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University Students' Perceptions toward the Use of an Online Student Response System in Game-Based Learning Experiences with Mobile Technology

Víctor H. Perera*
University of Seville, SPAIN

Carlos Hervás-Gómez
University of Seville, SPAIN

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Abstract: The progressive integration of mobile technology in the classroom is generating new scenarios to innovate teaching methods. The aim of this study was to analyse the perceptions of university students toward the use of Socrative and its implications in gamified learning situations. This is a descriptive-survey investigation, complemented with content analysis techniques. The data were collected using a questionnaire designed ad hoc by Quiroga-Estévez et al. and structured interviews. The sample consisted of undergraduate students (n=472) of the degree of Primary Education from the Faculty of Education Sciences of a Spanish university. The results show significant changes in the learning process of the students, in social relations and in the teaching methodology.

Keywords: *Pre-service teacher education, students' perceptions, mobile learning, socrative, active methodologies.*

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Introduction

At the present time, we are living through a digital era in which information and communication technologies are shaking and modifying every field of human existence, and education is not an exception. Continuous technological innovations, typical of this age of change, have brought numerous challenges in education. The evolutionary development of these emerging technologies toward mobile electronic devices with wireless connectivity and their wide field of application are generating new tendencies of educational uses with unpredictable consequences that need to be studied. In this sense, in the past decade, a large number of published studies described the effects that emerging educational technology has had on teaching and learning processes, creating teaching methods and pedagogical conceptions that are more in line with our current educational reality (Cukurova & Luckin, 2018; Odabasi et al., 2019).

The progressive integration of mobile technology in university classrooms is already a consolidated reality. In the last years, the use of mobile applications to evaluate learning in real time is raising the interest of educators who promote numerous innovations in the scope of teaching methodology (Jahnke & Liebscher, 2020; Qurat-ul-Ain et al., 2019). In the same vein, several authors assert that the pedagogical orientations of educators influence not only their teaching methods, but also the ways in which they integrate technology in the classroom and their interaction with the students (Al-Hamad et al., 2020; Gilakjani, 2017; Santos et al., 2019).

The new educational experiences supported by the BYOD (Bring Your Own Devices) model, by which students bring their own devices to the learning place, are not only promoting the use of creative methodologies (Çetin & Solmaz, 2020; Cochrane et al., 2014), which solve the problems that affect classroom management, but the needs of today's university students, i.e., the so-called "digital natives", are being met (Gallardo-Echenique, 2012). In this sense, different studies conclude that teachers attain important educational goals, e.g., the increase of motivation and active participation in the classroom (Costa et al., 2020; Dabbagh et al., 2019; Lim et al., 2019), dialogical and intercultural learning (Arpaci, 2015), thanks to the efficient use of mobile devices by the students. However, the learning results are significant when both students and teachers acquire an adequate level of competence in the use of mobile technology (Aljaloud et al., 2019a; Ozdamli & Uzunboylu, 2015).

* **Corresponding author:**
Víctor H. Perera, University of Seville, Department of Teaching and Educational Organization, Spain. ✉ vhperera@us.es

The previous studies suggest that mobile technology is opening up new possibilities in educational practice, encouraging teachers to innovate their traditional methodological practices. In the university scope, this phenomenon is raising a new methodological approach based on the use of gaming techniques with mobile technology to promote attractive learning experiences. Gamified learning with mobile technology has caught considerable attention in the literature about teaching methodology. These gaming techniques, known as *gamification*, not only increase the motivation to participate in complex tasks (Hanus & Fox, 2015; Hew et al., 2016; Vergara et al., 2019); in terms of academic performance, they have also shown significant improvements with respect to the traditional approach when evaluating practical activities (Chang & Hwang, 2019; De-Marcos et al., 2016; Ranieri et al., 2018; Turan & Meral, 2018). However, the positive effects of gamification on these aspects are not always infallible (Huizenga et al., 2019).

