno@unir.net

Keywords:

Gamification
Motivation
Badges
Leaderboards

Received: June 2025
Accepted: January 2026
Published: January 2026
DOI: 10.17083/f1c2r712

Abstract

This study investigates the isolated effects of two common gamification mechanics—badges and leaderboards—on student motivation and engagement in online forums, addressing a research gap where they are typically studied in combination. Using a quasi-experimental design with 42 master's students divided into a Group With Badges (GWB) and a Group With Leaderboards (GWL), the research assessed motivation and player profiles. The findings indicate that the GWL demonstrated significantly higher introjected regulation and relatedness, indicating that leaderboards foster a more competitive and social environment that helps sustain engagement over time, whereas badges boost initial participation that later declines. The study's originality lies in its direct, isolated comparison, advancing beyond prior research on combined mechanics. Its practical impact is to provide clear guidance for designing gamified learning: badges are effective for short-term activities, while leaderboards are better suited for maintaining participation and social connection in longer-term experiences.

1. Introduction

In gamified instructional designs, several combined gamification mechanics are often included, being tested simultaneously and without taking into account that each of them can vary in effectiveness.

In the context of higher education, Hamari et al. [1] found that gamification elements like badges and leaderboards can have varying effects on student motivation, depending on the specific learning environment. Similarly, Sailer & Sailer [2] demonstrated that the design of gamification mechanics significantly influences the types of motivation fostered in students, with leaderboards encouraging competitive behaviors while badges support social recognition.

Recent research highlights the mixed outcomes of gamification elements on student engagement and performance. Studies such as those by Foon & Ki [3] and Zhou et al. [4] have demonstrated that leaderboards can foster competition and motivation, while Balci et al. [5]

identified the importance of badge design in driving initial student engagement. This study aims to build on these findings by isolating the effects of badges and leaderboards in a gamified forum setting. The PBL (Points, Badges and Leaderboards) mechanics are characterized by invariable elements, not interpretable and not understandable in different ways [6]. The sum of points establishes a ranking, which is reflected, in turn, in a classification table, with the badges being attractive visual elements that indicate certain achievements as a team or individually [7].

The use of badges (digital badges or credentials) and leaderboards (digital rankings) are the most widely used gamification elements. However, findings on the effectiveness of badges and leaderboards are mixed [8]. In this sense, Glover [9] suggests further research to determine the effectiveness of digital badges as evidence of achievement or to encourage participation in informal and co-curricular learning activities. The study by Park, & Kim [10] contributed to solving the problems associated with the design of classification tables applied in gamified educational environments, highlighting 3 principles in its preparation: 1. The classification tables must be designed both at macro and micro; 2. Integrate each measurable element in the Gamified Learning Environment with a Micro Leaderboard; 3. Leaderboards should incorporate different elements of learning. On the other hand, Abramovich et al. [11] considered two different models of educational badge types: merit badges and video game achievement badges.

When digital discussion forums are used in educational contexts, debates on issues of a transversal nature can be generated, not only between students and teachers, but also among students. This tool implies a collaborative work methodology in an enriching way, with the teacher acting as a support and guide for the debate that is generated. The teacher can also serve as a dynamizing agent through the management of different gamification mechanics in the forums. For this, the instructor should wonder which mechanisms would have a higher impact to encourage participation and improve student motivation.

This study is grounded in Self-Determination Theory (SDT) [12], which posits that motivation is influenced by the satisfaction of three basic psychological needs: autonomy, competence, and relatedness. Regarding global motivation, intrinsic motivation is the highest degree of self-determination and refers to participating in activities for the satisfaction and pleasure that is obtained from doing them, distinguishing 3 types based on the Hierarchical Model of Intrinsic and Extrinsic Motivation (MJMIE). [13]: knowledge (commitment generated by the satisfaction experienced when understanding or learning something new), achievement (commitment to an activity due to the satisfaction experienced while the subject tries to improve himself), and stimulation (when the subject commits in an activity to experience pleasurable sensations associated with their own senses). On the other hand, extrinsic motivation is a multidimensional construct where different 4 types of motivation are distinguished, which are, from the lowest to the highest level of self-determination, external regulation (more controlled and less autonomous behavior), introjected regulation (behaviors internalized but not accepted as part of oneself), identified regulation (autonomous behaviors freely chosen for external benefits and not for the satisfaction inherent in the task itself) and integrated regulation (more autonomous and coherent behavior between behavior and the needs of the I). On the other hand, amotivation is understood as the absence of motivation, intrinsic or extrinsic [14].

Prieto [15] indicated that the educators must understand the negative and positive effects of gamification mechanics in curriculum design and consider player profiles. This study also seeks to understand the profiles of students in both gamified experiences. Classifying player types helps us gain insights into their behaviors and motivations, which are crucial for designing effective gamification strategies. To operationalize these motivational dimensions [12] in a gamified educational context, we adopted the Gamertype scale [16], a player typology specifically validated for learning environments. This framework classifies students into three

profiles aligned with SDT: The 3 main profiles are related to the suits and figures of the Spanish deck, the dominators are kings (oriented towards competition and achievement, eager to achieve their goals and to have an impact on others), the interactors are jacks (oriented to socialize and relationships, prefer group work with fairness and cooperativeness) and trackers are horses (rewards and autonomy oriented, eager to explore and get rewards and to have an impact on the gamified system elaborated). This integration allows us to hypothesize how badges and leaderboards may differentially resonate with each profile by addressing their distinct motivational needs. Our decision to employ the Gamertype scale by Prieto & Moreno-Ger [16] was based on its specific design and validation for educational contexts and not in video game environments. The Gamertype scale is conceptually grounded in the dynamics of learning environments, focusing on orientations directly relevant to educational gamification, such as reward-seeking, competition, and social collaboration within a classroom or online forum.

While the use of combined gamification elements has been extensively studied [9,10], limited research has focused on the isolated effects of specific mechanics such as badges and leaderboards. This study addresses this gap by comparing the motivational outcomes of these two widely used but separately applied gamification tools in a higher education setting. By isolating their effects, our research offers a clearer understanding of how each mechanic influences student motivation and participation, thus contributing to the ongoing debate on best practices in gamified educational environments The main objective is to compare the impact of the use of badges in the Group With Badges (GWB) and the use of classification tables in the Group with Classification Tables (GWL) on the motivation and participation of students in two digital forums on transversality, as well as knowing the type of player in each gamified experience. Our hypotheses are grounded in the Self-Determination Theory [12], which highlights the role of autonomy, competence, and relatedness in fostering intrinsic and extrinsic motivation. The use of badges and leaderboards is expected to influence these motivational factors differently, as prior studies suggest mixed effects of gamification elements on student engagement [7,8]. Based on these theoretical foundations, we hypothesize that students exposed to leaderboards will exhibit higher introjected regulation, while badges will more strongly support initial engagement through external regulation.

