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Can Gamification Influence the Academic Performance of Students?

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Abstract: Gamification along with a whole range of other active methodologies are being incorporated into university classrooms due to their potential benefits for student learning. The aim of this paper was to analyse how a multimodal learning environment based on gamification could affect the final grades of university students in a subject taught at the Faculty of Education in a spanish university. The research was made up of 133 Spanish university students (Mage = 19.60; SDage = 0.43 years old). A quasi-experimental post-test design with a control group was used. The control group and the intervention group consisted of 66 and 67 students respectively. A multimodal gamified learning environment was set up for the intervention group, in contrast to traditional teaching methods which were reserved for the control group. Each one was implemented throughout an academic year. The results revealed statistically significant differences in the final average grade ($p < 0.001$), with students from the intervention group obtaining higher overall scores. The same occurred in the voluntary learning tasks, with students from the intervention group earning more Health Points ($p = 0.006$), more Experience Points ($p = 0.005$), a higher Total Score ($p = 0.002$) and a higher Level Achieved ($p = 0.002$). These findings point to the fact that a multimodal gamified learning environment can influence the academic performance of students. However, more scientific research has to be carried out in order to support these findings.

Keywords: teaching/learning strategies; gamification; adult learning; media in education; distance education and online learning

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1. Introduction

The One of the 17 objectives established by the United Nations for their 2030 Agenda is to guarantee an inclusive, equal and quality education for all and to promote learning opportunities for everyone throughout their lifetimes [1]. Active methodologies which focus on the learning process and the student are becoming more prevalent and have been proven to provide a higher quality education [2,3]. The range of their potential benefits, such as lowering stress and anxiety levels, improving student performance and improving different skills in comparison to traditional methods, has been the focus of study for a number of authors [4–7], as well its effects on teacher behaviour [8].

1.1. Gamification as an Active Methodology

One of these methodologies is gamification. Over the last few years there has been an increase in scientific interest in this field [9]. Gamification in the educational sphere can be understood as a learning technique which uses elements from games and/or computer

games in non-recreational environments, with its main objective being to create behavioural patterns or to encourage certain behaviours in students [10]. It can affect the intrinsic and extrinsic motivation of the student and their effort and commitment towards carrying out a certain task [11,12]. In this sense, its aim is to create attractive and interesting learning experiences that arouse students' curiosity and capture their continuous attention [13]. By means of a systematic review of other empirical studies some authors [14] have studied the effects of gamification after its implementation and have confirmed that it can have positive effects, but that these depend on the context in which it is implemented, as well as on the particular users. Another paper [15] analysed the impact of a gamified educational experience, showing that it led to an improvement in a few of the studied areas, but a lower performance in others, leading the authors to question some of the common assumptions concerning the benefits of implementing gamification in education. This may be because, as is the case with games and video games, motivation may increase in some people but decrease in others given the ambivalent effect of games, whereby some players may experience feelings of frustration if they do not achieve their purpose [16]. Motivation is also influenced by the cognitive and emotional aspects (psychology and neuroscience) of gamification. In this sense, some authors [17] uphold the need to establish a cognitive-emotional approach to gamification in order for it to be successful and to engage participants by generating both positive and negative emotions, as there has been little written on how to create emotional experiences through gamification design.

Gamification began in the word of business and quickly caught hold thanks to its level of success in areas such as: improving customer loyalty, worker commitment to their respective companies or the increase in the purchase or contracting of certain products and services [18,19].

1.2. The Creation of Gamified Learning Environments (GLEs)

In the sphere of education, it is more correct to speak of the creation of gamified learning environments (GLEs), the design of which is comprised by 4 main blocks and more than 25 key elements [10] (see Figure 1).

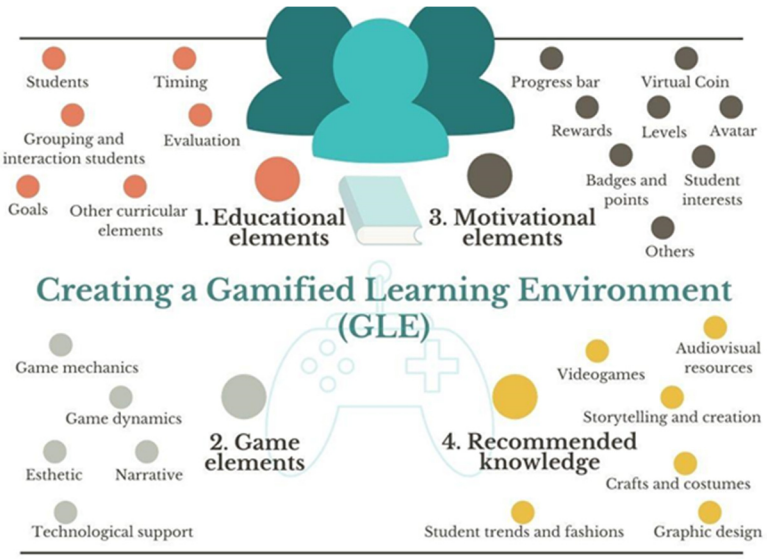

Figure 1. Creating a Gamified Learning Environment (GLE) [10].

Other authors, Toda et al. [20] have proposed a taxonomy of 21 game elements to be used in GLEs and have organized these elements into 5 categories depending on performance/measurement, environment, social/personal interaction and student experience.

Creating a GLE entails the planning and proper design of the entire process, the steps to be taken, the objectives to be achieved, and the assessment that will measure the attainment of the objectives. Furthermore, it also entails designing all the rules, dynamics,

incentive elements and, above all, integrating different areas of knowledge: educational, technological or creative, among others. Van Roy and Zaman [21] have pointed out that in order for gamification to be successful in the educational field, nine important premises must be fulfilled, and these have been extended by other authors (see Figure 2).

