



# Revitalising learning in three university contexts: Unleashing the power of the Quizizz app to increase self-efficacy, intrinsic motivation, satisfaction and performance

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## Abstract

Considering the innovative learning approach of incorporating gamification educational dynamics, this study focused on analyzing differences in the effects of using Quizizz depending on the degree of practical focus that different university degrees have. By applying game elements in non-game contexts, gamification has been recognized as a strategy that can increase student motivation and engagement. After applying the four-month innovation experience in three degree programs (Engineering, Business Administration, and Education), the perceptions of the 179 participating students were evaluated regarding intrinsic motivation, self-efficacy in learning, satisfaction with the use of applications to gamify learning and academic performance. Furthermore, possible differences in these dimensions were explored depending on the degree of practical orientation that each university degree has. The results suggest that students in the educational area express more favorable perceptions about the improvement of their learning with this gamification experience, while Business Administration students are those who express the worst perceptions. The implications of these results are discussed considering the influence that variables such as the active and participatory role of students, the usefulness of the content in the professional future, or the conceptual and theoretical nature of each university degree can exert.

**Keywords** Gamification · Quizizz · Practical orientation · Motivation · Self-efficacy · Satisfaction

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## 1 Introduction and theoretical framework

Although educational gamification processes continue to be a growing trend (Dicheva et al., 2015), their beneficial use has been suggested to improve active participation and immediate learning of students (Buckley et al., 2017). However, knowledge about the impact of these dynamics on more specific aspects of the educational process related to perceived self-efficacy in learning, intrinsic motivation, satisfaction or learning performance is not so common. Likewise, there are no studies that include a comparison of effects between students belonging to university degrees in different areas of knowledge. For example, in which university degrees do gamification processes have the greatest impact on different variables of the learning process? Does a university degree more oriented towards work practice mean that there are differences in the perceptions of students involved in gamification experiences?

Intrinsic motivation is one of the variables on which gamification has positive effects (Chou, 2015). This variable refers to performing an action because it is interesting or fun for the person. Previous research (Ryan & Deci, 2000; Taylor et al., 2014) has also revealed the correlation that exists between intrinsic motivation and learning performance. In fact, driven by interest and personal satisfaction in learning, intrinsic motivation positively correlates with the learning performance of Higher Education students (Mekler et al., 2017). Finally, gamification also plays an important role in increasing indicators related to learning satisfaction and self-efficacy (Arruzza & Chau, 2021; Hsiao et al., 2023). More specifically, self-efficacy corresponds to the belief of being able to successfully carry out a specific task (Bandura, 1977). The relationships between these variables have also been previously described in the literature. In the study by Chentanez et al. (2004) showed how as intrinsic motivation increased, self-efficacy to complete tasks was improved and active learning processes were initiated that led to deeper understanding. Even more than three decades ago, other authors (Schunk et al., 1987) already found that self-efficacy was highly correlated with learning performance. Finally, recent research (Hsu, 2022) has also reflected that satisfaction with the use of these gamified tools is usually conditioned by high levels of perceived self-efficacy in learning and intrinsic motivation.

On the other hand, gamification in the context of Higher Education has revealed differences in the perceptions of students depending on the study discipline in which they are involved (Subhash & Cudney, 2018). For example, in the case of university students linked to the area of education, a significant increase in perceived self-efficacy in their learning is observed, supported by the playful nature of gamified activities (González-Gómez et al., 2022). Thanks to this learning approach, the connection between theory and pedagogical practice is strengthened. In a similar sense, the intrinsic motivation of these students is also reinforced because the gamified experiences applied in the classroom are aligned with the educational objectives of the teaching-learning process and the motivation of future teachers (Zourmpakis et al., 2022). In university studies related to Business Administration and Management, the benefits of using gamification

have been related to an increase in the acceptance of digital learning tools and an improvement in the perception of the practical usefulness of theoretical concepts. (Silva et al., 2019). However, there is not so much research that relates the gamification experiences carried out with these students to an improvement in motivation, self-efficacy or perceived academic performance.

Considering these precedents, in this study an innovation experience was developed based on the application of gamification dynamics in the university classroom. After the application of the educational intervention, a research phase was carried out with the purpose of analysing the perceptions of the university students involved in the experience regarding different dimensions related to the improvement of the learning process: intrinsic motivation, self-efficacy in learning, satisfaction with the use of applications to gamify learning and academic performance. In this process, the existence of possible differences in these dimensions of analysis was also assessed depending on the university degree in which they were involved, that is, depending on the degree of experimentality and practical implication that each of them entails. The degree of experimentality would be understood as the degree of practical focus or practical experience that a university degree has. This degree may vary depending on the nature and characteristics of the careers.