The primary objective of this study is to assess the differential impact of badges and leaderboards on student motivation and participation in a gamified forum. Secondary objectives include exploring the types of player profiles that emerge in each group and their corresponding motivations in relation to the specific gamification mechanics employed. The following secondary Objectives and Hypotheses are proposed:

- O1-Check the effectiveness of leaderboards and badges on student motivation and performance.
- H1-In the GWL there will be greater motivation than in the GWB and there will be mixed results in terms of student performance. Based on Self-Determination Theory [12] and prior findings [10], leaderboards are hypothesized to foster higher introjected regulation by creating a competitive, socially comparative environment.
- O2-Determine the motivations of the students in both gamified experiences.
- H2-The motivations of the students will be oriented towards competition and relationships in the GWB, and autonomy in the experiences in the GWL. It is hypothesized that leaderboards, by making performance public, will emphasize competition and relatedness, while badges, as individual achievements, are expected to support more autonomous motivation [7, 12].
- O3-Know the type of player profile in both gamified experiences and its relationship with their motivations

- H3-The profile of the players oriented to the acquisition of badges will be that of "tracker", being the most autonomous and oriented towards achievement together with the dominators. Grounded in the validated Gamertype scale [16], the "Tracker" profile, characterized by reward-seeking, is hypothesized to be more attracted to the badge mechanic which directly satisfies this orientation.
- O4- Determine student participation in both gamified experiences (quantifiable count of student interventions with posts and replies).
- H4-Participation will be greater in the GWL. Drawing on studies like Foon & Ki [22], badges are expected to boost initial participation as novel rewards, while leaderboards are hypothesized to sustain engagement longer through ongoing social competition.

2. Methods and Material

2.1 Design

This study follows a quasi-experimental design to compare the two groups. An exploratory-descriptive approach was additionally applied to the qualitative analysis of forum interactions, complementing the quantitative data. The Group With Badges (GWB) received digital badges as rewards for high-quality contributions, while the Group With Leaderboards (GWL) utilized a dynamic leaderboard to rank students based on participation. This separation of mechanics allows for a more precise analysis of the individual effects of badges and leaderboards, addressing the gap in existing research where multiple mechanics are often combined without isolating their impacts. The use of two mechanics (badges and leaderboards) is addressed in two forums of the same course, although with different students. This study follows an exploratory-descriptive approach, using data analysis to identify and describe trends in student behavior within the gamified forum [17].

The discussion forum is designed so that the students could systematize their narratives, reflections and conclusions, the processing of this information being carried out through the content analysis method, which has its origins in the "grounded theory" [18], consisting of the generation of ideas from the collected data and which constitutes the basis of qualitative analysis [19].

The methodology used in this research consisted of three phases: planning, educational intervention and evaluation. In the first phase, the design of the pedagogical strategy was carried out according to the content of the course, considering Heraclie's story and the 6 questions on transversality in values that were formulated during the 3-week duration of the activity. In the second phase, the activity began with the story of Heraclie, putting the pedagogical proposal into practice, carrying out the educational intervention in two groups of the same subject, a Group With Badges (GWB) and another Group With Leaderboards (GWL). In the third phase, an evaluation of the participation and motivation of the students was carried out. Figure 1 presents a diagram summarizing the three phases of the proposed methodology.

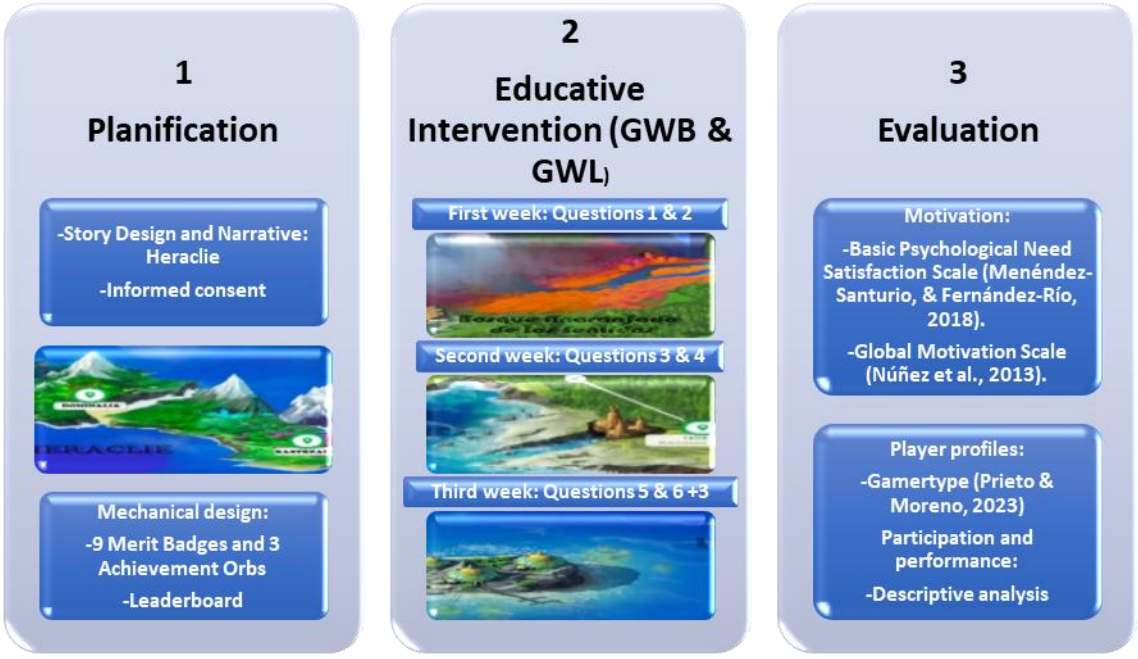

Figure 1. Phases of educational intervention

With this methodology, students were motivated to participate in the forum and carefully review the support material. On the other hand, the teacher acted as a supervisor, supporting students and providing feedback throughout the two gamified forums. This role also involved encouraging students to carefully review the material to improve their performance.

Regarding the design of learning strategies based on the implementation of two different gamification mechanics, in the GWL the use of the forum was combined with viewing the leaderboard stored in google docs, with rankings updated twice a week, and In the GWB, the best interventions were awarded with medals/distinctives, elaborated through the page makebadg.es (figure 2), and were displayed directly within the forum.

Figure 2. Badges awarded to the student body during Heraclie's story

Regarding the scoring system in the forum, both groups were provided with a rubric with the scoring system broken down into 4 levels of achievement for participation (30%), content (40%), interaction (20%) and writing (10%), explaining what they had to achieve to get the maximum score in each of the 4 evaluable aspects. Participation points were awarded for more than four relevant interventions; content scores were based on the interventions being well-founded, original and related to the theme of the forum; interaction points were awarded for relevant and pertinent replies to content from other students, generating constructive discussions and displaying collaborative word; and writing scored were based on wording, format and citations (academic style and language, complying with APA 7th ed. regulations).

2.2 Sample

The sample is made up of university students of a Master's Degree in Primary Education, with an initial sample of 71 students selected through intentional or deliberate sampling (37 men and 34 women). Since course cohorts are organized in groups based on the date when the students registered, these groups were used to separate the students: GWB (Group With Badges, made up of 13 women and 9 men); and GWL (Group With Classification Tables, made up of 21 women and 28 men).