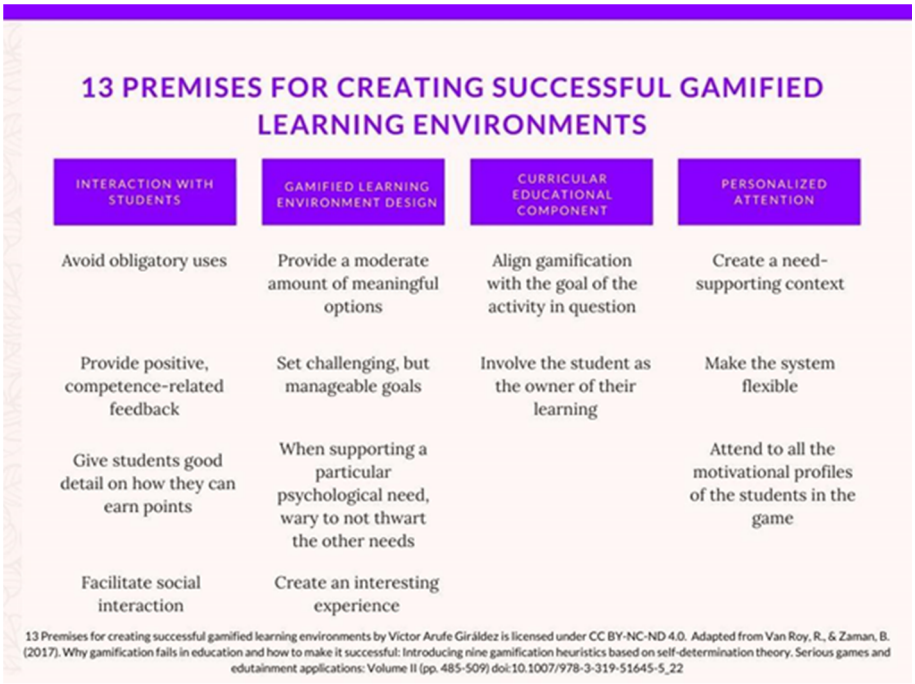

Figure 2. 13 Premises for creating successful gamified learning environments. Arufe-Giráldez, V., adapted from Van Roy & Zaman [21].

In our research, gamification focused on the establishment of a system of points, leaderboards and levels that were awarded to students for carrying out different academic activities voluntarily, to reinforce or expand the knowledge acquired during the development of the subject. Other studies [22] that addressed the establishment of a point system in students confirm that employing a combination of game elements such as leaderboard, points system, competition, badges, levels, and immediate feedback can serve as a recipe for interactive learning, hence, improves learning outcomes. A literature review on gamification and e-learning education [23] confirmed that within the creation of a gamified learning environment the most common gamification elements used and that have a powerful effect on students are points, leaderboards, the badge and the level. Other authors, Amo et al. [24] confirmed in a sample of 88,310 users strong causal evidence of points and classification tables established in a gamified informal learning environment, triggering certain structural and trait competitiveness, which interact to affect both engagement and performance growth in contexts informal learning.

Another important aspect to take into consideration in the creation of a GLE is that it must cater to the four player profiles established by Bartle [25] in order to guarantee a minimum degree of motivation for each student, regardless of their motivational profile in the game. These are, the killer player who, further than winning, guarantees the existence of losing players, the achiever player, who will seek to win above everything else, earning points, gathering badges, etc., the explorer player who likes facing new challenges and discovering things that others have not been able to and the socializer player, who prioritises the social aspect and interaction with other colleagues and adversaries over other roles. In this sense, Zaric, Lukarov & Schroeder [26] highlight the importance to create a balanced, gamified learning environment in which all learners are equally engaged and interested. However, finding the balance between heterogenic learners' traits and the variety of gamification design elements is a challenging, multistep process. The study

confirmed a positive influence of badges, leaderboards, and experience points on learners with reflective, global, visual, and intuitive learning tendencies.

1.3. The Creation of Gamified and Multimodal Learning Environments in Higher Education

The GLE can be further enhanced if it is set in the context of a multimodal system [27], whereby students can continue to work on the contents of the subject in different ways and seek rewards outside the formal educational environment. Thus, multimodal learning systems respond effectively to the demand of many people involved in teaching-learning processes in technologically enriched societies [28]. In addition, the use of the internet, social networks and different Information and Communication Technologies (ICTs) can favour content learning outside of the ordinary classroom hours by means of different learning techniques and strategies such as mobile-learning or e-learning [29–33].

A literature review [34] that addressed the perception of university students about gamification in Higher Education confirms a growing interest in the scientific community to propose works on gamification in Higher Education. In addition, a favorable predisposition of students towards the development of innovative didactic experiences based on gamification is corroborated. Among its potential, it stands out the increase in motivation, interest and participation of students in the teaching-learning process, together with the improvement of their academic performance and the development of the skills and competencies necessary for their professional development.

Taking into account everything that has been mentioned regarding how a multimodal GLE should be created so as to ensure the success of the gamification and the positive implications for students, the main aim of this paper was to analyse the impact of a GLE based mainly on points, leaderboards and levels on the academic performance of university students and compare this with the performance of students in a non-gamified learning environment which used traditional teaching methodologies. Thus contributing to the study of the impact of a gamified learning environment on the academic performance of Higher Education students. The GLE was based on the obtaining of points and levels for the accomplishment of voluntary academic tasks, and the feedback to the students through the publication of weekly classification tables. The following hypothesis were established: firstly, that the incorporation of a multimodal GLE improves the academic performance of students and secondly, that students who get the most involved in the gamification and who earn the most points in the completion of volunteer academic tasks obtain a higher final grade in the subject.

