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Assessing health science students' gaming experience: a cross-sectional study

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Background: Digital gamification applied to university students enrolled in health-related degrees is considered an innovative and beneficial tool that complements traditional teaching.

Objectives: To analyze the enjoyment experience obtained by university students in the Faculty of Health Sciences and to know the gender differences after participating in a digital game.

Design: Cross-sectional descriptive study.

Participants: A total of 156 university students from the Faculty of Health Sciences, University of Zaragoza.

Methods: The activity of a digital game took place in the academic year 2021–2022 and was carried out as a teaching innovation project with the final approval of the University of Zaragoza. The tools used were the Spanish version of the Gameful Experience Scale and a self-administered questionnaire on satisfaction and suitability reported by the activity.

Results: A total of 156 students participated with an age of 21.2 ± 6.2 years. The highest score is the enjoyment dimension (4 ± 0.7), and the lowest score is the negative affect dimension (1.5 ± 0.9). Cronbach's alpha for the whole Gameful Experience Scale was 0.95. There were significant differences in three dimensions of the Gameful Experience Scale: male students had more enjoyment than female students ($p = 0.05$), enjoyed a greater sense of domination ($p = 0.01$), and had fewer negative effects ($p = 0.0$). In the highest corresponding positions it was used for other topics such as learning (m 4.4; SD 0.5), motivation to learn (m 4.1; SD 0.8) or helping memorize concepts (m 4.4).4; SD 0.5).

Conclusion: Gender influences student satisfaction after carrying out a gamification activity, especially after a digital game. The dimensions in which gender differences were found were fun, absence of negative effects, and dominance.

KEYWORDS

gamification, virtual game, university students, gender, satisfaction

1 Introduction

For some years now, higher education has encouraged students to participate in their own learning process through active teaching, to improve teaching and learning (Gentry et al., 2019). Therefore, professors who teach university education face the challenge of designing activities that involve student motivation. The demotivation among students (Lizarte, 2020) may be the cause of the high dropout rate from studies within the university community (Bernardo et al., 2020).

Following the definition of Werbach and Hunter (2012), the aim is for the student to integrate and relate knowledge through a learning strategy different from that traditionally established in the subjects.

Recent advances in technology have accelerated educational innovations such as blended learning by providing easy access to information (Dehghanzadeh and Jafaraghaee, 2018). Academic classrooms for health science degrees have become an appropriate framework for integrating new technologies into learning processes. Activities related to digitization and gamification are especially easy for students born between 1995 and 2009 because the so-called Gen Z grew up doing business with technology (Veluchamy et al., 2016).

Blended learning is a new student-centred instructional approach that includes online and in-person learning through technology (Dehghanzadeh and Jafaraghaee, 2018). Over the past few years, learner needs, goals, and achievements have changed; undergraduates often have quick and easy access to information and prefer to be present in collaborative learning environments with activities focused on learning (Mellati et al., 2015; Munir et al., 2018). Currently, active learning activities are created as an instructional method that engages students in the learning process and contributes to the evolution of pedagogical practices (Grossi et al., 2014).

In the field of pedagogical innovation, gamification based on digital games is an effective tool in teaching, and apart from creating fun environments manages to draw students to the intrinsic motivation to learn (Albuquerque et al., 2017) and makes them move towards the acquisition of the learning objectives established by the teacher (Noriega-Cano, 2013). Serious games are defined as games in which entertainment is secondary to education (Donovan et al., 2021; Lateef et al., 2021) and game principles are used for learning, training, and skill development (Abensur Vuillaume et al., 2021).

In addition, the use of gamification in the classroom manages to reduce the stress that students may experience and shows that the existence of errors during the activity is not penalized and is understood as a key element for achieving learning (Sevilla and García, 2019). Not only the growth of knowledge and skills is favoured but also the ability to work as a team (Manzano et al., 2021), ask for help, and develop a critical mindset (Pensieri et al., 2023). Research suggests that the use of serious games leads to more addictive learning (Gatti et al., 2019), increases the retention of new knowledge (Koivisto and Hamari, 2019), and increases student satisfaction and motivation (Arruzza and Chau, 2021). In addition, it presents satisfactory outcomes in various university degrees, such as marketing (Koivisto

and Hamari, 2019), education (Landers and Landers, 2015), and health-related degrees such as nursing (Antón-Solanas et al., 2022; Rodríguez-Ferrer et al., 2022). Therefore, various studies have concluded that gamification carried out in the classroom is beneficial to university students (Krishnamurthy et al., 2022) and is a tool that reduces dropout rates (Martínez-Álvarez et al., 2021) and improves student performance (Alonso et al., 2021; Polyanska et al., 2022).