The approach of this research represents a significant advance within the educational context because it not only focuses on exploring in detail the effects of gamification on learning, but also provides valuable insights on how these strategies may vary according to the practical approach of different university majors. In this sense, the value of this research lies in its interdisciplinary approach and its ability to analyse significant differences in academic perceptions and outcomes among university students from different fields.

## 2 Intervention and research context

The intervention was developed during the 2022-23 academic year in three subjects belonging to independent degrees of the Spanish university system: the Degree in Teaching in Primary Education, the Degree in Industrial Design Engineering and the Degree in Business Administration and Management. The gamification initiative employed the Quizizz application, an interactive educational platform enabling teachers and students to create immersive learning experiences. This application makes it possible to create and participate in gamified questionnaires and teachers can design personalized and interactive evaluations (Handoko et al., 2021; Pitoyo & Asib, 2020).

When each of the subjects involved in this innovation experience for the 2022-23 academic year began, the teachers presented the operation of the application to the students and offered them the necessary instructions for its use. Initially, the teachers generated the questions and entered them into the Quizizz computer application. Subsequently, the students had to access a web page in which they were asked to enter a PIN code to access the designed questionnaires. From their own mobile devices, tablets or computers, students recorded their names and they were projected on the classroom's digital screen. Before the start of the experience, the students and

teachers reached an agreement on the provision of the general rules of the gamification dynamic. Once the game dynamics were activated, the students had to answer the questions using their technological devices and each time selecting the answer they considered correct. The intervention sessions were carried out weekly with a game dynamic using Quizizz for approximately 20–25 min. Similarly, in this intervention process, the Quizizz tool was used to carry out a formative evaluation that allowed teachers to identify possible gaps in student learning to address them. That is why the use of the application facilitated the analysis of learning progress not only from an individual perspective. It also allowed the identification of concepts that had been less assimilated by students (Fig. 1).

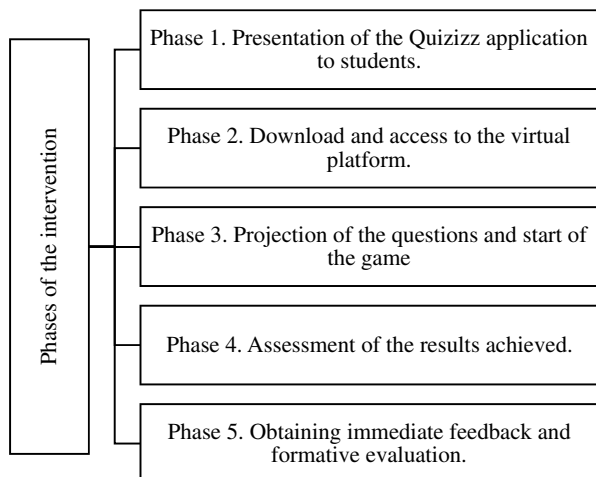
### 3 Method

In order to address the research objectives, a quantitative study was planned through a descriptive survey. More specifically, a non-experimental approach was adopted, based on the administration of a questionnaire for data collection. These studies align with the study's purpose without making alterations to the variables, aiming to explore and describe the phenomenon (Lietz, 2010). Furthermore, these designs enable a systematic, objective, and comparable description of the characteristics and events within a population. Therefore, they serve as a valuable source of information for analyzing the perceptions of university students engaged in intervention programs based on innovative experiences.

#### 3.1 Sampling and data collection

The sample of the study consists of 179 students of the academic year 2022–2023, distributed across different degree programs. Specifically, approximately 42% of the students are studying Education, 46% are enrolled in Business Administration and

**Fig. 1** Phases of the intervention process with Quizizz



the remaining 12% are studying Industrial Design Engineering. As can be seen in Table 1, the majority of the sample consists of women living with their families. There is a higher percentage of Industrial Design Engineering students who live more independently. Most of the students have no previous experience of innovation. However, there are significant differences between the degree programs: only about 14% of the students of Industrial Design Engineering and Management, 27% of the students of Business Administration and 44% of the students of Education have had such experience. Higher entry grades are found in Business Administration ( $M = 11.41$ ) and Industrial Design Engineering (11.01).

### 3.2 Survey design and data analysis procedure

At the end of the innovative experiences in the different subjects, the participating students were asked to indicate their level of agreement with 16 questions about the effects of the use of gamified activities on the development of different variables related to the improvement of learning: intrinsic motivation, perceived self-efficacy in learning, satisfaction with the use of this technological application and attributions of academic performance. To do this, a questionnaire was used with a Likert scale ranging from 0 (strongly disagree) to 10 (strongly agree). This scale was used because it corresponds to the natural evaluation system in the Spanish educational system (Bisquerra & Pérez-Escoda, 2015). Precisely for this reason, the students are used to this type of scale. Students completed the questionnaire on a digital medium, once they had completed all the sessions of the subjects involved in the gamification experience. The digital platform on which the questionnaire was available was accessible from the end of April until the end of May 2023.