One of the elements that best describes the efficacy of gamification in learning is the reinforcement system in student participation based on rewards (e.g., points, badges or leaderboard). Recent research on rewards has been focused on the relationship between different factors and the motivation of students to help them to participate more actively in their learning activities (Ciampa, 2014; Su & Cheng, 2015). Few empirical studies have analysed the effects of reinforcement systems on academic performance (Attali & Arieli-Attali, 2015). Some researchers suggest that rewards do not have a significant impact on academic performance, although it improves information retention and conceptual understanding (Filsecker & Hickey, 2014). Wardrip et al. (2016) concluded that rewards provide teachers with new information about their students, although they did not report changes in their teaching practices.

From the 1990s, an increasing number of studies have shown interest in the functioning of interactive applications based on student response systems (devices commonly known as Clickers). Since then, these systems have become popular and are being recognised with different names in the specialised scientific literature, such as classroom response system, audience response system and student response system (SRS), which are some of the main ones. These systems provide immediate feedback to teachers from the answers given by students to the questions they are asked (Abdulla, 2018; Balta et al., 2018; Balta & Tzafilkou, 2019), as well as valuable statistical reports for teachers. The assessment of learning with these systems is very useful for teachers because it allows to know *in situ* the level of knowledge acquired by students (Klimova, 2019; Molin et al., 2020; Petrucco, 2019).

Among the several mobile educational applications available today, *Socrative* is one of the SRS platforms with the highest acceptance and usage by teachers (Haintz et al., 2014). Several studies suggest that the use of these systems facilitates active learning (Pettit et al., 2015), improving interaction in the classroom (Hwang & Chen, 2019; Suryasa et al., 2020), confirming an increase in attendance, participation (Fitzpatrick et al., 2011) and student motivation (Molin et al., 2020) and the improvement of academic results upon evaluation of students´ knowledge (Al Sunni & Latif, 2020; Fabian & Topping, 2019; Gómez-Espina et al., 2020; Santos et al., 2019; Talan, 2020). Furthermore, other studies have demonstrated that the use of this system for educational purposes is not limited to teachers, since it is also effectively used by students (Lindell, 2020).

The scientific literature about SRS has been focused on the positive effect of these platforms on the learning experiences of university students (Aljaloud et al., 2019b; Perera & Hervás-Gómez, 2019; Muir et al., 2020). Similarly, it has been shown that these applications have a positive impact on the communication of their users, modifying the communicative interactions in the classroom (McEnroe-Petitte & Farris, 2020; Parra-Santos et al., 2018) and, thus, favouring cooperative learning and commitment of the students in the classroom (Hegarty & Thompson, 2019; Muir et al., 2020; Wang, 2018) and, consequently, improves academic performance (Abdulla, 2018; Awedh et al., 2014; Castillo-Manzano et al., 2016; Dakka, 2015; Feraco et al., 2020; Wang et al., 2009). In their studies, Hunsu et al. (2016), Kim et al. (2020) and Rahmahani and Pranowo (2020) found that the use of mobile technology based on SRS had significant effects on the results of cognitive learning (memory, comprehension, problem solving, etc.) and non-cognitive aspects (perception, attitude, interest, etc.). In a different study, Yeong (2015) concluded that the type of questions arranged in the assessments performed through these systems might influence the possibility of developing greater thinking skills. This author states that students feel more challenged when these systems include assessments with essay questions, which promote critical thinking.

The educational scope of SRS systems depends on several factors. Technological factors (in terms of usability, e.g. portability, information availability or access to the Internet) and individual factors (e.g. attitude toward mobile applications, developing, exchanging and adapting ideas with other students), which positively influence the use of mobile technology in the learning process, have been studied (Klarić et al., 2019). Other equally influencing factors considered are: mastery of the subject matter by students, number of attendants in the classroom and the frequent use of the devices (Hunsu et al., 2016). Wang (2015) demonstrated that the continuous use of SRS led students to change their positive perception toward the ease of use, their concentration, their involvement in the classroom and the perceived learning, with a slight decrease of motivation and commitment.