The mechanics of the game refer to the challenges and knowledge associated with the content of the programme, while the development of the game sets the basic structure and emotional elements (Werbach, 2014). Each element that integrates gamification, or the combination of these, generates different psychological and motivational effects on users. We must consider that the individual motivation of the student that is produced through gamification is a relevant factor in generating changes in behaviour (Von Elm et al., 2007; Mauricio et al., 2015). This gamification methodology, which implies the choice and development of roles, allows the development of coping tools for various situations but also reflects the limitations associated with the cultural and social constructions of these roles in the development of learning itself. Therefore, our research aims to analyze the gaming experience and the possible gender stereotypes that affect the satisfaction of university health science students in the context of gamification.

2 Methods

2.1 Design

An observational cross-sectional study was carried out following the STROBE recommendations [Strengthening the Reporting of Observational Studies in Epidemiology (STROBE); Márquez-Hernández et al., 2019]. The study was carried out at the Faculty of Health Sciences, University of Zaragoza.

2.2 Participants and study location

The study population was made up of students enrolled in the Faculty of Health Sciences, in the degrees of Physiotherapy, Occupational Therapy, and Nursing ($n = 156$). All the students who participated in the study did so voluntarily, completing the informed consent form prior to their participation in the proposed gamification activity. This activity consisted of a digital game carried out in the classroom based on questions related to the contents of the subjects.

2.3 Description of the digital game

The students formed groups of eight and had 45 min to complete the game. Within each group, the students formed pairs, in each game four pairs complete by rolling virtual dice on a digital board and moving tokens as indicated. If the answer to the question contained in

the box was correct, the pairs continued to roll the dice and advance on the board until they answered incorrectly, at which point the turn passed to another group. The winning pair was the one that reached the centre of the board first.

The questions were related to the key concepts, which were important for the theoretical and practical aspects of the task. Do not expose yourself to anyone in a specific order so that the student can integrate and connect the knowledge taught in class through critical thinking. The difficulty of the questions was similar to those asked in class, and each question had four possible answers, with only one being true. Students who did not sign the informed consent or who did not attend class on the day of the activity were excluded from the study.

2.4 Data collection

The evaluation of the activity was carried out individually, immediately after finishing the game, by completing a self-administered online questionnaire consisting of sociodemographic variables (age and gender), the Gameful Experience Scale (GAMEX), and six questions about their opinion on the result of the activity.

The Spanish version of the Gameful Experience Scale (GAMEX) was used (Eppmann et al., 2018). The questionnaire was originally developed by Eppmann et al. (2018) and comprises 27 items classified into the 6 following dimensions: (1) Enjoyment (items 1 to 6); (2) Absorption (items 7 to 12); (3) Creative thinking (items 13 to 16); (4) Activation (items 17 to 20); (5) Absence of negative effects (items 21 to 23); and (6) Dominance (items 24 to 27; Gómez-Urquiza et al., 2019). Each of the items was measured with a Likert scale ranging from 1 (never) to 5 (always). Cronbach's alpha for the whole scale was 0.85, ranging from 0.79 to 0.89 for each separate dimension (Eppmann et al., 2018).

Finally, we included six questions based on a questionnaire used in previous studies (Gómez-Urquiza et al., 2019) to evaluate the outcome of the game activity. The responses to these questions were assessed on a 5-point Likert-type scale ranging from 1 (strongly disagree) to 5 (strongly agree).

2.5 Statistical analysis

R Ver. 4.1.3 (R Foundation for Statistical Computing, Institute for Statistics and Mathematics, Welthandelsplatz 1, 1,020 Vienna, Austria) was used for statistical analysis. The significance level was set at $p < 0.05$. The Shapiro–Wilk test was used to test the distribution of quantitative variables in each course. Quantitative variables were