The indicators of the dimensions included in this study were taken from the previous research by Bicen and Kocakoyun (2018) and Polo-Peña et al. (2021). However, certain modifications were made to the wording of some items in order to adapt

**Table 1** Sociodemographic characteristics of the sample

	Bachelor's degree		
	Education	Business administration	Engineering
Gender			
Male	37.33	30.49	27.27
Female	62.67	69.51	72.73
Independent life			
I live with my family	61.33	82.93	54.55
I live independently	38.67	17.07	45.45
Previous experience with innovation			
Yes	44.00	26.83	13.64
No	56.00	73.17	86.36
University entrance grade (on a scale of 14)	8.87 (1.42)	11.41 (1.23)	11.01 (1.47)
Num individuals	75	82	22

them to the specific context of this gamification experience with Quizizz. The first dimension of intrinsic motivation included four indicators related to enjoyment of learning, an increase in interest in the tasks proposed in class and in learning in general, and a deeper understanding of learning. Secondly, perceived self-efficacy was defined by four indicators related to self-confidence and learning ability, a greater perception of mastery of subjects and a sense of greater achievement. Thirdly, satisfaction with the use of these digital tools was explained by four other indicators, again related to the use of Quizizz: feeling comfortable in the classroom context, satisfaction with the educational experience with Quizizz and with the content learned, and preference for working on subject content with this tool. Finally, four indicators were included to define the attributions of academic performance. On this occasion, the indicators were related to the perception of improved performance thanks to the activities with Quizizz and the ability to solve tasks.

## 4 Results

### 4.1 Sample characterization

Table 2 presents descriptive statistics for scales of perceptions about different variables that influence the improvement of learning: intrinsic motivation, perceived self-efficacy in learning, satisfaction with the use of technological applications, and learning performance. The measurement of these scales varies between “strongly disagree” (0) to “strongly agree” (10), and they are categorized by Bachelor’s Degree. The table includes the means, standard deviation, item total correlation (correlation coefficient between the score on the individual item and the sum of the scores on the remaining items), and the Cronbach’s alpha coefficient when the individual item is excluded from the scale. In the last column, a test of mean differences in students’ perceptions among different degrees is presented. Here it is observed that the Engineering Degree exhibits the highest values of Cronbach’s alpha and item-total correlation, followed by the Business Administration Degree, and lastly the Education Degree. In conclusion, the scale demonstrates excellent internal consistency and reasonable contributions from individual items. These findings indicate that the scale is reliable and can be confidently used in the study.

The results show that students enrolled in the Education Degree program exhibit the highest average in all dimensions of analysis. Furthermore, their confidence levels show minimal variability. This indicates that they tend to have greater belief in their abilities, and this belief is fairly consistent among the students within the group. Following them are students in the Engineering Degree program, who also manifest moderately high perceptions in all of these learning variables but with slightly more variability compared to the Education Degree students. However, those enrolled in the Business Administration Degree program show lower average perceptions with higher variability, suggesting a less uniform belief in their abilities within this group when participating in interventions mediated by gamification. These findings suggest a notable difference among the different degree programs in perceptions on motivation, learning self-efficacy, satisfaction, and academic performance (see the