2. Materials and Methods

2.1. Specific Research Questions

The research had the following specific research questions: Does a multimodal gamified learning environment based on points, levels and leaderboards lead to higher academic performance in students? and Did the students who get more involved in gamification (get the most points) get a higher academic grade in the subject?

2.2. Study Design and Participants

To carry out this research, a quasi-experimental design was developed with post-test measures involving a control group, which carried out longitudinal, descriptive, analytical and comparative analysis [35]. Quasi-experimental research has been chosen due to the impossibility of randomizing the sample. As Fernández-García, et al. [36] points out, quasi-experimental studies are characterized by studying the impact of treatments and/or processes in situations where the subjects have not been assigned according to a random criterion, being able to be even imposed by some organization, such is the case of this study, where students from one group or another are grouped into one class or another in alphabetical order of their surnames.

In addition, the strengths and weaknesses identified in the systematic review on gamification conducted by Hamari et al. [14] were taken into account for the design of the GLE.

The study sample consisted of a total of 133 university students (92.5% women and 7.5% men) from the Faculty of Education from a Spanish university, with an average age of 19.60 (SDage = 0.43). The sample selection was of non-probabilistic type according to the student body accessed. The participants were not randomly assigned to groups, but rather to natural groups according to whether they belonged to the same class and academic year (2018–2019 vs. 2019–2020).

Thus, initially, a group of students (control group. CG) received a traditional teaching methodology (without gamification) during the 2018/2019 academic year. And another group of students (experimental or intervention group. IG) had the opportunity to voluntarily participate in the gamified learning environment during the 2019/2020 academic year. As participation in gamification was voluntary, within this experimental group, two subgroups were established, experimental group with participation in gamification (IGwithPG) and experimental group without participation in gamification (IGwithoutPG).

A control group (CG) was established [N = 66 (50.4%)], made up of students from the 2018–2019 academic year who were taught following a traditional style and an intervention group (IG) (N = 67) from the 2019–2020 academic year, of which 39 (29.3%) participated voluntarily in the gamified experience (Intervention Group with participation in gamification, IGwithPG) and 27 (20.3%) did not (Intervention Group without participation in gamification, IGwithoutPG). In this study, the authors refer to traditional teaching as one where the teacher does not use active methodologies, predominantly lectures given by the teacher and practical sessions with greater intervention by the student but always directed by the teacher. However, in active methodologies the use of gamification is incorporated through which students are autonomous in learning and obtain knowledge about different contents of the subject on their own initiative through the performance of different voluntary tasks. The control group students were told that if they did any merit related to the different gamification tasks, they should notify the teacher of the merit, in no case were they informed of the objective of this analysis and neither of the obtaining of possible points. This was done to register the possible points that could be obtained in case of gamification.

2.3. Process

Research was carried out over a two-year period within the framework of the same subject taught by the same teacher to two separate academic years. In this sense, during the initial 2018/19 academic year the control group (CG) of students (N = 66) received a traditional style of teaching, in contrast to the intervention students (N = 67) from the second 2019/20 academic year, who, over the course of the same subject received a multimodal GLE. Participation in the GLE was voluntary and so the intervention group had two subgroups: Intervention Group with participation in gamification (IGwithPG) which had N = 39 students who actively participated and the Intervention Group without participation in gamification (IGwithoutPG) which had N = 27 students who did not attempt to earn points (Figure 3).

Both the final grades of each student for this particular subject as well as the average grades from all their other course subjects were taken into account so as to be able to qualify the possible effects of the gamification on the student's academic performance and rule out the fact that students with higher overall grades may also be the ones getting the highest grades in this particular subject.

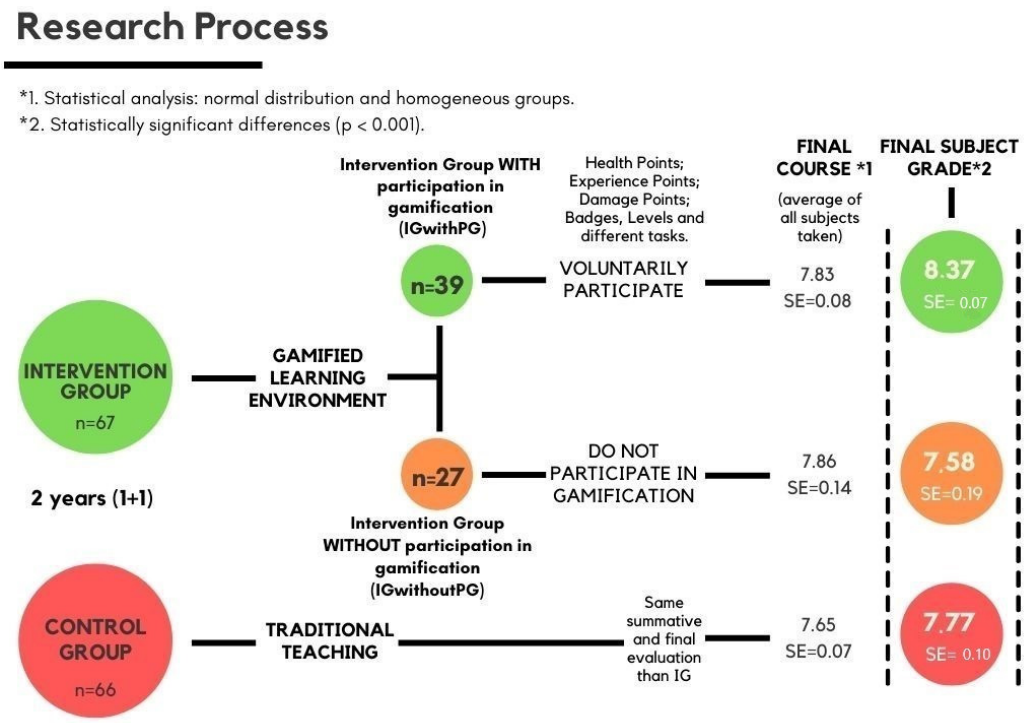

Figure 3. Scheme process research. Source: Self made. Explanatory note: One student in the intervention group dropped out of the subject, so he was not subsequently assigned to any of the intervention subgroups.