Therefore, both groups are composed of students enrolled in the same course, taught by the same teacher, working on the same transversal contents and with the same lecture contents. As an inclusion criterion, those students enrolled in the subject who would like to collaborate with the completion of the list of questionnaires will be taken into account, voluntarily, since the same evaluation rubric set by the department will continue to be applied in the forum.

Given the nature of the study, participation in the forum was part of the continuous assessment of the subject, detailing to the students the non-compulsory nature of their participation in the study by answering all the questions or completing the questionnaires. Their actual grade was not related to their participation in the study whatsoever. The study was approved by the ethics committee of the university

After completing the study, the sample was reduced to 42 subjects (20 women and 22 men), given that 11 participants did not engage with the activity and 18 did participate but did not send the completed questionnaires. Figure 3 shows the flow diagram of the sample selection process.

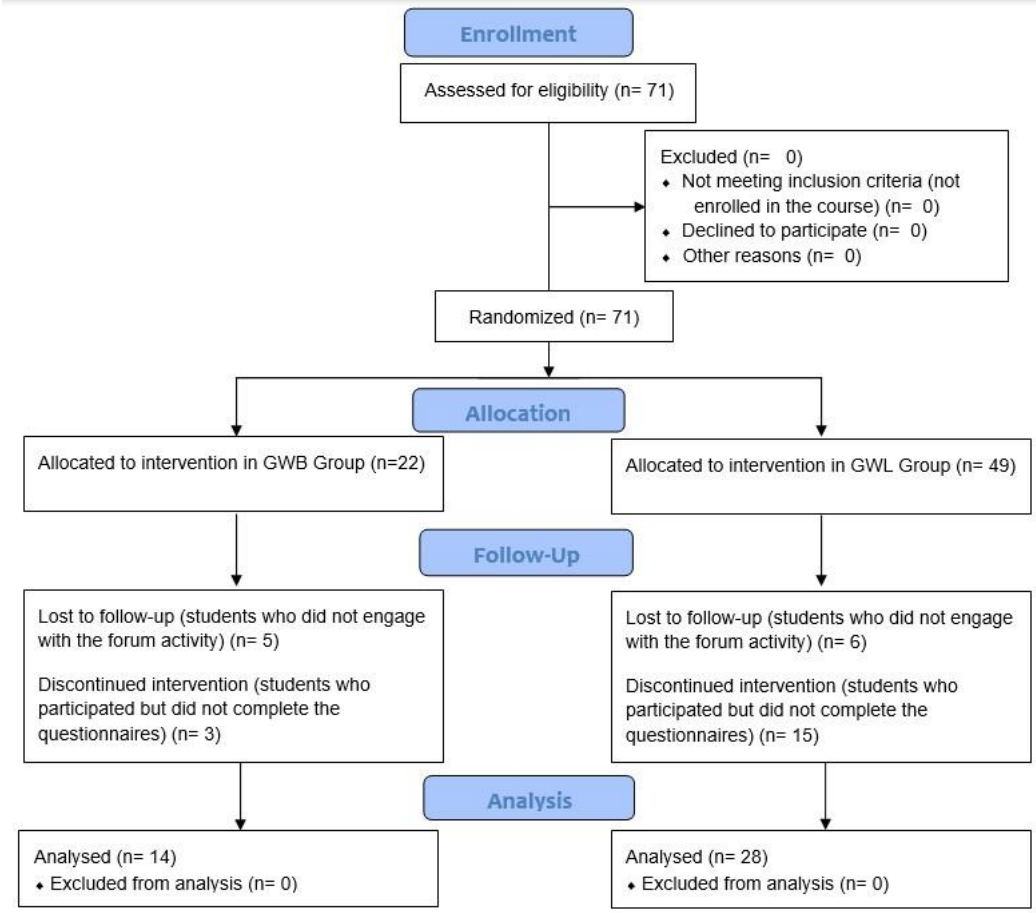

Figure 3. Participant Flow Diagram (CONSORT)

2.3 Procedure

The course utilized a gamified discussion forum over three weeks to explore content related to expressive artistic physical activities. The scenario was set on the planet Heraclie, where students, embodying one of three hero races (dominators, trackers, interactors), worked to restore stolen values by answering weekly questions. A defined time limit was set to maintain engagement and focus. The same subject was taught in the same semester with different students and in both experiences the same dynamic was followed, although certain gamification mechanics were used in both subjects, badges in the Group With Badges (GWB), and classification tables in the Group With Classification Tables (GWL).

In order for the students to identify the scenario in which gamification was applied, the forum began with the presentation of a short video. The teacher explained the dynamics and mechanics with which the students interacted during the 3-week forum. To encourage participation in the forum, the GWB rewarded the best participations in terms of content, interaction and number of interventions, awarding students with different badges depending on the student's contribution (figure 2); in the GWL, the students who participated the most were awarded a space in the forum's classification table, following the principles of Park, & Kim [10].

In both groups, throughout the forum, questions of intervention were raised to form a community of dialogue in which the best contributions were rewarded with the obtaining of "orbs", valuable objects within the history of Heraclie, having in the GWL, In addition to the classification table according to the number of interventions, another classification table with the students who accumulated the most orbs. On the other hand, in the GWB, the students who got the orbs were awarded badges. Both the badges in the GWB and the leaderboard (ranking)

in the GWL were fully visible to all participants within their respective forums. During the entire 3-week intervention process of the forum, 6 questions were raised that controlled the interventions in order to maintain a discursive unit in accordance with the Heraclie story.

First week:

- (1) How would you work on values education in an interdisciplinary way?
- (2) Between the methodology by projects and the fantasy spaces, through which methodology would you work the theater or the stories? Which one do you consider the most appropriate and why?

Second week:

- (3) What do you think is the best way to foster a prosocial climate in the classroom?
- (4) Do you think that education today uses this transversality? Do you see it necessary? Because?

Third week:

- (5) Do you consider educating in positive values applying natural consequences or punishments to negative behaviors?
- (6) Share some strategy to get our students to comply with some rules, giving them a reward so as not to reach punishment by repressing the movement.

Once the activity was over, the teacher provided the students with a link to the list of questionnaires that they had to complete to assess the profiles of the players, their overall motivation and their basic psychological needs, to later collect the information and record in the data matrix.