**Table 2** Descriptive statistics of student's perceptions of learning improvement

Perception	Bachelor's Degree						Difference Test $X^2(2)$			
	Education			Engineering						
	Mean (S.D.)	C $\alpha$	ITC	Mean (S.D.)	C $\alpha$	ITC				
<b>Intrinsic Motivation</b>										
Q1. I enjoyed working on the subject with Quizizz/Kahoot activities	8.97 (1.07)	0.932	0.477	7.48 (1.82)	0.953	0.574	8.63 (1.33)	0.941	0.515	36.59***
Q2. My interest in the subject increased by working on the content through Quizizz/Kahoot	7.99 (1.47)	0.930	0.469	6.34 (2.26)	0.952	0.568	7.41 (2.09)	0.939	0.505	26.11***
Q3. I participated in the activities with Quizizz/Kahoot because I had an interest in learning.	8.45 (1.48)	0.932	0.479	7.91 (1.72)	0.957	0.598	8.09 (2.20)	0.943	0.522	4.55
Q4. The use of Quizizz/Kahoot helped me learn with a significantly deeper understanding.	8.64 (1.32)	0.932	0.478	6.87 (2.15)	0.951	0.563	8.09 (1.69)	0.940	0.512	35.95***
<b>Perceived self-efficacy in learning</b>										
Q5. The use of Quizizz/Kahoot allowed me to feel more confident in my ability to learn	7.68 (1.74)	0.930	0.470	6.06 (2.49)	0.950	0.561	6.95 (1.94)	0.937	0.497	19.19***
Q6. The use of Quizizz/Kahoot helped me better master the content of this subject	8.33 (1.12)	0.928	0.462	5.90 (2.52)	0.950	0.560	7.41 (1.59)	0.938	0.500	47.42***
Q7. I have a sense of greater achievement in learning by using Quizizz/Kahoot	8.02 (1.52)	0.931	0.472	5.97 (2.51)	0.950	0.560	6.72 (2.10)	0.939	0.508	31.19***
Q8. With the use of Quizizz/Kahoot, I now feel more capable and could teach others the content	7.43 (1.82)	0.932	0.476	5.59 (2.39)	0.950	0.558	5.45 (2.67)	0.944	0.529	27.82***
<b>Satisfaction with the use of these applications</b>										
Q9. I feel comfortable with the atmosphere generated in class using Quizizz/Kahoot	9.33 (0.84)	0.938	0.501	8.03 (1.84)	0.959	0.607	9.36 (0.90)	0.946	0.540	31.84***
Q10. I am satisfied with this educational experience in which we used Quizizz/Kahoot	8.97 (1.11)	0.931	0.472	7.54 (1.69)	0.953	0.576	8.77 (1.19)	0.938	0.504	36.14***
Q11. I like that some of the content in this subject was covered using Quizizz/Kahoot	9.16 (1.01)	0.933	0.479	7.40 (2.10)	0.951	0.564	9.09 (1.15)	0.942	0.521	44.49***

Table 2 (continued)

Perception	Bachelor's Degree						Difference Test $X^2(2)$			
	Education		Business Ad.		Engineering					
	Mean (S.D.)	C $\alpha$	ITC	ITC	Mean (S.D.)	C $\alpha$		ITC		
Q12. I am satisfied with what I learned thanks to the use of Quizizz/Kahoot in this subject	8.63 (1.35)	0.931	0.473	6.68 (2.24)	0.950	0.557	7.95 (1.76)	0.937	0.498	37.18***
Learning performance										
Q13. I believe that having done some activities with Quizizz helps improve my academic performance in the subjects	8.15 (1.33)	0.928	0.462	6.40 (2.48)	0.951	0.563	7.14 (2.10)	0.940	0.512	23.98***
Q14. I am satisfied with the improvement in my academic performance that the use of Quizizz/Kahoot has enabled me to achieve	8.01 (1.32)	0.930	0.468	5.96 (2.49)	0.950	0.557	6.91 (2.20)	0.937	0.500	32.56***
Q15. I was good at solving activities with Quizizz/Kahoot	7.99 (1.40)	0.935	0.488	6.23 (2.31)	0.953	0.574	7.59 (1.50)	0.938	0.501	29.85***
Q16. My current academic performance is generally very good	7.23 (1.40)	0.934	0.483	5.52 (2.89)	0.954	0.581	6.91 (2.33)	0.941	0.517	16.20***

C $\alpha$  Cronbach's alpha, ITC Item total correlation\* $p < 0.1$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$

histograms of students' perceptions by degree in the Appendix Table 5). These mean differences observed are statistically significant, except for Q3: "I participated in the activities with Quizizz/Kahoot because I had an interest in learning." The "Satisfaction with the use of these applications" dimension yields the highest perceptions. Additionally, across all degrees, the highest mean is observed for perception Q9: "I feel comfortable with the atmosphere generated in class using Quizizz/Kahoot".

Figure 2 displays alluvial diagrams representing students' perceptions. Alluvial diagrams are used to analyze patterns of responses. The figure is partitioned into four distinct blocks, each categorizing different perceptions. Within each block, four vertical bars mean specific aspects of students' perceptions. These bars include nodes, each representing different levels of agreement regarding the learning-related variables analyzed in this study. The node size corresponds to the frequency of responses falling within that particular range (from 0 to 10). By studying each alluvial diagram, we can observe the collective flow and connections of responses related to the four perception dimensions, while also gaining insights into the frequencies associated with each selection.