presented as mean \pm standard deviation and qualitative variables as absolute and relative values (%). The sample size was calculated with the value of Cronbach's α calculated with the responses of the GAMEX scale of the first 20 subjects recruited under the null hypothesis of obtaining a value greater than 0.9 using the critical value to the right of the distribution F2 (Taber, 2018). The GAMEX reliability, in total and in each of its dimensions, was evaluated using the standardized Cronbach's (alpha) calculated from the polychoric correlation matrix. The presence of significant differences between courses was analyzed using the Kruskal–Wallis H test in the case of the GAMEX scale, with *post hoc* tests using the Mann–Whitney U test with Bonferroni correction. In the *ad hoc* survey, Fisher's exact test was used with *post hoc* tests with Bonferroni correction. On the GAMEX scale, the effect size was calculated with epsilon squared (epsilon²; King et al., 2018) being defined as small (<0.08), moderate (0.08–0.26), and large (>0.26), whereas on its own scale it was calculated with Cramer's V (Acock and Gordon, 1979) being defined as small (<0.21), moderate (0.21–0.35), and large (>0.354).

A Biterm Analysis of Thematic Models (BTM) was also applied, which allowed analysis of the occurrence of themes throughout short texts. The selection of the optimal number of subjects was based on the highest likelihood value.

2.6 Sample size

Accepting a risk $\alpha < 0.05$ and a minimum power of 90%, 165 participants were needed.

3 Results

A total of 156 students participated, the most numerous belonging to the courses Nursing (66 students) and Physiotherapy (74 students). Most of the students were women (84.8%) with an age of 21.2 ± 6.2 years (Table 1).

The results of the GAMEX questionnaire are presented in Table 2. The average that reached a higher score was enjoyment (4 ± 0.7) and the lowest score was obtained in the dimension of the absence of negative effects (1.5 ± 0.9). Cronbach's alpha for the whole GAMEX instrument was 0.95 and ranged from 0.8 (Dominance) to 0.9 (Enjoyment) for each separate dimension (Table 2). The presence of significant differences between genders was evident in the responses of the GAMEX scale for *I think that playing is very entertaining* ($p = 0.04$), with more positive scores for men than for women (4.5 ± 0.6 vs. 4.1 ± 0.8), *While playing I felt upset* ($p = 0.03$), with more positive scores for men than for women

TABLE 1 Demographic characteristics of the university students enrolled in health sciences degrees.

| | | Nursing (n = 66) | Physiotherapy (n = 74) | Occupational therapy (n = 16) | Total (n = 156) |
|-------------|--------|------------------|------------------------|-------------------------------|-----------------|
| | | n (%) | n (%) | n (%) | |
| Gender | Female | 56 (84.8) | 65 (87.8) | 10 (62.5) | 131 |
| | Male | 10 (15.2) | 9 (12.2) | 6 (37.5) | 25 |
| | | Mean (SD) | Mean (SD) | Mean (SD) | |
| Age (years) | | 21.2 \pm 6.2 | 20.1 \pm 4.8 | 20.8 \pm 3.7 | 20.3 (3.8) |

(2 ± 1.5 vs. 1.3 ± 0.8), *While playing I felt frustrated* ($p = 0.01$), with more positive scores for men than for women (2.1 ± 1.5 vs. 1.4 ± 0.9), *While playing I had dominance, the feeling of control* ($p = 0.002$), with more positive scores for men than for women (3.2 ± 1.2 vs. $2.5 \pm 1.$), *While playing I felt influential* ($p = 0.01$), with more positive scores for men than for women (3.2 ± 1.2 vs. 2.5 ± 1), and *While playing I felt safe* ($p = 0.004$), with more positive scores for men than for women (4.1 ± 0.8 vs. 3.4 ± 1.06 ; Table 3).

The Mann–Whitney U test was used for the analysis from the gender differences/gender perspective ($p < 0.05$ was considered significant). As can be seen in Table 4, there were significant differences in three dimensions of the GAMEX scale: men had more

enjoyment more while playing than their women peers ($p = 0.05$), enjoyed a greater sense of domination ($p = 0.01$), and experienced fewer negative effects ($p = 0.0003$). No statistically significant differences were found in the rest of the dimensions. The analysis by dimensions of the GAMEX scale shows the highest scores in the sense of enjoyment of the students (Dimension 1: m 4; SD 0.4). No differences were found regarding the suitability for the application of the digital game in other subjects (Table 4).

The results obtained in the analysis of the transferability of the digital game to other activities in the field of health sciences are shown in Table 5. It can be seen that its application to other subjects of the degree (m 4.4; SD 0.5), motivation to study (m 4.1; SD 0.8), and help when remembering concepts (m 4.4; SD 0.5) were some of the items with the highest scores (Table 5).