The reviewed studies show the need for delving into the perceptions and valuations of students who have experienced the use of these SRS systems in learning activities and knowledge assessments, in order to identify new variables that foster the benefits of using these systems in educational contexts and determine the effects of new factors that develop the methodological potential of these tools.

Based on the above, the aim of this study was to know the perception of university students towards their experience with the use of SRS for the development of learning techniques in the subject Information and Communication Technologies applied to Education. The specific aims proposed were: a) to analyse the perception of students toward their learning experience with *Socrative* in gamified learning activities; b) to know the valuation of students about the implications of using *Socrative* in gamified learning activities; c) to determine the features of *Socrative* usage related to satisfaction; and d) to know, in depth from the narrative of the students, specific aspects related to the use and experience of the Socrative application in learning processes.

Methodology

The design of the present study was non-experimental, descriptive and based on survey methodology. In this study, methods for the analysis of quantitative data were used. According to the aims established, the analysis techniques included the calculation of mean values and frequencies in the different dimensions and variables of interest. Furthermore, one of the aims of the study involved the use of correlational methods for the study of causal comparisons between variables. Specifically, the contingency coefficient was used to provide information about the intensity and direction of the relationship between variables. Content analysis was also used as a qualitative analysis method to respond to the last of the study objectives.

Participants and sample

A non-random sample selection method was used; specifically, a causal, non-probabilistic sampling was carried out, in which the most common acceptance criterion for the subjects that constituted the sample was based on their accessibility. More specifically, the intentional criterion for sample selection was that they were students of the same academic programme of that subject, and that they had mobile devices with Internet connection.

The participants of this study were students from nine groups of the first year of the Degree in Primary Education at the Educational Science Faculty at a Spanish university. Generally, they showed similar sociodemographic characteristics, and their ages were between 18 and 20 years. At first, the study was intended to include all 573 students registered in the course. However, data could only be collected from 472 students, which nonetheless was a statistically significant sample size for a confidence level of 95%, with a sampling error below ±1.9% and P=Q. Lastly, 29 groups of four participants each carried out the interviews, with 116 students finally participating in this part of the study.

Procedure

The study began with convincing the teachers that the use of mobile devices as a pedagogical resource may reinforce teaching methodologies and, as a consequence, favour the learning capacity of students in the classroom. Teachers adapted the module programme considering *Socrative* among their learning methods and also as a tool to evaluate the knowledge acquired by students. The experiment took place throughout three academic years (since 2016/2017 to 2018/2019), involving two teachers and students from nine groups of the subject Information and Communication Technologies applied to Education. The subject contained ten lessons and in each of them three evaluation tests were administered. The tests generally lasted between 5 and 10 minutes.

During this period, several techniques were carried out, with different guidelines and educational aims. The types of activities scheduled for the use of *Socrative* in the classroom comprised different assessment modalities, implemented as a three-moment cycle in a subject matter or lesson: a) *moment prior* to the presentation of a lesson, at which a diagnostic test was applied to know the ideas that students had of a specific topic; b) *intermediate moment*, which took place during the course of a lesson through a group competition test about the knowledge of a developing subject; and c) *closing moment*, which consisted of a final test to assess the topic taught. In all of these three cases, the students answered, individually and in groups, and according to the conditions of the technique proposed, to a set of questions previously formulated by the teacher using the *Socrative* platform. All activities were gamified, adding to their design a system of reinforcement in the participation of the students based on rewards.

The questions were different in number, formulation and level of complexity depending on the type of test to which they corresponded. In this sense, the initial and final surveys included a different number of questions adapted to a specific topic, focusing on the fundamental theory concepts that the students should master, whereas the competition tests encouraged to reinforce the theory contents that the students should have already learned. In the first group, the initial tests posed open questions and true/false questions. The final tests consisted of multiple-choice concept check questions. With respect to the competition tests, they all consisted of multiple-choice questions.

The *Socrative* platform recorded the choices selected or written by the participants in real time, allowing to offer, in the first case, a report of the results obtained, which in turn allowed to observe the individual progress and the comparative analysis of the whole classroom group with respect to the level of knowledge of a topic.