This figure confirms the general trends already observed in Table 2, particularly indicating that in the third block, "Satisfaction with the use of these applications", the highest perceptions are reflected. Within this block, we observe thicker flows in the higher ranges of perceptions, which suggests a considerable number of

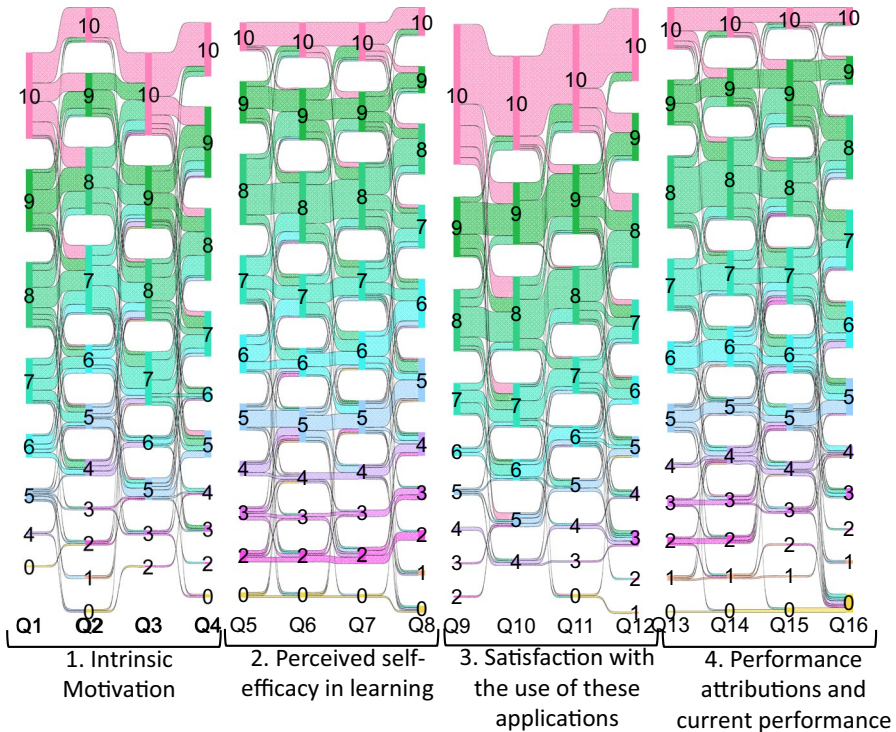


Fig. 2 Alluvial diagram for student's perceptions students' perceptions of learning improvement

students reported a high level of contentment with the usability and effectiveness of the Quizizz application. Possible reasons for this observation could include a better understanding and mastery of the applications, leading to increased satisfaction, or a selection bias favouring those who are more adept with technology or more predisposed to participate in innovation projects.

## 4.2 Multivariate ordered probit model for self-efficacy estimates

The variables to be explained in this study are discrete in nature. Several approaches can be used to assess the factors influencing the perceived improvement in the learning variables included in this study. One common method is to estimate individual equations, such as ordered probit, for each indicator. However, this approach ignores the potential simultaneous behaviour between these indicators. As they all contribute to the same dimension of “perceived learning improvement”, ignoring their interrelationship may lead to limitations. To address this concern, our study employs multivariate ordered probit models. By using this approach, we aim to overcome the limitations associated with other techniques and to gain a more comprehensive understanding of the determinants that influence perceived self-efficacy.

The econometric model that summarizes the behavioural framework presented includes the perceptions of learning improvement ( $Y_{iq}$ ) of students as dependent variables, where  $i = 1, \dots, N$  represents individual students, and  $q = 1, \dots, Q$  denotes different perceptions of improvement of learning. To evaluate these perceptions, which encompass socio-demographic effects shared among all the alternatives, we consider a set of exogenous explanatory variables ( $X$ ). The model is specified as follows:

$$Y_{iq}^* = \beta_q' X_i + \varepsilon_{iq}, \text{ where } Y_{iq} = j_q \text{ if and only if } \mu_{j-1,q} < Y_{iq}^* < \mu_{j,q} \quad (1)$$

where  $\beta_q$  are parameters to be estimated,  $\mu_{j,q}$  is the upper bound threshold for count level  $j$  of perception  $q$  ( $\mu_{0,k} < \mu_{1,k} \dots < \mu_{J,k}$ ;  $\mu_{0,k} = -\infty$ ,  $\mu_{J,k} = +\infty$  for each objective  $k$ ). These threshold bounds establish a range for the underlying latent continuous variable that corresponds to each observed discrete outcome. The  $\varepsilon_{iq}$  a standard normal error term with:

$$\begin{pmatrix} \varepsilon_{i1} \\ \varepsilon_{i2} \\ \dots \\ \varepsilon_{iq} \end{pmatrix} \approx N \left[ \begin{pmatrix} 0 \\ 0 \\ \dots \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & \rho_{12} & \dots & \rho_{1k} \\ \rho_{21} & 1 & \dots & \rho_{2k} \\ \dots & \dots & \dots & \dots \\ \rho_{k1} & \rho_{k2} & \dots & 1 \end{pmatrix} \right] \text{ or } N[0, \Sigma] \quad (2)$$

The off-diagonal elements of  $\Sigma$  capture the covariance of errors among the underlying continuous latent variables of distinct perceptions. In other words, they reflect the influence of shared unobserved factors that affect a more positive perception about improved learning. If  $\rho_{12}$  is positive, it indicates that students who exhibit an above-average inclination towards learning improvement in the first indicator within their peer group are also likely to display an above-average inclination towards learning improvement in the second indicator. It's widely recognized that in cases where all correlation parameters are set to zero, the model

system described in Eq. (1) should be estimated as independent ordered response probit models for each indicator. This approach yields dependable and asymptotically efficient estimations for all model parameters.