In the question *What would you include as an improvement?* the topics with the greatest weight were topic 8, which alludes to changes in the organization of the game and, in particular, providing more time, topic 10, which affects the need to make changes in the format of the tests used, and topics 2 and 13, which allude to the need to relate the questions more to the knowledge that students must acquire in the subject. In the question *Add what you want*, the most important topics/themes were topic 2, which again alludes to the need to relate the questions more to the knowledge that students must acquire in the subject, topic 4, which refers to the possibility of doing more games of this type, theme 3, which again refers to making changes to the format of the tests, and theme 1, which affects how the learning of the content of the subject is reinforced through a playful activity (Figure 1).

TABLE 2 Average score and standard deviation for each dimension of the GAMEX questionnaire and reliability for each dimension.

| Items | Mean (SD) | Cronbach's alpha |
|-----------------------------------|-----------|------------------|
| GAMEX total | | 0.95 |
| GAMEX-enjoyment | 4. ± 0.7 | 0.95 |
| GAMEX-absortion | 2.9 ± 1 | 0.94 |
| GAMEX-creative thinking | 3.2 ± 1 | 0.94 |
| GAMEX-activation | 2.9 ± 0.9 | 0.87 |
| GAMEX-absence of negative effects | 1.5 ± 0.9 | 0.93 |
| GAMEX-dominance | 2.8 ± 0.9 | 0.83 |

Standard deviation (SD).