2.4 Instruments

From the forum and in the presentation class of the subject, the procedure that was carried out was explained to them, requesting the disinterested and voluntary collaboration of the students to carry out the list of the following questionnaires:

- Basic Psychological Need Satisfaction Scale [20] for the achievement of objectives 1 & 2 to determine the effectiveness of leaderboards and badges on student motivation in both gamified experiences. It allows knowing in a general way the basic motivations of a user with respect to 3 needs: competence, autonomy and relationships. It was provided at the end of the educational intervention. The three dimensions of the scale exceeded the minimum reliability values through the Composite Reliability Coefficient (CFC): autonomy 0.85, competence 0.93 and relationship 0.84. In this study, a Cronbach's alpha of 0.30 was obtained in autonomy, 0.94 in competence, and 0.90 in the relationship construct.
- Global Motivation Scale [21] for the achievement of objectives 1 & 2 to determine the effectiveness of leaderboards and badges on student motivation in both gamified experiences. It allows to evaluate the global motivation in university students. It is constituted by 3 types of intrinsic motivation: knowledge, achievement and stimulation; and by 3 types of extrinsic motivation: external regulation, introjected regulation and identified regulation, omitting the integrated regulation indicated by the literature. This scale also measured a seventh construct, amotivation. It was provided at the end of the educational intervention. The values obtained by the authors regarding the internal consistency of the scale evaluated through Cronbach's alpha were between .70 for the intrinsic motivation subscale towards achievement, and 0.90 for the intrinsic motivation subscale towards knowledge. In this study, a

Cronbach's alpha of 0.86 was obtained for the entire scale, and 0.77 for the introjected regulation construct, specifically.

- Gamertype [16] for the achievement of objective 3 to know the type of player profile in both gamified experiences and its relationship with their motivations. It was provided before the start of the forum and just after filling in the final form. The author obtained a Cronbach's alpha of 0.73 for the Dominator (D) component, 0.71 for the Tracker (T) component, and 0.73 for the Interactor (I) component, obtaining a Cronbach's alpha of 0.82 for the entire 30-item scale. In this study, 0.73 was obtained in the pretest and 0.67 in the posttest, for the entire scale. On the D scale of 0.62 in the pre and 0.61 in the post; on the T scale of 0.59 in the pre and 0.54 in the post; and on the I scale of 0.68 in the pre and 0.64 in the post.

The completion of the list of questionnaires was carried out through an online platform (Google Forms). The URL was included in the forum to carry out the online questionnaire. Each participant voluntarily generated a personal ID through a series of questions whose answers are impossible to know by the researchers presenting an invariable algorithm: 1: Initial of the name (only of the first name if there is more than one) of the maternal grandfather; 2: Initial of the name (only of the first name if there is more than one) of the maternal grandmother; 3: Your mother's birthday day; 4: Your father's birthday.

2.5 Statistic analysis

To carry out statistical calculations, the statistical package IBM SPSS Statistics in its version 25.0 was used. To examine the relationships between motivational constructs and participation, we employed the Pearson Correlation Coefficient for continuous parametric variables. Additionally, a linear regression model was applied to predict the variance in student motivation based on the gamification mechanics (badges vs. leaderboards). This approach allowed us to identify significant predictors such as introjected regulation and external regulation, which were instrumental in understanding the motivational profiles of the participants. In addition to the previously mentioned statistical methods, we applied a chi-square test to compare the distribution of player profiles (dominators, trackers, interactors) between the two groups. The chi-square test is appropriate for this comparison as it assesses the significance of differences in categorical data. The results showed no statistically significant differences between the two groups ($p > 0.05$).

3. Results

The results are presented following the order of the objectives proposed in the study: Effectiveness of leaderboards and badges on student motivation; Motivations of the students in both gamified experiences; Profile of the players; & Student participation in both gamified experiences

3.1 Effectiveness of leaderboards and badges on student motivation

Following the first objective proposed in the study, it was intended to verify the effectiveness of the classification tables and badges in the motivation and performance of the students, maintaining the hypothesis that in the GWL there would be greater motivation than in the GWB and that there would be mixed results in terms of student performance. The results based on the Global Motivation Scale [21] regarding the performance based on the classification and the

total number of interventions, as well as on the quality of the content and the replicas carried out, did not provide significant differences in both groups.

On the other hand, as can be seen in Table 1, the GWL had less amotivation than the GWB (8.64/9.00, p<.005), not confirming the hypothesis, although the results were not significant. On the other hand, there was a significant relationship with the "introjected regulation", being higher in the GWL (11.08/9.47, p<.005) and there was a significant relationship with "relationship", being higher in the GWL (16,80/10,76).

Table 1. Basic motivations and global motivation in both gamified experiences

	Achievement	Knowledge	Stimulation	Identified R.	Introjected R.	External R.	Amotivation	Autonomy	Competence	Relationship
GWL	12,12	12,48	11,60	12,68	11,08	8,52	8,64	16,68	17,92	16,80
GWB	12,35	12,53	11,06	12,47	9,47	8,35	9,00	17,47	15,00	10,76

Applying the Student T-test for independent samples, the variables with significant differences were "Introjected_Reg" (p=0.009) and "Relationship" (p=0.004) showing significant differences between the groups.

On the one hand, in the Levene test of the relationship variable (F = 0.230, p = 0.634), equal variances are assumed (p>0.05). The t test is: t=3.063, gl=40, p=0.004, the difference in means is 6.03529, so there is a significant difference in "Relationship" between the groups (p<0.05), with a difference of 6.03529.

On the other hand, in the Levene Test of the variable Reg:Introjected (F = 4.350, p = 0.043), the value p < 0.05 indicates that the variances are not equal, so the results of the row "Equal variances are not assumed" are used. The t Test is: t = 2.735, gl = 37.686, p = 0.009, the difference in means is 1.60941, so there is a significant difference in "Reg_Introjected" between the groups (p < 0.05), this difference being 1.60941.

The variables without significant differences were "MI_Achievement", "MI_Knowledge", "MI_Exp", "Reg_Identified", "Reg_External", "Amotivation", "Autonomy", and "Competence" do not present significant differences (p > 0.05). In significant cases, the magnitude of the difference can be interpreted from the "Difference in means" shown in Table 1, and the confidence intervals give us an idea of the possible variability of that difference.

3.2 Motivations of the students in both gamified experiences

The second objective that was proposed was to determine the motivations of the students in both gamified experiences, following the hypothesis that the motivations of the students would be oriented towards competition and relationships in the GWB, and to autonomy in the experiences in the GWL. Following Table 1, only significant relationships with the relationship construct stand out, being higher in the GWL compared to the GWB (16.80/10.76, p<.005), not confirming the hypothesis.

On the other hand, Table 2 shows a linear regression, where the use of classification tables (GWL) or badges (GWB) is related, as a dependent variable, with basic motivations and global motivation, as well as with player profiles. The data in Table 2 indicate that the variables that contribute the most to the variance (76.3%) are: Introjected_Reg, External_Reg, amotivation, autonomy, competence, relationship, Interactor_POST, Tracker_POST and Dominator_POST. While alternative statistical models were considered, we retained the linear regression analysis due to its predictive power in identifying key factors such as introjected and external regulation. This model explained a substantial portion of the variance (76.3%) in motivational outcomes

and provided valuable insights into the relationship between gamification mechanics and student engagement. Besides, 38.8% of the variance can be predicted by all the factors indicated in Table 2. The combination of these variables significantly predicts the motivational profile of the subjects who participate in GWB and GWL ($F(3.002)=10.11$, $p<.001$). The model ($y=a+\beta x$) whose dependent variable (y) is membership of the GWB or GWL, has a constant (a) of 5.89, with the coefficient (β) indicated in table 2 for each factor.