Tables 3 and 4 display the outcomes of the multivariate ordered probit model, which jointly considers the factors influencing students' perceptions of learning improvement across various scales. Table 3 displays the estimation results using socio-demographic variables as explanatory factors, whereas Table 4 illustrates the correlation coefficients of the random components linked to each perception of learning improvement. Referring to the approach by Greene and Hensher (2010), the effectiveness of the multivariate ordered probit model in generating more efficient outcomes relies on the collective requirement that these correlations are non-zero. Towards the conclusion of Table 3, the results of a statistical test evaluating this condition are displayed. The test outcomes suggest that distinct statements are correlated due to unobserved factors, resulting in an enhancement of estimation efficiency. Additionally, Table 4 indicates that all indicators exhibit positive and significant correlations, underscoring their interdependent nature. This implies that students do not conform uniformly to a single scale of perception of learning improvement. Instead, the likelihood of concurring with a particular item hinge on whether agreement has already been established for other items.

One of the most significant results to emphasize from Table 3 is the significance of the test for variations in perceptions based on students' different Bachelor's Degrees. When controlling for various socio-demographic variables, it becomes evident that, in all instances, the lowest perceptions are associated with Business Administration students, while the highest perceptions are linked to Education students. The magnitude of the estimated coefficients in Table 3 does not possess a direct interpretation. However, it can be inferred that an increase in a variable with a positive coefficient enhances the likelihood of the dependent variable falling into the highest category (high perception of learning improvement), while concurrently reducing the likelihood of it falling into the lowest category.

The university entrance grade positively influences perception in 7 out of the 16 perspectives under analysis. More specifically, this effect is evident in all perceptions related to "Attributions of academic performance" from Q13 to Q16, where the most significant values are observed. Concerning the explanatory variable associated with the previous experience of university students with educational innovation, no significant impact is observed on most of the perceptions of the dimensions analyzed. Only in relation to the Q1 statement "I enjoyed working on the subject with Quizizz/Kahoot activities," it is noticeable that students with previous experience were less inclined to believe that the gamification methodology enhanced this particular indicator.

Regarding the correlation coefficients presented in Table 4, highly significant correlations were observed among all variables. Furthermore, the table employs color intensity to indicate the magnitude of correlation. The darker the color, the stronger the correlation between different perceptions of improved learning. The highest correlations are observed between the indicators that define the dimensions related to perceived self-efficacy in learning, and satisfaction with the use of technology. From a general perspective, the weakest correlations are detected between some indicators of intrinsic motivation and satisfaction with the use of technological applications.