2.3.1. Narrative

Narrative is a very important feature in the creation of a GLE. It constitutes a veritable driving force behind motivation and is part of the taxonomy of gamification [20]. To determine it, student's interests must be taken into account in order to gain as much participation as possible.

The professor should consider the content or type of leisure activities consumed by the students. In this sense, in this university setting, many of the students follow a series on the audio-visual entity Netflix© called La Casa de Papel (Money Heist). The GLE narrative was consequently based on this highly popular series which, last year, was the most viewed on the Netflix platform with over 65 million views [37]. On the experimental group's first day of class, they were shown a specially created video-trailer, which had a strong motivational component whereby The Professor, who was wearing a mask, asked for student participation to help complete an important mission which would improve current society. The objective of the mission was closely linked to the skills, objectives and learning contents established by the Official Teaching Guide for the subject and also to the sustainable development objectives 3 and 4 of the 2030 Agenda [1].

The initial video warned students that only those who got the most involved and who obtained the most final points would be selected by The Teacher to carry out an important mission which would change the lives of many people. In order to increase the motivation of the students and to increase their commitment to the gamification, a photoshoot of each team was carried out on the first day to strengthen the cohesion among the groups.

The creation of the subgroups within this experimental group was established at the end of the subject when all the merits made by the students were analyzed.

Those students who voluntarily performed academic tasks proposed by the teacher and who added health or experience points, were assigned to the intervention group with participation in gamification. And those students in the intervention group who did not feel motivated to do the extra tasks that were gamified were assigned to the intervention group without participating in the gamification.

As an explanatory note, it can be seen that class attendance was included in these gamified tasks, however, the students who only obtained points in this task were not considered as members of the intervention group with participation in the gamification, but as members of the intervention group without participation in the gamification, since attending class in a certain way was mandatory to be eligible for the evaluation.

2.3.2. Rules and Dynamics of the Gamification and Point System

Students were invited to visit the website where all the information regarding the project was published, such as the objectives they had to fulfil, the activities and tasks they could do to earn points, etc. Three types of points were used: health points, experience points and damage points. They could all be obtained through different actions or tasks which were related to the subject matter and which served to improve the student's performance. A range of ICTs had to be used in order to carry out the different activities, including: Youtube, Microsoft Teams, Moodle, Wordpress, Twitter, Facebook, LinkedIn, Instagram, Office, Dialnet, Web of Science, Scopus, among others.

Health Points (HP)

Health Points (HP) are points that students can earn to improve their health. The player's health is understood as a state of personal well-being, in which knowledge and critical thinking are strengthened, and social interaction is promoted, providing feedback to others regarding what the student can contribute during the course. In short, the player's health depends on a series of actions and/or activities developed to improve his or her professional and human resources, values, knowledge, ethics, morals and psychological and psychosocial variables. To achieve HPs the student can carry out the actions indicated in the following table (Table 1).

Table 1. List of actions the student can carry out to earn HP.

Action	Health Points (HP)
Share an article related to the subject on Social Media	1 HP
Share a thought-provoking sentence on Social Media	5 HP
Attend class	5 HP
Good behaviour and attitude in class	5 HP
Attend tutorial sessions to learn more about topics covered in class	5 HP
Read a scientific article related to the subject and provide an analysis	20 HP
Read a chapter of a book related to the subject	20 HP
Read a whole book related to the subject	200 HP
Win a battle	300 HP
Other agreed upon actions	X HP

Students will be able to share their own phrases with non-copyrighted images on social networks that invite people to reflect on the importance of the content of the subject by tagging the teacher and using a previously agreed upon hashtag.

Experience Points (EP)

Experience Points (EP) are points that students can earn to improve their experience in regards to their future careers. In contrast to health points, EPs revolve around gaining experience for their future profession as teachers. These points will give the student greater qualifications, skills and professional efficiency. In order to achieve EPs, these actions can be carried out as indicated in the following table (Table 2).

Table 2. List of actions the student can carry out to earn EP.

Action	Experience Points (EP)
Complete a secret mission	10 EP
Interview teachers who have been awarded for their teaching	20 EP
Informal coffee or drink with an educational expert	20 EP
Volunteer in the educational sphere	25 EP
Attend a course or congress that lasts less than 9 h	25 EP
Attend a course or congress that lasts more than 10 h	150 EP
Other agreed upon actions	X EP

Damage Points (DP)

Damage Points (DP) are points which the student can receive directly or indirectly. These will be subtracted from the sum of their HPs and EPs. Players can receive DPs if they carry out any of the actions listed in Table 3.

Table 3. List of actions which cause DP.

Action	Damage Points (DP)
Inappropriate language	20 DP
Arrive late to class	20 DP
Inappropriate behaviour	50 DP
Lose a battle	500 DP
Other agreed upon actions	X DP

Health points and experience points were always positive, whereas damage points were subtracted from the sum of the previous two. Finally, after reaching 50 points, players could ascend to a new level, with these levels being infinite.

Students could earn points weekly both within and outside the class period. In order to qualify all the tasks and activities they were carrying out, a public forum was opened on the project website where students had to upload all the tasks they had completed together with an explanation for each, before each Saturday at 11.59 pm. On Sunday, the teacher would then download all the assignments and would establish a new ranking (leaderboards) which would be published on Monday on the project's website and sent out by email to the students so that they would know how they were ranked.