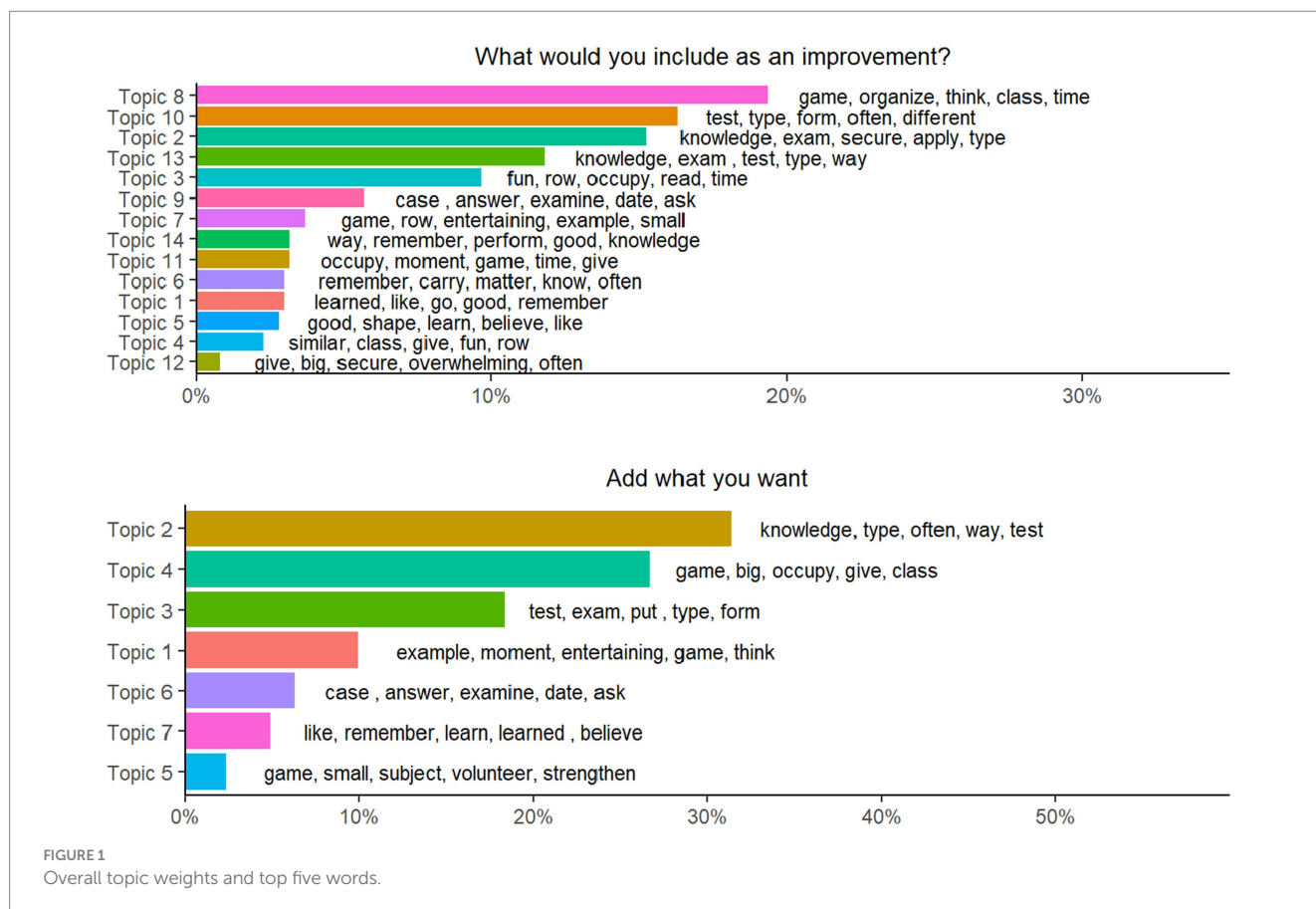


FIGURE 1 Overall topic weights and top five words.

TABLE 3 Differences in the GAMEX scale between genders.

| | Female | Male | ^a <i>p</i> value |
|---|-----------|-------------|-----------------------------|
| <i>n</i> | 131 | 25 | NA |
| | Female | Male | <i>p</i> |
| Enjoyment | | | |
| Playing was fun | 4.2 ± 0.7 | 4.3 ± 0.8 | 0.21 |
| I liked playing | 4.1 ± 0.8 | 4.4 ± 0.8 | 0.07 |
| I really enjoyed playing | 4 ± 0.8 | 4.2 ± 0.9 | 0.23 |
| My experience was pleasant | 4.3 ± 0.7 | 4.3 ± 0.8 | 0.74 |
| I think that playing is very entertaining | 4.1 ± 0.8 | 4.5 ± 0.6 | 0.04* |
| I would play this game by myself, not just if asked | 3.2 ± 1.1 | 3.7 ± 1.1 | 0.06 |
| Absorption | | | |
| Playing makes me forget where I am | 3.1 ± 1.1 | 3.2 ± 1.2 | 0.62 |
| I forgot about the environment while playing | 3.2 ± 1.2 | 3.4 ± 1 | 0.37 |
| After playing, I felt like returning to the real world as if I had returned from a trip | 2.4 ± 1.2 | 2.5 ± 1.2 | 0.66 |
| Playing meant that I got away from everything | 2.6 ± 1.1 | 2.8 ± 1.2 | 0.64 |
| While I was playing, I was completely oblivious to everything | 2.8 ± 1.2 | 3 ± 1.2 | 0.56 |
| While I was playing I asked for the notion of time | 3.1 ± 1.2 | 3.3 ± 1.1 | 0.47 |
| Creative thinking | | | |
| Playing sparked my imagination | 3.2 ± 1 | 3.5 ± 1 | 0.18 |
| While I was playing I felt that I was creative | 3.3 ± 1.1 | 3.6 ± 0.9 | 0.15 |
| While I was playing I felt like I could explore things | 3.2 ± 1.1 | 3.6 ± 0.9 | 0.06 |
| While I was playing I felt adventurous | 2.9 ± 1.2 | 2.9 ± 1 | 0.73 |
| Activation | | | |
| While playing it was activated | 3.8 ± 0.9 | 3.9 ± 0.8 | 0.54 |
| While playing I was nervous | 2.4 ± 1.3 | 2.7 ± 1.3 | 0.22 |
| While playing I was frantic | 2.4 ± 1.2 | 2.5 ± 1.4 | 0.71 |
| While playing I was excited | 3 ± 1 | 3.4 ± 1.1 | 0.14 |
| Absence of negative effects | | | |
| While playing I felt upset | 1.3 ± 0.8 | 2.04 ± 1.53 | 0.03* |
| While playing I felt hostile | 1.5 ± 0.9 | 2.1 ± 1.6 | 0.10 |
| While playing I felt frustrated | 1.4 ± 0.9 | 2.1 ± 1.5 | 0.01* |
| Dominance | | | |
| While playing I had dominance, the feeling of control | 2.5 ± 1 | 3.2 ± 1.2 | 0.002* |
| While playing I felt influential | 2.5 ± 1 | 3.2 ± 1.2 | 0.01* |
| While playing I felt autonomous | 3.2 ± 1 | 3.6 ± 1.1 | 0.08 |
| While playing I felt safe | 3.4 ± 1 | 4.1 ± 0.8 | 0.004* |
| Playing this game has helped me in studying the subject | 4.4 ± 0.6 | 4.5 ± 0.7 | 0.16 |
| I enjoyed playing | 4.2 ± 0.7 | 4.1 ± 0.8 | 0.38 |
| I think this game will help me pass the exam | 3.9 ± 0.9 | 4.1 ± 0.8 | 0.26 |
| I recalled and applied subject knowledge during the game | 4.3 ± 0.6 | 4.2 ± 0.7 | 0.58 |

^aSignificant if $p < 0.05$ (shown with *).