Table 2. Linear regression for the use of leaderboards (GWL) or badges (GWB)

Step	Predictor variables	□	p	□R^2	p
1	**Motivations & profiles**				
	Achievement	-2,004	1,286		
	Knowledge	,029	,114		
	Stimulation	,040	,073		
	Identified R.	,029	,072		
	Introjected R.	-,044	,052		
	External R.	-,068	,042		
	Amotivation	-,072	,040		
	Autonomy	-,044	,048		
	Competence	,037	,038		
	Relationship	-,008	,017		
	Interactor profile	-,044	,015		
	Tracker profile	,045	,032		
	Dominator profile	,020	,044		
				76.3%	<,001
			R^2	58.2%	<,001
			$R^2_{adj.}$	38.8%	<,001

Table 1 shows how the relationship construct was higher in the GWL compared to the GWB (16.80/10.76, $p<.005$), as can be seen in Table 2 (β=-0,008, p=,017); able 1 also shows a significant relationship with the introjected regulation, being higher in the GWL (11.08/9.47, $p<.005$). This trend towards significance can be seen in Table 2 (β=-0,044, p=,052).

On the other hand, it can be seen that a lower external regulation (β=-0,068, p=,042), a lower amotivation (β=-0,072, p=,040), a lower relationship (β=-0,008, p=,017), and lower autonomy (β=-0,044, p=,048) influences the use of badges or leaderboards. In a different way, greater competition influences the use of badges or leaderboards (β=0,037, p=,038).

In summary, following the results of tables 1 and 2, the subjects who followed a gamified experience based on the mechanics of classification tables had a higher Introjected_Reg (11.08/9.47), External_Reg (8.52/8.35), competence (17.92/15.00) and relationship (16.80/10.76), although lower motivation (8.64/9.00) than the subjects who went through a gamified experience based on badges. The use of leaderboards or badges had no significant relationship with the intrinsic motivation of achievement, knowledge and stimulation, nor with the regulation identified.

3.3 Profile of the players

The third objective that was established was to know the type of player profile in both gamified experiences and its relationship with their motivations, hypothesizing that the profile of players oriented towards the acquisition of badges would be that of "tracker", being the most

autonomous and Achievement oriented along with dominators. Continuing with the results of the present study, the GWB obtained a higher mean compared to the GWL in the tracker profile both in the pre and posttest of the gamertype (30.17/29.22), confirming the hypothesis, as can be seen in the Table 3. On the other hand, the GWB are more dominant (23.26/21.86), although less interacting than those of the GWL (27.91/28.36).

Table 3. Player profiles in both groups.

	Dominator	Tracker	Interactor
GWL	21,86	29,22	28,36
GWB	23,26	30,17	27,91

To better compare the percentages between the groups, we conducted a chi-square test (Table 4), which is more appropriate for categorical data. The chi-square test results indicated that there was no significant difference between the player profiles of the groups GWL and GWB ($p = 0.217$). For the player profiles there are significant differences ($p < 0.05$), which indicate that the frequency distributions are not random and there is some relationship between the categories, which indicates that there is a statistically significant difference between the observed and expected categories in these variables. These findings suggest that while some trends were observed, such as a higher proportion of tracker profiles in the Group With Badges (GWB), the differences are not statistically significant.

Table 4. Chi Square for player profiles and the groups GWL and GWB

Group	Chi-square	df	Asymptotic significance (p)
Group (GWL/GWB)	1,524	1	0,217
Interactuador_PRECAT	38,714	2	0,000
Interactuador_POSTCAT	48,143	2	0,000
Rastreador_PRECAT	27,429	2	0,000
Rastreador_POSTCAT	39,571	2	0,000
Dominador_PRECAT	89,429	3	0,000
Dominador_POSTCAT	43,000	2	0,000

N. Chi-square: Value of the chi-square statistic calculated for each group. df: Degrees of freedom corresponding to the number of categories minus one. Asymptotic significance (p): The corresponding p value, which indicates whether the difference between the observed and expected frequencies is statistically significant (usually $p < 0.05$).

Following table 2, it can be seen that a lower profile of interactor (β=-0,044, p=,015) and a higher profile of tracker (β=0,045, p=,032) and dominator (β=0,020, p=,044), influences the use of badges or leaderboards. Therefore, the subjects who followed a gamified experience based on leaderboard mechanics had an interacting profile (28.36/27.91), and those subjects who went through a gamified experience based on badges had a more tracker profile (30.17/29.22) and dominator profile (23.26/21.86).

On the other hand, Figure 3 shows the basic motivations, the global motivation and the profiles of the subjects who experienced both gamified forums, with classification tables (GWL) and with badges (GWB).

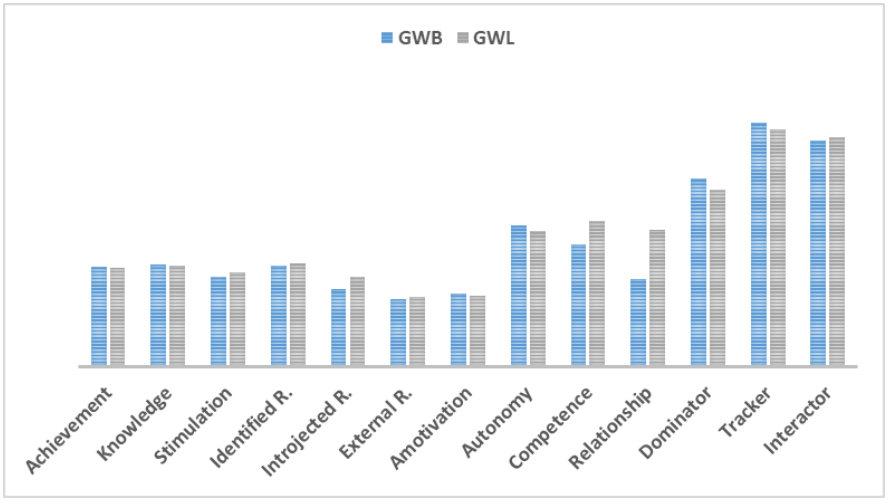

Figure 4. Global motivation, basic motivations and profiles in GWL and GWB

The results indicate that students in the Group With Badges (GWB) predominantly exhibited tracker profiles, characterized by a desire for rewards and exploration within the gamified system. In contrast, the Group With Leaderboards (GWL) showed a higher prevalence of interactor profiles, which align with a preference for group work and collaboration. These findings suggest that different gamification mechanics may attract and nurture distinct player types, influencing how students engage with the learning environment.

3.4 Student participation in both gamified experiences

The fourth objective was to determine the participation of the students in both gamified experiences, with the hypothesis that participation would be greater in the GWL. Figure 4 shows the participation of students in both forums, in the forum with classification tables (GWL) and in which badges were used (GWB).