Students could indicate the activities they had carried out in order to get a score starting from the first week of class up until the last week of class. The subject had a duration of four months. Participation in the GLE was not associated with any gain in the student's academic qualification, it was voluntary and the only benefits obtained were the final points and levels.

2.3.3. Subject Assessment

The assessment was the same for both academic years, including both the control group and the experimental group, and was divided into three separate parts. Firstly, a final project done by groups of 4–5 students was assessed and marked, then the 5 compulsory tasks that the students had to do during the four-month period were assessed and thirdly, students had to take a final written test.

2.4. Data Collection Instrument

To calculate the points they had earned, the transformation of these into levels, as well as the creation of individual and group rankings, a specific excel sheet was created, which was updated weekly with the latest provisional ranking. Then, following the conclusion of the subject, this data was checked and prepared and a data file was created in IBM's SPSS statistical programme for the statistical processing of the data.

2.5. Ethical Aspects

To carry out this research, permission was requested from the participating university data protection office to obtain the academic qualifications of the students for research purposes. The entire research protocol was sent to the Ethics Committee of the national EDUCA platform for review so as to receive any input that could improve the research process, being accepted by said institution with code 12018. Also, throughout, the work complied with the ethical recommendations reflected in various official documents and treaties on ethics in educational research, thus guaranteeing the anonymity of the participants, respect for them, confidentiality in the data reflected in the form, compliance with professional deontology and other ethical considerations related to research in education [38,39].

2.6. Data Analysis and Statistical Treatment

Descriptive statistics and differences were calculated according to the group variables: Control Group (CG) and Intervention Group (IG) divided into these two groups: Intervention Group with participation in gamification (IGwithPG) and the Intervention Group without participation in gamification (IGwithoutPG). The normality tests (kolgomorov-Smirnov) revealed a normal distribution. The T-test for independent samples was used to evaluate the differences of the Control groups (CG); Intervention with participation (IGwhithPG); Intervention without participation (IGwhihoutPG) in the different scores that were assessed in the gamification [i.e., Final grade for subject (GFS), Health points (HP), Experience points (EP), Total Points (TP), Level Reached (LR)].

Statistical power was expressed using Cohen's d statistic, with d = 0.20 being low; d = 0.50 mean; d = 0.80 high. The significance level was set at $p \leq 0.05$ for the different tests. Analysis was carried out using the IBM SPSS statistical program (v. 25.0).

3. Results

3.1. Descriptive Analysis, Normality and Reliability Analysis

The results of the Kolmogorov-Smirnov test indicated that the data displayed a normal distribution with respect to the average grade of students (p = 0.354), the benchmark variable. In addition to the average grade of the subject, students' average grades for the academic year were also analysed so as to rule out any possible influence in this sense. The analysis carried out indicated that the groups were homogeneous with respect to students' average grades for the academic year as there were no statistically significant differences (t (131) = −1.804; SE = 0.11; $p > 0.05$).

3.2. Analysis of the Variables after the Implementation of the Gamified Learning Environment

Table 4 shows an overview of the averages and the standard errors committed by the control group and the intervention group.

Table 4. Averages and standard error of the variables studied in the control and intervention groups.

Variables	Control Group		Intervention Group with Participation in Gamification (IGwithPG)		Intervention Group without Participation in Gamification (IGwithoutPG)	
	A	SE	A	SE	A	SE
Final grade for subject (FGS)	7.77	0.084	8.37	0.07	7.58	0.19
Health points (HP)	43.68	2.31	491.79	155.44	40.77	0.98
Experience points (EP)	16.80	6.58	684.10	224.08	0.00	0.00
Total Points (TP)	60.48	6.94	1175.89	332.78	40.70	0.98
Level Reached (LR)	1.35	0.13	23.53	6.66	1.00	0.00

Grade: A = Average; SE = Average standard error.

Given the normal characteristics of the data, parametric tests were used. The results show significant differences in the FGS variable [t (131) = −4.294; p = 0.001; d = 0.75], with

students who had participated in the gamified experience (IGwithPG) achieving a higher grade in the subject.

In terms of Health Points, there are again statistically significant differences [t (131) = −2.882; $p = 0.006$, d = 0.50], with the students who participated in the experience having the greatest motivation to carry out the tasks in order to achieve these points (it is important to remember that these points, like the previous ones, did not alter student's final grade in the subject).

With regard to the Experience Points [t (131) = −2.977; $p = 0.005$; d = 0.52], students participating in the gamified experience obtained more points by taking part in more activities. The same holds true for the Total Points [t (131) = −3.351; $p = 0.002$; d = 0.59], with students participating in the gamified experience achieving the highest total score by engaging in more tasks in order to achieve a greater number of Health Points and Experience Points. Finally, with regard to the Level Reached, the students from the experimental group achieved a higher level. In comparison with the control group [t (131) = −3.329; $p = 0.002$; d = 0.58].

As for the students belonging to the intervention group who chose to participate as opposed to those who did not, in spite of having been invited to participate, statistically significant differences were found in all the previous variables (i.e., FGS ($p = 0.001$); HP ($p = 0.006$); EP ($p = 0.004$); TP ($p = 0.002$) and LR ($p = 0.002$); with students who participated obtaining higher scores and a higher overall final grade than those who did not take part.

Table 5 shows the minimum and maximum values obtained in terms of health points, experience points and the total points in both groups (control and intervention group). A high number of the obtained points can be seen in the sum of the activities aimed at achieving health points as well as experience points and total points.

Table 5. Minimum and maximum values for health points, experience points and total points for the control group and the intervention group.

Points	Control Group		Intervention Group	
	Minimum	Maximum	Minimum	Maximum
Health Points	0	250	30	5063
Experience Points	0	450	0	5185
Total Points	10	495	30	6283

The box plot (Figure 4) shows the average points obtained by the control groups and experimental group 1 (active participation in the GLE) and experimental group 2 (no active participation in the GLE).