Instrument

The data were collected through surveys. We followed the first edition of the questionnaire designed by Quiroga-Estévez et al. (2015) to evaluate the use of *Socrative* and the experience that the students acquired with it. This instrument consists of 19 items, measured in a Likert scale of five points, and organized in two blocks, with which it is intended, on the one hand, to know the learning experience with *Socrative* (items 1 to 6) and, on the other hand, to know the implications derived from its use (items 7 to 19). This second block of items includes three theoretical cores focused on measuring pedagogical (learning process), social (teacher-students relationship) and methodological aspects (tutorship, academic performance, etc.).

The data gathered with this instrument showed, in general terms, the perceptions of the participants toward their experience with the use of *Socrative* in the context of the different evaluation activities carried out in the course of the subject. This instrument was designed *ad hoc* by its own authors. A reliability analysis based on Cronbach´s alpha obtained a value of .93, which demonstrated a high degree of internal consistency for the scale of the instrument. Therefore, and considering the aims set in this study, the original proposal of items was faithfully maintained, as well as their structure and organisation. The administration of the instrument was conducted two weeks before the end of the semester, and it was considered appropriate to speed up the gathering of data through the use of Google Drive, by which the opinions of a total of 472 students were collected.

Then, once the data from the questionnaires were collected, the script for the structured interview was designed. The final version contained seven questions. The first three questions were related to the use of Socrative: 1. Why do you think that the use of Socrative has been easy for students? What problems or inconvenience can occur in the use of this application? (e.g., technical problems, internet connection failure, etc.); 2. Why does using Socrative satisfy most students?; and 3. Why do you think the Socrative application is motivating for learning? While the remaining four questions were related to the students' experience with said application: 4. How do you think Socrative influences your learning process? (e.g., it gives you more control, helps you to pay more attention, to assimilate the content better, to remember and reflect on concepts, etc.); 5. Do you think that Socrative will have a positive effect on your academic performance?; 6. Do you think that the use of Socrative improves communication between classmates? And between students and teachers? (e.g., improvement in treatment, tutoring and guidance by the teacher, etc.); and 7. How do you think Socrative improves the teacher's teaching methodology?

These questions allowed delving into those items that were of interest and for which more information was needed to respond to the last objective established in this study.

Data collection, analysis and ethics

Once the fieldwork phase was concluded, the data collected were analysed, which was initially performed by organising and arranging the information of the questionnaires in data matrices produced with Excel software, in a way that these could be easily exported to IBM SPSS® Statistics software (version 25) for their subsequent statistical treatment.

During the data dump, the names of the students were codified in order to preserve their anonymity. The processing of personal data was conveniently dealt with the utmost caution from the beginning to avoid any possible mistakes that could lead to their unintended dissemination. However, this information related to the identity of the participants was not considered of interest; therefore, it was ignored at the time of publishing the results of the study.

Since the analyses to be carried out had to be focused on the data collected from the questionnaire regarding the perception of the students toward their learning experience during the practical lectures developed with *Socrative*, the next step was to calculate the frequency in the answers to each of the items, considering in their presentation the two differentiated blocks which the questionnaire referred to, as well as the three categories that constituted the second block. According to the process described for the treatment of data, and in order to comply with one of the aims set, the direction and degree of the relationships between some of the variables of interest were also analysed, through a correlation analysis.

Finally, the focus group interviews were conducted by the two teachers who participated in the study and two researchers in training. Each interview conducted was audio-recorded and was conducted face-to-face, lasting approximately 30 minutes. The information collected was processed through qualitative data analysis using a deductive system of categories, created from the in-depth questions originating from the questionnaire data. This category system made it possible to analyse the information collected by obtaining descriptive results for each of the seven categories (Miles & Huberman, 1994). The process of coding and extraction of results was supported by the MAXQDA software for qualitative data analysis.