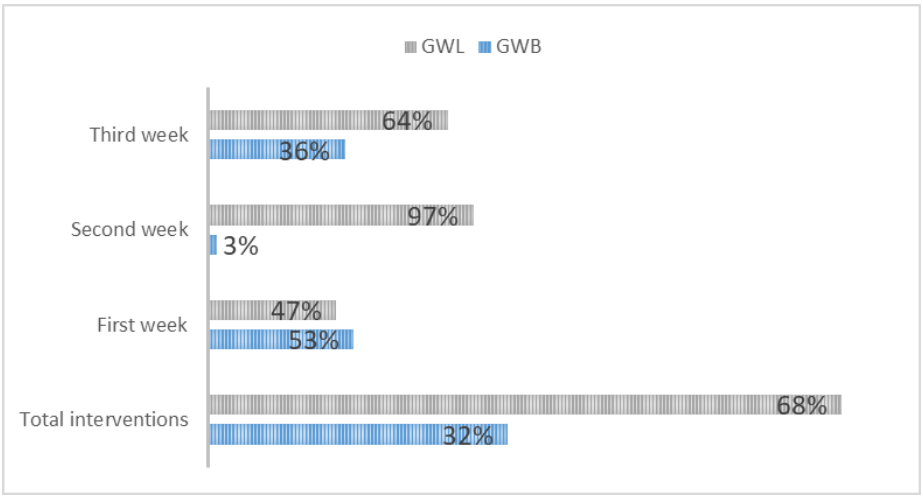

Figure 5. Regularity of participation in both forums

After analyzing Figure 4, it can be seen how the GWL students performed a greater number of interventions than the GWB students, confirming the hypothesis. Regarding the regularity of participation, it stands out how the GWB students hardly participated during the second week, concentrating their participation in a similar way during the first and last week.

Regarding the GWL, it participated to a lesser extent during the first week and subsequently in a balanced way during the last two weeks.

4. Discussion

Our findings align with recent studies, such as those by Park & Kim [10], which show that leaderboards can enhance introjected motivation by encouraging competition. However, our results also indicate that badges are more effective in fostering initial participation, supporting the findings of Hamari et al. [1], who highlighted the role of extrinsic rewards in early stages of gamified experiences.

Our results, which show higher introjected regulation in students exposed to leaderboards, are consistent with the findings of Foon & Ki [22], who reported similar trends in their study on competitive gamification mechanics. However, the lack of significant differences in overall performance aligns with the findings of Balci et al. [5], who also observed mixed results in the relationship between gamification elements and academic outcomes.

In this study, the objective was to compare the impact of the use of badges and classification tables on the motivation, participation and performance of students in a digital forum on transversality. Mekker et al. [23] discussed whether separate game mechanics could improve intrinsic motivation in higher education, with points, levels, and leaderboards, in particular. Following their results, the implementation of these mechanics significantly increased performance, but did not affect perceived autonomy, competence or intrinsic motivation, suggesting that these mechanics separately fail to improve users' intrinsic motivation in contexts that are not. of game.

Regarding the effect of gamification mechanics on motivation and academic performance, our results showing no significant performance differences, align with previous studies on isolated gamification elements (e.g., Balci et al. [5, 8]; Mekler et al. [23]), which also reported mixed outcomes on academic performance despite motivational shifts. On the other hand, Bräuer, & Mazarakis [24] investigated the effects of badges and leaderboards on student motivation and performance using an augmented reality repository, using HoloLens. The implementation of the leaderboard significantly increased performance, although both mechanics (boards and badges) generated mixed results on their influence on motivation. In the present study, the GWL obtained greater introjected regulation than the GWB, finding no significant differences regarding performance. On the other hand, a significant relationship with relationship construct is also highlighted, being greater in the GWL compared to the GWB.

The motivation in this type of learning was given by the need to inquire about the questions posed, stimulating the students intellectually, improving their ability to transmit personal opinions in a coherent, logical and reasonable manner. In this sense, the formative process of mere cognitive accumulation was transformed into one of generations of competences around the capacity for self-learning and creativity, this process being motivated both by the badges and by the classification tables. On the other hand, collaborative but also competitive work was evidenced in the GWL. The disadvantage of the competition is that failure or success depends mostly on the results of others, and on many occasions, they are the subject of comparisons.

Regarding the typology of badges, Abramovich et al. [11] considered two different models of educational badge types: merit badges and video game achievement badges. In Hakulinen et al. [25] evaluated the use of achievement badges in an online learning environment (TRAKLA2) where students solved exercises, being evaluated automatically, concluding that the qualification was the same for both groups (group with badges and control group), although In the group with badges, significant differences were observed regarding the time spent on each exercise and the total time, being higher in the group with badges, students

reporting being more motivated with achievement badges. In the present study, no significant relationships were found in any of the motivational constructs in the students who obtained the highest number of achievement badges (orbs).

In this study, it was proposed to know the influence of basic motivations and global motivation with the use of different mechanics in the GWL and GWB groups, although it has not been possible to compare them with the motivations of a Control Group (CG), since which was not the intention of the study, since most studies with CG observe that gamification mechanics increase student motivation [5,8,23]. In Dicheva et al. [26] This comprehensive review identifies and categorizes the use of game elements in education. In its analysis, it highlights that badges are primarily used for recognition and representation of achievements, while leaderboards are employed to foster competition. It points out that the effectiveness of each element critically depends on the context and implementation design, and that leaderboards can often be demotivating for students who rank in lower positions. Abramovich et al. [11] used badges within an intelligent tutor system for teaching mathematics in high school students, demonstrating that they improved student motivation, highlighting that the patterns of badge acquisition were different among students with different levels of prior knowledge, being motivated to obtain different types of badges. In this case, the badges probably acted as extrinsic motivators, having a negative influence on learning.

Other studies have looked at student perceptions of applying badges and leaderboards. In the study by Zhou et al. [4] compared students' opinions on the use of physical or virtual badges, finding that the badges encouraged them to actively participate in learning, although they felt that the digital badges were less satisfactory than the physical badges, concluding that the digital badges They are an effective mechanism to motivate students, and can be a more innovative and authentic element of instruction and evaluation in blended learning classrooms. Along the same lines, Glover [9] replaced the delivery of certificates of recognition on paper with badges made in open badges, comparing the impressions of the students with respect to previous paper certificates, resulting in university students seeing digital badges as a way to to promote their achievements.

On the other hand, Foon, & Ki [22] investigated the effects of badges and leaderboards on student participation in third grade mathematics, carrying out 3 experiments: 1. Checking the effects of badges and tables on participation, having the same effect both mechanics; 2. Check the effects of a classification table and a scoring system on participation, with the use of the table being more effective; 3. Compare the effects of digital badges with physical stickers, with those who received the digital badges being more motivated to participate and complete more challenges. In the present study, the GWL had more participation than the GWB, highlighting that the use of badges favors participation in a first contact, dissipating said participation during the course of the forum, while the use of classification tables during the course of the forum, although it does not improve participation at first, it favors participation to a greater extent with respect to the use of badges. Along the same line, in Garcia-Iruela & Hijón-Neira [27], although badges were also highly valued by students in longer experiences, in the shortest experience it was one of the worst valued elements.