It should be noted that we have considered publishing the voluntary academic tasks (Figures 5 and 6) carried out by the total number of students in the intervention group, but these have actually been carried out mostly by the students who were most involved in gamification (students in the intervention group with participation in gamification).

The quantitative analysis of the number of academic tasks associated with health points carried out by the students of the intervention group indicates that their preference was to share phrases to make the population aware of the importance of physical activity in children's health (subject content). In second place were the tasks related to sharing news related to the content of the subject and finally the students read a total of 79 books also related to the content of the subject.

In relation to obtaining experience points, the activity most carried out by students was attending courses or conferences lasting less than 9 h, followed by courses and congresses lasting more than 10 h, which provided students with important knowledge by the official extra-academic route.

The following scatter plots (Figure 7) provide a visual representation of the total point spread and the final grade of the subject obtained by the students in the intervention group

(Intervention Group with participation in gamification, IGwithPG and Intervention Group without participation in gamification, IGwithoutPG). Some students stand out because of their high involvement in the gamification. The multimodal GLE had a voluntary participation of 58.2% of the students, while 41.8% were not motivated to perform any of the proposed tasks and obtain points.

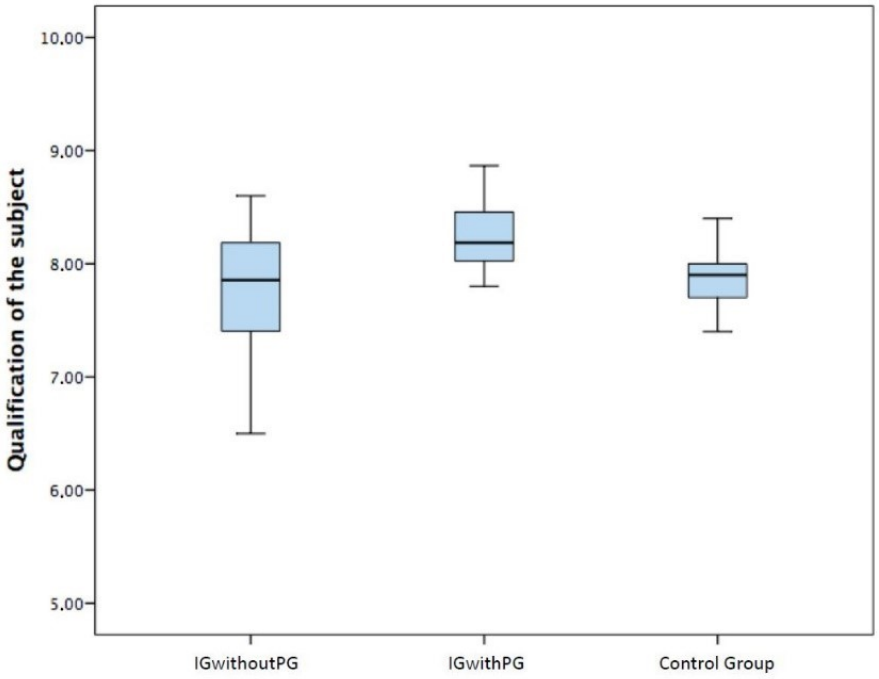

Figure 4. Box plot showing the final grades obtained in the subject by the three groups.

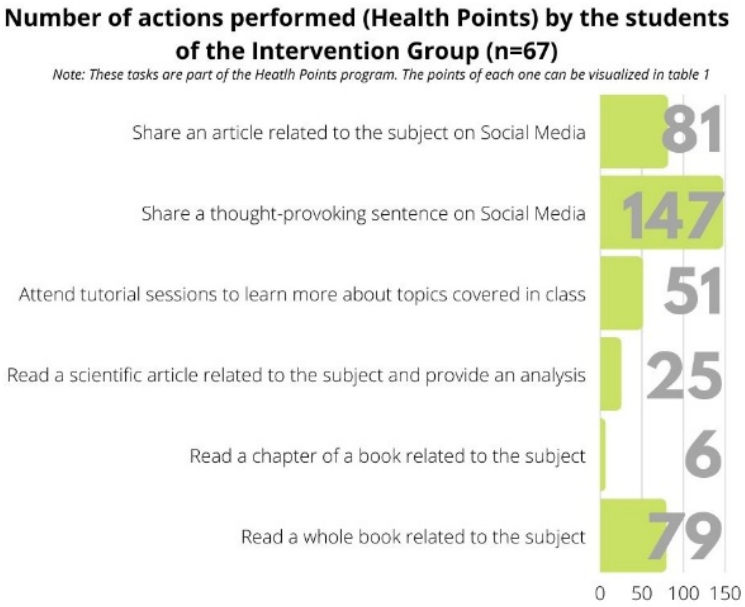

Figure 5. Number of academic tasks carried out by the students of the intervention group to obtain Health points.