**Table 3** Multivariate ordered probits for students' perceptions of learning improvement

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16
	Coef (S E)	Coef (S E)	Coef (S E)	Coef (S E)	Coef (S E)	Coef (S E)	Coef (S E)	Coef (S E)	Coef (S E)	Coef (S E)	Coef (S E)	Coef (S E)	Coef (S E)	Coef (S E)	Coef (S E)	Coef (S E)
Bachelor's Degree																
Business Administration	-1.151*** (0.260)	-0.976*** (0.227)	-0.515*** (0.234)	-1.225*** (0.230)	-0.846*** (0.231)	-1.283*** (0.244)	-1.002*** (0.228)	-0.997*** (0.252)	-1.268*** (0.263)	-1.017*** (0.264)	-1.248*** (0.296)	-1.000*** (0.241)	-1.105*** (0.235)	-1.179*** (0.232)	-1.370*** (0.262)	-1.062*** (0.253)
Engineering	-0.363 (0.300)	-0.453 (0.288)	-0.318 (0.300)	-0.565** (0.272)	-0.560** (0.238)	-0.617** (0.245)	-0.746*** (0.248)	-0.990*** (0.280)	-0.127 (0.285)	-0.231 (0.258)	-0.202 (0.291)	-0.415* (0.259)	-0.787*** (0.259)	-0.759*** (0.265)	-0.668 (0.256)	-0.450* (0.278)
Bach Deg Test ( $\chi^2(2)$ )	21.52***	18.65***	4.86*	28.44***	13.83***	27.70***	20.21***	18.33***	27.74***	16.38***	20.40***	17.50***	22-78***	26.26***	27.81***	17.97***
Female	0.072 (0.161)	0.275* (0.167)	0.223 (0.179)	0.129 (0.163)	0.170 (0.157)	0.309** (0.157)	0.162 (0.155)	-0.006 (0.161)	-0.052 (0.177)	0.214 (0.161)	0.108 (0.166)	0.203 (0.163)	0.177 (0.162)	0.256 (0.160)	0.085 (0.161)	0.012 (0.156)
Live independently	0.102 (0.188)	0.072 (0.169)	0.118 (0.183)	0.122 (0.159)	0.223 (0.166)	0.027 (0.159)	0.181 (0.163)	0.014 (0.166)	-0.117 (0.176)	0.194 (0.167)	0.157 (0.172)	0.272* (0.167)	0.071 (0.166)	0.156 (0.166)	0.086 (0.170)	0.051 (0.164)
Previous experience with innovation	-0.284* (0.170)	-0.183 (0.170)	-0.073 (0.184)	-0.215 (0.175)	-0.174 (0.166)	0.023 (0.168)	-0.110 (0.160)	0.028 (0.164)	-0.035 (0.183)	0.100 (0.170)	-0.120 (0.179)	-0.071 (0.169)	-0.256 (0.176)	-0.012 (0.172)	-0.238 (0.179)	-0.160 (0.163)
University entrance grade	0.059 (0.059)	0.049 (0.054)	0.072 (0.054)	0.078* (0.047)	0.065 (0.052)	0.037 (0.051)	0.047 (0.053)	0.087* (0.054)	0.088 (0.060)	0.049 (0.051)	0.063* (0.038)	0.033 (0.054)	0.092* (0.051)	0.096* (0.052)	0.172* (0.055)	0.165*** (0.057)
Eq test ( $\chi^2(6)$ )	33.72***	31.61***	10.79*	36.51***	29.05***	47.65***	35.84***	28.24	36.02***	27.83***	33.27***	35.35***	34.40***	45.17***	37.30***	22.65***
Global test ( $\chi^2(96)$ )	196.35***															
All rho = 0 ( $\chi^2(120)$ )	6148.46***															
Num obs	179															

\* $p < 0.1$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$

**Table 4** Estimated error correlation matrix

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15
Q2	0.425***														
Q3	0.270***	0.347***													
Q4	0.362***	0.439***	0.314***												
Q5	0.430***	0.430***	0.324***	0.423***											
Q6	0.380***	0.482***	0.299***	0.484***	0.515***										
Q7	0.388***	0.440***	0.233***	0.447***	0.501***	0.571***									
Q8	0.338***	0.377***	0.243***	0.366***	0.495***	0.493***	0.515***								
Q9	0.215***	0.180***	0.150***	0.247***	0.169***	0.221***	0.191***	0.176***							
Q10	0.390***	0.328***	0.197***	0.385***	0.324***	0.404***	0.355***	0.341***	0.371***						

\* $p < 0.1$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$

## 5 Discussion and conclusions

In general, the findings of the study suggest that students in the educational area are those who express more favourable perceptions about the improvement of their learning (in the different dimensions of analysis) after being involved in this innovation experience, followed by Engineering students, and the Business Administration and Management students. One of the possible explanations for this result could be linked to the degree of experimentality and practical content that Education and Engineering training have by their very nature. That is to say, these degrees are provided as learning contexts in which the active and participatory role of students is more commonly encouraged. Furthermore, they place the focus of the usefulness of the content on future professional application (Cochran-Smith et al., 2015). Different authors (Flores, 2018; Walther et al., 2017) have highlighted how these disciplines offer students more practical training from the beginning and the possibility of acquiring the skills and knowledge necessary to successfully enter the workplace at the end of the studies. university studies. On the contrary, and as Piperopoulos and Dimov (2015) argue, initial training in the context of business administration tends to be more conceptual and theoretical in nature. A wide range of training is offered to students, but sometimes less focused on immediate practical skills.

Taking into account that it is a key factor in the learning process, the intrinsic motivation after participating in this gamification experience has been significantly higher in Education and Engineering students. According to previous literature (Borah, 2021; Oudeyer et al., 2016), this pattern would be logical as academic programs more oriented towards practical applications and more defined professional opportunities can positively influence student motivation. These results also support the idea that the relationships between active learning approaches during university training and future professional applications can act as an intrinsic motivation factor (Plump & LaRosa, 2017). In this sense, it could be that students of degrees related to Education and Engineering perceive gamification processes to be more aligned with their learning styles (Candel et al., 2023; Patil & Kumbhar, 2021). Some skills required by gamification, such as problem solving, decision making, interaction and active participation, are more common in curricula related to these areas of knowledge. As the way of learning is more aligned with the skills to be acquired in the degree, a more

positive perception of these university students has been observed regarding their motivation levels after participating in a learning experience with Quizizz.