Despite the limited sample size, our study revealed significant trends regarding the differential effects of badges and leaderboards on student motivation. These insights are crucial for shaping future research and practice, as they provide a foundation for more robust, large-scale studies. The trends observed here, particularly the increased introjected regulation in the Group With Leaderboards (GWL), offer promising avenues for further exploration in gamified educational environments.

This study contributes to the growing body of research on the nuanced effects of gamification in education. By isolating the use of badges and leaderboards, we provide new insights into how these mechanics independently influence student motivation. Our findings

build on recent studies by Sailer & Sailer [2] and Hamari et al. [1], confirming that the context in which gamification mechanics are applied plays a critical role in their effectiveness.

Furthermore, the superior performance of leaderboards in sustaining engagement may be partly attributed to the formal higher education setting itself. Leaderboards, which publicly display performance and rank, conceptually mirror the traditional grading and ranking systems that are deeply embedded in academic culture. Students' pre-existing perceptions of these hierarchical rewards likely made the leaderboard mechanic more immediately meaningful and motivating compared to badges, which represent a less conventional form of academic recognition.

4.1 Discussion of objectives and hypothesis

- O1-The GWL had greater introjected regulation than the GWB, not finding significant differences in both groups regarding performance. Introjected regulation is a type of extrinsic motivation that refers to behaviors that are internalized by the person and implies internalizing the regulation but not accepting it as part of oneself. The introjected regulation tends to show higher levels in those students who persist in their studies than in those who abandon them [21], the use of classification tables being relevant if it is intended that students persist in the didactic task. entrusted. There was a significant difference in introjected regulation (internal pressure-based motivation) between the two groups. Students who used leaderboards show higher levels of introjected regulation than those who used badges. This suggests that the leaderboard methodology might generate more internal pressure to comply, possibly due to the competitive nature of this approach.
- H1- The findings of this study partially support Hypothesis 1, which predicted higher motivation in the Group With Leaderboards (GWL) compared to the Group With Badges (GWB). Specifically, GWL participants exhibited significantly higher introjected regulation, which is consistent with previous research [10] that suggests leaderboards can enhance motivation by fostering a sense of competition. However, no significant differences were found in overall performance, aligning with the results of Balci et al. [5], who also reported mixed outcomes regarding the impact of leaderboards on academic performance.
- O2-Subjects who followed a gamified experience based on leaderboard mechanics had higher Introjected_Reg, External_Reg, competence and relatedness, although less amotivation than subjects who went through a badge-based gamified experience. A significant relationship with the relationship construct stands out, being greater in the GWL compared to the GWB. The relationship refers to the feeling that one has of belonging to a certain social environment, this feeling being greater if classification tables are used instead of badges, facilitating intrinsic motivation, since as indicated by Menéndez-Santurio, & Fernández- Río [20] the satisfaction of this basic psychological need is related to positive variables such as subjective vitality. There was a significant difference in relatedness (feeling of social connection) between the two groups. Students who used leaderboards report higher levels of relatedness than those who used badges. This may be because leaderboards generate a more competitive and socially interactive environment, reinforcing social connections between students.
- H2-Hypothesis 2, which suggested that students in the GWL would be more autonomy-driven while those in the GWB would prioritize relationships and competition, was not fully supported. Although GWL participants demonstrated higher introjected regulation, the relationship construct was also significantly higher

in the GWL group, contrary to expectations. This finding contrasts with prior studies by Hamari [7] which indicated that badges typically foster social and relational engagement. Further research may be needed to explore the contextual factors that influenced these outcomes in our study.

- O3-The subjects in the GWL gamified experience were more interacting than those who participated in the GWB, with the subjects who participated in the GWB having a more dominating and tracking profile. Following Prieto & Moreno [16], interactors prefer group work with fairness and cooperativism, dominators have the objective of achieving their goals in order to have an impact on others, and trackers have the objective of exploring and getting rewards in order to have an impact on others. the gamified system developed. In the GWB, the badges that were awarded to students for a good reply, for their participation, for the quality of the content of their interventions, or for obtaining one of the 3 orbs, were all understood as rewards, so that the profile of the students in this group was probably more tracker than in the GWL.
- H3- Although initial trends suggested differences between the player profiles in the two groups, the chi-square test revealed that these differences were not statistically significant. As such, Hypothesis 3, which posited a difference in player profiles between the Group With Badges (GWB) and Group With Leaderboards (GWL), cannot be accepted based on the current data.
- O4-The use of badges favors participation in first contact, dissipating said participation during the course of the forum, while the use of classification tables during the course of the forum favors participation to a greater extent with respect to the use of badges. Therefore, the use of badges in short-term gamified experiences and the use of leaderboards in long-term gamified experiences would be recommended.
- H4-The hypothesis is partially fulfilled, the results indicate that badges encourage initial participation, but this dissipates over time. In contrast, leaderboards promote greater sustained participation throughout the forum. Therefore, it is recommended to use badges in short-term gamified experiences to boost first engagement and to employ leaderboards in long-term gamified experiences to maintain active participation over a longer period.

4.2 Limitations and future research

While our study offers valuable insights into the differential effects of badges and leaderboards, the results should be interpreted in light of the study's limitations. The small sample size (N=42) particularly limits the statistical power and generalizability of our findings. The trends observed, especially regarding player profiles which showed no statistical significance, should therefore be interpreted as preliminary indications rather than conclusive evidence. Future research with larger samples is crucial to verify these patterns. The conclusions drawn from this study should be viewed as preliminary, offering initial insights rather than definitive answers. The quasi-experimental design and exploratory nature of this research are appropriate for identifying trends and relationships between gamification mechanics and student motivation, but larger sample sizes will be necessary to confirm these findings and establish broader conclusions. Future research should aim to replicate these findings in larger, more diverse populations to better understand the nuanced interactions between gamification mechanics and student motivation.

Additionally, exploring the long-term effects of these mechanics on intrinsic motivation could yield important insights for designing more effective gamified learning environments.

Our findings add to the ongoing debate regarding the effectiveness of badges and leaderboards in education. Consistent with Mekler et al. [23], the implementation of these mechanics did not significantly enhance intrinsic motivation, suggesting that while gamification can boost engagement through extrinsic motivators like competition, its impact on deeper learning outcomes remains limited. This study highlights the need for further exploration of how different gamification elements may interact with student motivation in varied educational contexts.

5. Conclusions

Leaderboard and badge methodologies show no significant differences in achievement, knowledge, motivational experience, identified regulation, external regulation, amotivation, or autonomy. However, students who used leaderboards show significantly higher levels of introjected regulation (internal pressure-based motivation) and relatedness (social connection), suggesting that this methodology may foster greater internal pressure and greater social interaction compared to badges. Besides, competition is close to significant, suggesting that leaderboards might be related to greater perceptions of competence, although this is not conclusive. This analysis suggests that leaderboards generate a more competitive and social environment, whereas badges might be less likely to elicit internal pressure or social competition.