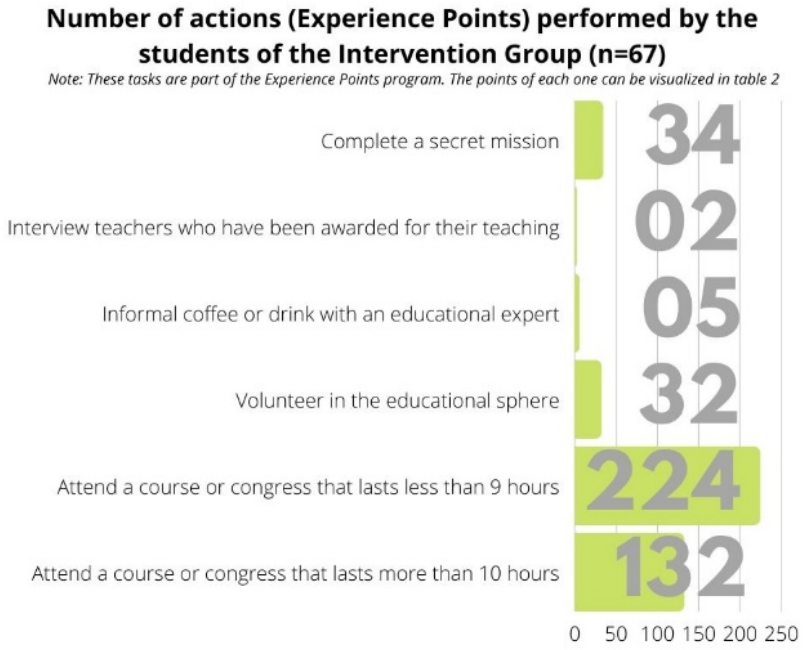

Figure 6. Number of academic tasks carried out by the students of the intervention group to obtain Experience points.

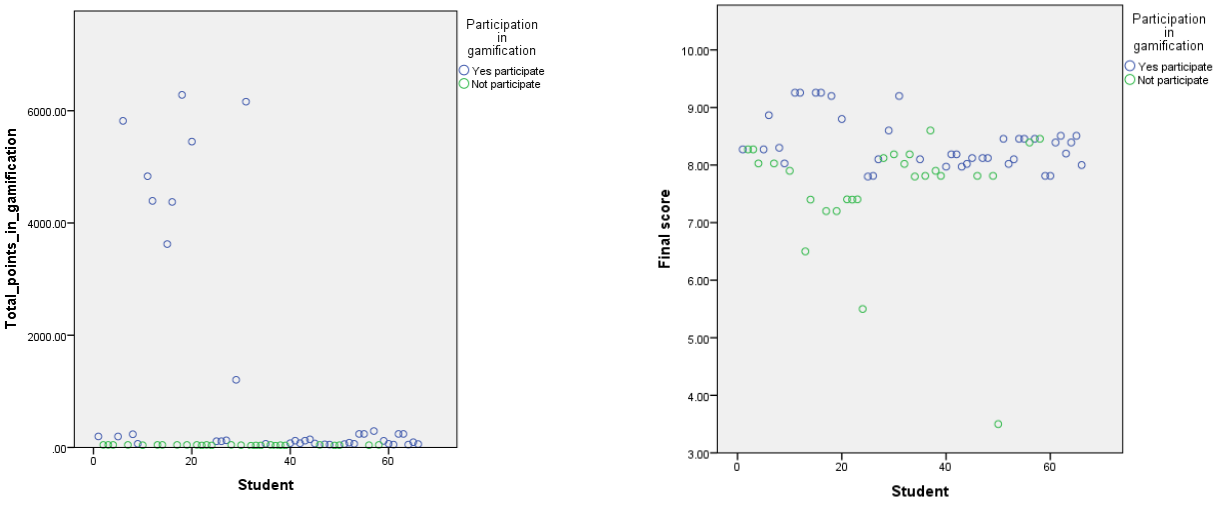

Figure 7. Scatter plot of Intervention Group with participation in gamification (blue) and Intervention Group without participation in gamification (green), regarding the total points earned in the Gamified Learning Environment (**left graph**) and the final grade obtained in the subject (**right graph**).

4. Discussion

4.1. Diversity of Protocols in Educational Research Linked to Gamification

In the creation of a GLE, despite these sharing common elements from the protocols of diverse research projects, they do not follow the same configuration [40]. This makes it difficult to compare the results from the different studies which have investigated the possible influence of the GLEs on the academic performance of students. Using the self-determination theory as a basis, one study conducted by Sailer, Hense, Mayr & Mandl [41] analysed different configurations of game design elements and how they affect the satisfaction of basic psychological needs. In doing so, they found that badges, league tables and performance charts positively affect the satisfaction of the need for competition, as well as the feeling of having carried out a meaningful task, while avatars, the narrative and teammates affect the interpersonal experiences. The perceived freedom of decision,

however, was not affected as expected. The authors interpret their results as a general support to the main hypothesis that gamification is not effective per se, but that specific elements of game design have specific psychological effects.

In another study [42] in which two samples of subjects were studied over a one year period, and an intervention group was created using a gamified system, it became clear that the use of a reward system improved the activity and participation of the subjects in the intervention group. In our study, we were able to get more students in the intervention group to participate in the voluntary tasks proposed, although it has to be said that not all the students in this group got involved to the same extent.

The inclusion of gamification in the educational field affects students in different ways, from behavioural aspects to emotional or cognitive ones. One such study with a focus on these aspects [43] analysed how a GLE affected the participating Greek secondary students. It was found that there was a significant increase in all three types of participation (behavioural, emotional and cognitive). However, the analyses did not show a significant increase in student participation in the two classes of students that made up the study sample, and the authors concluded that there are different confounding variables present in gamification processes. As mentioned above, this was also the case in our study.

In line with the above results are the conclusions of a recent meta-analysis [44] in which the results of multiple studies that measured the effects of gamification on cognitive, motivational and behavioural learning were systematically analysed. Results from random effects models showed minor significant effects of gamification on cognitive (g = 0.49, IC of 95% [0.30, 0.69], k = 19, N = 1686), motivational (g = 0.36, IC del 95% [0.18, 0.54], k = 16, N = 2246) and behavioural learning outcomes (g = 0.25, IC of 95% [0.04, 0.46], k = 9, N = 951).