4 Discussion

The results of our research show that students enjoyed the learning experience through gamification. The majority of student participants were women; gender differences can be explained by the fact that

women have greater access to healthcare studies than men. This is because historically they have been considered an extension of the female role (Arroyo et al., 2011), and in addition, we still see gender biases incorporated into the professional expectations of students (Porcel-Gálvez et al., 2015).

TABLE 4 Suitability for the application of the game in other subjects of the degree.

| | | | |
|--|-----------|-----------|------|
| There should be more activities like this in the degree | 4.2 ± 0.8 | 4.4 ± 0.8 | 0.17 |
| The game motivated me to study the subject even if there was still time until the exam | 4.1 ± 0.8 | 4 ± 0.8 | 0.61 |
| The game format could be applicable to other subjects of the degree | 4.3 ± 0.7 | 4.5 ± 0.7 | 0.31 |
| In the basic subjects of the degree, it would be difficult to carry out this type of activity | 2.9 ± 1.4 | 2.7 ± 1.4 | 0.56 |
| I consider that these types of activities are not appropriate in a health sciences degree | 1.6 ± 1.2 | 1.6 ± 1.2 | 0.89 |
| The realization of this type of activities should have greater importance in the field of university education | 4 ± 1 | 4.1 ± 0.8 | 0.88 |

TABLE 5 Characteristics of the suitability of the activity and learning experience.

| | | Female | Male | p value |
|--|----------------|------------|-----------|---------|
| | | N (%) | N (%) | |
| Did you think it was an appropriate learning strategy? | No | 1 (0.7) | 1 (3.7) | 0.74 |
| | Yes | 137 (99.3) | 26 (96.3) | NA |
| Did you find it an innovative learning strategy? | No | 4 (2.9) | 0 | 0.83 |
| | Yes | 134 (97.1) | 27 (100) | NA |
| Have you already used it as learning? | No | 71 (51.4) | 10 (37) | 0.24 |
| | Yes | 67 (48.6) | 17 (63) | NA |
| | | Mean (SD) | Mean (SD) | |
| Total score | | 3.2 ± 0.5 | 3.5 ± 0.6 | 0.06 |
| | Disagree | 11 (8.0) | 1 (3.7) | 0.45 |
| | Neutral | 88 (63.8) | 15 (55.6) | NA |
| | Agree | 35 (25.4) | 9 (33.3) | NA |
| | Strongly agree | 4 (2.9) | 2 (7.4) | NA |

The men, despite being in a minority, enjoyed the serious game activity more, had a greater feeling of dominance, and experienced fewer negative effects. It was shown that there were gender differences in the performance of the gamification activity regarding the feeling of self-control predominantly over the rest of the dimensions studied. This could be because male students are more competitive (Corchuelo-Rodríguez, 2018). Additionally, in line with the data indicating that

63% of male students had already used this learning strategy, which could motivate them and enable them to enjoy the game because they did not have to be aware of the dynamics of the game. In terms of the transferability of the activity to other subjects within the nursing degree, students gave higher scores for the “motivation to study” and “helped to remember concepts”.

Effects associated with different digital generations (such as X, Y, and Z) were found to be associated with the strongest contextualization of web content obtained among Generation X (those born between 1965 and 1979) (Yawson and Yamoah, 2020). However, it must be considered that students characterize the game as a comfort zone; they are the generation that has had to live with such technology, so they must know the educational intent of the use of games. If this is not explained, it can generate a perception of time loss in students with regard to activities that have little to do with their learning (Koivisto and Hamari, 2019). We have to take into account that students spend an average of 7.42 h a week dedicated to playing video games [Asociación Española de Videojuegos (AEVI), 2022]. EChanges in the average weekly time spent playing video games (in hours) among the Spanish population from 2013 to 2022 (Statista, 2022). In addition, the academic satisfaction associated with the fun that “the game” could generate is perceived as the pleasant state that occurs in the student, who can gain a high level of identification and enjoyment in what you do (Salinas et al., 2008; Calbacho et al., 2021).