Statistically significant differences have also been observed in perceived self-efficacy in learning depending on the university degree in which the gamification experience was developed. The lowest levels of self-efficacy have been recorded in Business Administration and Management students. This finding would be consistent with the idea that perceived self-efficacy in learning is positively related to achievement orientation and career aspirations (Bandura, 1977; Honicke et al., 2020). In the case of Teaching and Engineering degrees, professional aspirations are much more defined and delimited. However, the tasks to be performed in the future job would be somewhat less defined in the Business Administration and Management degree (Coates & Koemer, 1996). Therefore, the perception of having acquired specific skills and competencies with gamified learning could be influenced by the perception of practical applicability of the content acquired by these students from different university degrees.

Satisfaction with the use of the Quizizz tool also stood out more positively among students in the area of Education and Engineering. This result could be linked to the active and participatory nature of these two disciplines, which coincides with one of the main features that define gamified learning (Murillo-Zamorano et al., 2021). The literature has also suggested that satisfaction with technological learning tools is related to a perception of greater usefulness and effectiveness (Joo et al., 2018). Precisely for this reason, greater proactivity and active protagonist of university students of Teaching and Engineering could have favoured a better assessment of gamification with Quizizz as an effective learning strategy. In this context, gamified technological tools can act as enhancers of active participation and also take advantage of students' predisposition to direct involvement in learning (Chen et al., 2018).

These results suggest that the intrinsic nature of the discipline and exposure to innovative educational contexts that promote active participation can play a crucial role in students' willingness to accept new educational experiences. Training in practical disciplines not only prepares students for job performance, but also encourages them to be agents of change and promoters of innovation in university educational contexts. For these reasons, the results of this research suggest the need to design specific learning strategies and apply pedagogical innovations in university contexts (and, more especially, in those related to business management). All this placing attention on achieving a balance between a more theoretical tradition and more practical and motivating approaches that improve learning experiences.

Finally, the analysis of these results provides a solid basis for future research and educational practices. By considering variables such as the active role of students, the relevance of the content for their future professional career and the conceptual nature of each discipline, this research provides guidance for the design and implementation of effective gamification strategies in different university contexts. Therefore, it has highlighted the importance of considering the particularities of each discipline when implementing these strategies. By offering meaningful and practical insights, this study gathers the basic foundations for future research focused on maximising the potential of gamification to enhance learning in diverse and dynamic university learning contexts.

## Appendix

**Table 5** Histograms students' perceptions by bachelor's degree (in %)

Intrinsic Motivation			
Q1. I enjoyed working on the subject with Quizizz/Kahoot activities	Q2. My interest in the subject increased by working on the content through Quizizz/Kahoot	Q3. I participated in the activities with Quizizz/Kahoot because I had an interest in learning.	Q4. The use of Quizizz/Kahoot helped me learn with a significantly deeper understanding.
Perceived self-efficacy in learning			
Q5. The use of Quizizz/Kahoot allowed me to feel more confident in my ability to learn	Q6. The use of Quizizz/Kahoot helped me better master the content of this subject	Q7. I have a sense of greater achievement in learning by using Quizizz/Kahoot	Q8. With the use of Quizizz/Kahoot, I now feel more capable and could teach others the content
Satisfaction with the use of these applications			

Table 5 (continued)

<p>Q9. I feel comfortable with the atmosphere generated in class using Quizizz/Kahoot</p>	<p>Q10. I am satisfied with this educational experience in which we used Quizizz/Kahoot</p>	<p>Q11. I like that some of the content in this subject was covered using Quizizz/Kahoot</p>	<p>Q12. I am satisfied with what I learned thanks to the use of Quizizz/Kahoot in this subject</p>
<p>Performance attributions and current performance</p>			
<p>Q13. I believe that having done some activities with Quizizz helps improve my academic performance in the subjects</p>	<p>Q14. I am satisfied with the improvement in my academic performance that the use of Quizizz/Kahoot has enabled me to achieve</p>	<p>Q15. I was good at solving activities with Quizizz/Kahoot</p>	<p>Q16. My current academic performance is generally very good</p>

Red color: Education; Blue color: Business Administration; Green color: Engineering. Vertical lines indicate the mean value

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**Data availability** The data is available in the following repository: <https://docs.google.com/spreadsheets/d/1TeMWTsbcnQYRIfzR3iPfEmx3xKXbrshj/edit?usp=sharing&oid=118388042740959513758&rtopof=true&sd=true>.

### Declarations

This research has been approved by the Ethics Committee of the Government of Aragon (Spain), with approval code: PI20/385.

**Conflict of interest** The authors of the article declare that there is no conflict of interest.

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