4.2. Gamification, Motivation and Academic Performance

In another line of research [45] of a quasi-experimental design which included pre-testing and post-testing, the impact of a GLE on learning performance, intrinsic motivation, self-efficacy and engagement was analysed. It lasted 6 weeks and involved a sample of one hundred engineering students divided into a control group (N = 50) and an experimental group (N = 50). The students carried out compulsory tasks and optional tasks to obtain different badges. Data on the variables of intrinsic motivation, self-efficacy and personality and an assessment test on the subject matter were collected through self-reporting questionnaires. The results show a statistically significant improvement in the participation of students from the gamification group, in comparison to the control group. However, no significant impact on learning performance, intrinsic motivation, or self-efficacy was observed. The authors concluded that further research is needed to understand the lack of connection between the variables mentioned. In our study, we recorded a higher academic performance in the students from the intervention group in comparison to the control group, although we did not use questionnaires to analyse the level of intrinsic motivation, self-efficacy or the personality of the students. Another study that analysed the influence of a gamified mobile learning system found that it positively influenced learning performance and motivation, in comparison to non-gamified mobile learning or traditional teaching methods, thus finding a beneficial relationship between learning performance and student motivation [46]. In a systematic review [47] which aimed to analyse the benefits of gamification and/or serious games versus traditional teaching among health professionals, it was found that after analysing 30 studies with a total sample of 3634 participants, the results suggest that serious games were at least as effective as other forms of digital education in achieving these outcomes. There was not enough evidence to conclude whether any one type of serious play intervention and/or gamification is more effective than any other.

4.3. Gender and Participation in Gamification

Another authors, Zahedi et al. [48] investigated the possible gender differences in relation to the motivation and participation of Computer Science students in a gamified

learning environment. The results show that virtual points and the leaderboard contributed to improved performance for students of all genders. However, the authors point out that most women did not actively enjoy or were motivated by the virtual points or leaderboard. It is important to take into account the different types of players that can be established when creating a gamified learning environment. In this sense, and following the Hexad model [49] that allows precise measurement of user preference in gamification, some studies find significant differences in gender and age [50] in the types of players, socialisers, free spirits, achievers, philanthropists, players and disruptors and others only found differences without being significant [51]. This invites us to reflect on the strategies for the design of gamification based on the gender of the predominant students in the classroom. In this research we have not been able to analyze the possible differences in involvement in gamification based on gender, since practically all the students who took this subject are women.

4.4. Use of Digital Tools and Gamification

Some authors [52] have been able to obtain better learning results in a sample of university IT students by incorporating the use of digital tools into the teaching and learning process, such as specific apps linked to subject matter. In their study, they used the DS & Algo app and noted an increase in student knowledge after using this app. However, some scientific studies have proven that gamification can have a negative effect on intrinsic motivation as well as on the grades of students. Hanus & Fox [53] concluded that gamified systems with high rewards may have detrimental effects. In another study [54] it was found that both teacher involvement and the creation of an appropriate GLE are key to the success of the gamification, highlighting the fact that software on its own may not be as effective at creating a fun experience which simultaneously helps student to learn. In a study [55] carried out on distance education university students, a positive impact on collaborative learning was confirmed using gamification, although academic performance was not measured. In our work, an increase in academic performance was verified, but a single digital tool or a certain software was not used, but rather a multimodal learning environment was established.

All these findings showcase the need to carry out more empirical studies in order to further increase the scientific evidence.

5. Conclusions

The aim of this paper was to analyse whether the implementation of a multimodal Gamified Learning Environment could influence the final grades of a sample of university students. This was done by comparing the effectiveness of a traditional teaching methodology with an active methodology based on gamification. The results of the study show that the group of students who underwent a GLE obtained higher final grades than students from the control group who took the subject following traditional teaching methods. Further than statistically significant differences in the final grade, significant differences were also recorded within the intervention student group, with those who actively participated in the gamification completing more complementary tasks for the subject and as a result, earning more points in the gamification which ultimately culminated in higher final grades in the subject.

The study provides a new endorsement to use correctly planned gamification in university classrooms, given the best academic results obtained by the students who were most involved in the gamified learning environment.

The multimodal learning environment and the use of computers and the Internet offered an opportunity for students to continue growing academically and improve their knowledge by being able to perform voluntary tasks linked to the contents of the subject. And that these will grant them more points for gamification. Thus, students accessed different databases such as Web of Science or Scopus for voluntary reading of scientific articles, surfed the internet to share news of interest on the subject on their social networks, took

online training courses through their computers and electronic devices or they interviewed outstanding professionals in the contents of the subject they studied.

In the analysis of the tasks that students did the most to achieve points, a certain preference was observed for tasks that implied the use of social networks and for continuous training through courses and conferences. For future studies, it would be advisable to analyze the motivation of the students to choose some and not others and thus obtain points. We suspect that the use of social networks generates more motivation for them, hence their preference to obtain health points by choosing two of the activities that involved the use of social networks. In itself, the use of a virtual environment can be motivating. In relation to the tasks associated with points of experience, the same motivation that the students were looking for was evident since many of the courses and congresses they took were online, again it is suspected that in view of future gamification proposals in university students it is advisable to analyze the impact of academic tasks linked to virtual environments and social networks, since a preference for the use of these environments is observed. In the GLE we observed how a proportion of students were very involved in the gamification process and earned many health points, experience points and high final scores, while other students showed no motivation or predisposition to earn points. There is a need for more empirical research to compare the different teaching methodologies and to analyse how GLEs affect the both the final grades of students and their level of motivation. The Gamified Learning Environment used in this experience can be reproduced in other university classrooms given its versatility, it would only be necessary to make a change in the objective of the narrative and adjust it to the objective of the subject taught by each teacher. In this research we have not been able to analyze the possible differences in involvement in gamification based on gender, since practically all the students who took this subject are women. For future research, we recommend analysing participants' level of motivation together with the impact of the gamification on the final grades. This type of analysis could lead to a better understanding as to why some students get more involved than others within the same gamified learning process.

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