The classification of the groups acts as motivating elements for those participants who appear in the top positions but may be demotivating for those who are not at the top of the list (Aldemir et al., 2018). Therefore, Sousa et al. (2022) suggest that the game should not generate situations in which some players feel intimidated as this can affect motivation (Sousa et al., 2022); however, the game should not be too easy as it will cause disinterest and boredom (Contreras and Eguia, 2017).

An interesting concept is “flow,” which is a state that an individual reaches when they are fully focused on enjoying the activity they are carrying out (Csikszentmihalyi, 1990). As the game progresses, this flow channel must be maintained through the learning of constant skills/knowledge. In our study, this state is generated through the questions that are proposed and the relationship that is generated between groups.

The characteristics of our participants were like those of other studies conducted with the Spanish university population, with most participants being women. Gender has already been shown to influence engagement in video game activities (Ogletree and Drake, 2007). Our research demonstrates that the dimension of absence of negative effects and the items “while playing I was disappointed” and “I was frustrated” were scored significantly higher by the male gender. As reported in other studies, men tend to be more independent, competitive, and affirmative, are more instrumental in their behaviour, and are more influenced by technology than women (Suppan et al., 2021).

The impact of language on the messages conveyed by a serious game has scarcely been studied and deserves attention and could be an appropriate way to identify learner profiles and adapt the game accordingly (Jaccard et al., 2021). Therefore, it is recommended that special care is taken in the design, planning, and implementation of the strategy (La, 2017).

The influence of gender in the learning process is considered a demographic variable and the most important in decision-making (Venkatesh and Morris, 2000; Chen et al., 2016). In addition, these

meetings should explore different topics such as these developments and may also reveal cultural differences. It could be appropriate to carry out focus groups to determine the shortcomings of the current version of this game and the elements that could make it more engaging. Different focus groups would be required to take into consideration elements specific to particular social, cultural, and linguistic backgrounds.

Gamifying consists of building a scenario in which the participants become the protagonists and advance to achieve a proposed challenge using some of the game elements. We have to take into account that this type of learning through play becomes active and critical learning and is a commitment to self-learning. Therefore, it is very necessary to develop the proposed activities so that they are experienced as a game (Gee, 2008). Furthermore, it would be interesting to consider the design of the activities, and it would be convenient to implement individualized gamification activities within the classroom for each of the genres or groups so that motivation could be enriched through the self-learning of the students. Discover concepts and stimulate student learning in a supportive classroom environment (Dicheva et al., 2015).

5 Limitations

This study has limitations. First, given that the university degrees in health sciences at the University of Zaragoza are attended mostly by women, men are under-represented in the sample. Second, the gamification activity designed in this study was carried out for the first time in the 21–22 academic year; therefore, it has not been possible to determine whether there has been an improvement in academic performance compared with other courses based on traditional teaching.

6 Conclusion

Given the same gamification activity, there are gender differences. In the dimension of the GAMEX scale of absence of negative effects and dominance, it was the male students who scored higher than the female students. In addition, practically all participants from both genders considered the application of the game in other subjects of the university degree suitable.

It would be interesting to take this into account for the design of the activities, in addition to being able to implement individualized gamification activities within the classroom for each of the genders or for the groups to be of different genders so that the experience could be enriched (men are more competitive and the female participants focus more on the mechanics of the game), and therefore, they could complement each other and promote the learning of the concepts presented. In this way, the skills of the students would be strengthened and, consequently, the quality of their future professional work would be improved.

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Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding authors.

Ethics statement

The participants provided their written informed consent to participate in this study.

Author contributions

BR-R: Conceptualization, Data curation, Investigation, Methodology, Writing – original draft, Writing – review & editing. EC: Conceptualization, Data curation, Investigation, Methodology, Writing – original draft, Writing – review & editing. IG-S: Conceptualization, Data curation, Investigation, Methodology, Writing – original draft, Writing – review & editing. YM-R: Conceptualization, Data curation, Investigation, Methodology, Writing – original draft, Writing – review & editing. JC-Z: Conceptualization, Data curation, Investigation, Methodology, Writing – original draft, Writing – review & editing. EA-G: Conceptualization, Data curation, Investigation, Methodology, Writing – original draft, Writing – review & editing. AS-V: Conceptualization, Data curation, Investigation, Methodology, Writing – original draft, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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