The classification tables show that they increase the introjected regulation and the relationship, although it has not been possible to confirm that they do improve the autonomous learning of the students, although both badges and tables do so with respect to participation in the forum, and, with this , the consolidation of the contents and the acquisition of a series of necessary skills and attitudes are improved to guarantee a complete, integral and transversal training, so necessary in a digitized and globalized society.

Gamification mechanics place the motivation, participation and emotions of the students at the center of the design of learning scenarios and the use of learning tools and technologies. However, for the implementation of the different gamification elements in any teaching-learning process, matching technologies are needed, as well as specific mechanics and dynamics adjusted to the player's profile in a gamified context.

Acknowledgments

No funding sources; however, it is part of the research project "Heraclie: A Transversal Forum Gamification Project," code: PI:076/2022.

Conflicts of interest

The authors declared no potential conflicts of interest concerning to the research, authorship, and/or publication of this article. The authors also declared that there was no funding for the research. To access the matrix data, go to https://doi.org/10.6084/m9.figshare.24155763.v1

References

[1] J. Hamari, N. Hanner, and J. Koivisto, "Why pay premium in freemium services? A study on perceived value, continued use and purchase intentions in free-to-play games," International Journal of Information Management, vol. 51, p. 102040, 2020. doi: 10.1016/j.ijinfomgt.2019.102040

[2] M. Sailer and M. Sailer, "Gamification of in-class activities in flipped classroom lectures," Br. J.

Educ. Technol., vol. 52, no. 1, pp. 75-90, 2021. doi: 10.1111/bjet.12948
[3] H. K. Foon and L. C. Ki, "Using digital badges and leaderboards in primary school math lessons," in Shaping the Future of Education, Communication and Technology, Singapore: Springer, 2019, pp. 71-90, doi: 10.1007/978-981-13-6681-9_6
[4] L. Zhou et al., "Students' perception of using digital badges in blended learning classrooms," Sustainability, vol. 11, no. 7, p. 2151, 2019, doi: 10.3390/su11072151
[5] S. Balci, J. M. Secaur, and B. J. Morris, "Comparing the effectiveness of badges and leaderboards," Educ. Inf. Technol., pp. 1-36, 2022. doi: 10.1007/s10639-022-10983-z
[6] R. Tulloch, "Reconceptualising gamification: Play and pedagogy," Digit. Cult. Educ., vol. 6, pp. 317-333, 2014.
[7] J. Hamari, "Do badges increase user activity?," Comput. Hum. Behav., vol. 71, pp. 469-478, 2017, doi: 10.1016/j.chb.2015.03.036
[8] S. Balci, J. M. Secaur, and B. J. Morris, "Badges and leaderboards," in EdMedia+ Innovate Learning, 2019, pp. 1090-1096, doi: 10.1007/s10639-022-10983-z
[9] I. Glover, "Student perceptions of digital badges," in Foundation of Digital Badges, Cham: Springer, 2016, pp. 443-455, doi: 10.1007/978-3-319-15425-1_24
[10] S. Park and S. Kim, "Leaderboard design principles," JMIR Serious Games, vol. 9, no. 2, p. e14746, 2021, doi: 10.2196/14746
[11] S. Abramovich, C. Schunn, and R. M. Higashi, "Are badges useful in education?," Educ. Technol. Res. Dev., vol. 61, no. 2, pp. 217-232, 2013, doi: 10.1007/s11423-013-9289-2
[12] E. L. Deci and R. M. Ryan, "The 'what' and 'why' of goal pursuits," Psychol. Inq., vol. 11, no. 4, pp. 227-268, 2000, doi: 10.1207/S15327965PLI1104_01
[13] R. J. Vallerand, "Toward a hierarchical model," in Advances in Experimental Social Psychology, vol. 29, 1997, pp. 271-360, doi: 10.1016/s0065-2601(08)60019-2
[14] J. L. Núñez et al., "Validación de la versión española de la Escala de Motivación Global," Rev. Mex. Psicol., vol. 30, no. 2, pp. 131-142, 2013, doi: 10.1174/021093910790744590
[15] J. M. Prieto-Andreu, "How to avoid negative effects when gamifying," REMIE, vol. 14, no. 2, pp. 244-266, 2024, doi: 10.17583/remie.11765
[16] J. M. Prieto-Andreu and P. Moreno-Ger, "Playing it right," Rev. Esp. Pedagog., vol. 82, no. 288, pp. 85-102, 2024, doi: 10.22550/2174-0909.4056
[17] R. Hernández, C. Fernández, and P. Baptista, Metodología de la Investigación. México: McGraw-Hill, 2010.
[18] B. Glaser and A. Strauss, The Discovery of Grounded Theory. Chicago: Aldine, 1967.
[19] V. Braun and V. Clarke, "Using thematic analysis in psychology," Qual. Res. Psychol., vol. 3, no. 2, pp. 77-101, 2006, doi: 10.1191/1478088706qp063oa
[20] J. I. Menéndez-Santurio and J. Fernández-Río, "Versión española de la escala," Rev. Int. Med. Cienc. Act. Fís. Deporte, vol. 18, no. 69, pp. 119-133, 2018, doi: 10.15366/rimcafd2018.69.008
[21] J. L. Núñez, F. Grijalvo, C. Fernández, and J. Martín-Albo, "Validación de la versión española de la Escala de Motivación Global en el contexto Educativo Universitario," Revista Mexicana de Psicología, vol. 30, no. 2, pp. 131–142, 2013, doi: 10.1174/021093910790744590.
[22] H. K. Foon and L. C. Ki, "Using digital badges and leaderboards in primary school math lessons," in Shaping the Future of Education, Communication and Technology, Singapore: Springer, 2019, pp. 71-90, doi: 10.1007/978-981-13-6681-9_6
[23] E. D. Mekler et al., "Do points, levels and leaderboards harm intrinsic motivation?," in Proc. Int. Conf. Gameful Design, 2013, pp. 66-73, doi: 10.1145/2583008.2583017
[24] P. Bräuer and A. Mazarakis, "Badges or a leaderboard?," GamiFIN, vol. 2359, pp. 229-240, 2019.
[25] L. Hakulinen, T. Auvinen, and A. Korhonen, "The effect of achievement badges," Int. J. Emerg. Technol. Learn., vol. 10, no. 1, pp. 18-30, 2015, doi: 10.3991/ijet.v10i1.4221
[26] D. Dicheva, C. Dichev, G. Agre, and G. Angelova, "Gamification in education: A systematic mapping study," Journal of Educational Technology & Society, vol. 18, no. 3, pp. 75–88, 2015, doi: 10.30191/ETS.201507_18(3).0006
[27] M. Garcia-Iruela and R. Hijón-Neira, "What perception do students have," IEEE Access, vol. 8, pp. 134386-134392, 2020, doi: 10.1109/access.2020.3011222