Lastly, with respect to the ethical aspects of this study, we ensured the confidentiality and anonymity of the information. In this sense, both the participants and the researchers signed a confidentiality statement, which gathered the terms concerning the collection, treatment and publication of the information. Moreover, we informed the participants on their right to leave the study at any time if they wished so, which would imply the exclusion of their data from the study.

Results

Considering the aims proposed in this study, Table 1 and Table 2 show, in a concise manner, the most relevant statistical results according to the items of the questionnaire.

Descriptive Analysis of the Data

The first aim proposed was to analyse the perceptions that students had regarding the learning experience with *Socrative*. According to the results obtained, it could be asserted that the participants perceived that this application was easy to use (item 1, $\bar{x}$=4.30), although some difficulty was perceived in the use of this tool when accessed through the teacher profile (item 2, $\bar{x}$=3.62) compared to the student profile (item 3, $\bar{x}$=4.30). This important difference may be due to the fact that most of their experiences with *Socrative* have been carried out as students, since different practical lectures were conducted during the course of the subject. They were not required to access *Socrative* as teachers in any of the activities performed and, therefore, those who knew the application under such profile acquired that knowledge and capacity on own initiative and personal interest. A second aspect that defines this application, from the perspective of its users, is its potentially encouraging capacity (item 4, $\bar{x}$=4.07, δ=.845), although not all students were convinced that this application would be motivating on its own, which is why such capacity will depend on the type of experience performed.

Table 1: Opinions of the pre-service teachers about their learning experience with SRS of gamified learning activities

Survey Questions	$\bar{x}$	δ
1. In general, I think that the SRS is easy to use	4.30	.779
2. I could use the SRS for teachers without great difficulties	3.62	1.10
3. I found it easy to use the SRS for students	4.30	.806
4. In general, the use of this SRS is motivating on its own	4.07	.845
5. In general, I can assure that this first contact with the SRS to gamify learning was satisfactory	4.19	.822

Note: n=472, number of student responses. Likert-type ratings (1–5) are percentages of students responding in each of the three categories; $\bar{x}$, Mean; δ, Standard deviation; SRS, *Socrative*-based Student Response System.

The second objective of this study was to know the valuation of the students about the implications of the use of *Socrative* in gamified learning activities. In this sense, we considered three theoretical areas that better explain this wider dimension of their usage experience. Firstly, this tool offers a huge benefit for students to develop certain cognitive activities associated to their learning process, such as feeling more motivated (item 7, $\bar{x}$=4.14), paying more attention in the classroom (item 6, $\bar{x}$=4.11), absorbing the contents of a topic (item 9, $\bar{x}$=4.03), remembering its basic concepts (item 10, $\bar{x}$=3.92) and reflecting about them (item 11, $\bar{x}$=3.89), which eventually results in the possibility that the students may demonstrate a good academic performance (item 15, $\bar{x}$=3.84), and that they consider *Socrative* as a useful learning tool (item 19, $\bar{x}$=4.34). Secondly, *Socrative* is perceived by the students as a resource that increases the academic interactions within the classroom, which in turn improves the relationship with the teacher (item 17, $\bar{x}$=3.78), due in part to the feedback that could be required for tackling the answers (item 8, $\bar{x}$=3.80), and the relationships among the students themselves (item 13, $\bar{x}$=3.90). Finally, *Socrative*, used as a learning method, has the capacity to transform the image of the teacher, bringing him/her closer to the technologically competent profile of a person who is more adapted to the digital society in which the students develop their academic and personal lives (item 12, $\bar{x}$=4.24), and it also brings the formal learning context to new, less conventional, more digitalised scenarios (item 14, $\bar{x}$=4.25). According to the students' opinions, *Socrative* does not only make learning more active (item 16, $\bar{x}$=4.19), but it also makes it possible for them to have a greater control over their learning, for the sake of a greater autonomy (item 18, $\bar{x}$=3.93).

Table 2: Opinions of the pre-service teachers about the implications of the use of SRS of gamified learning activities

Survey Question	$\bar{x}$	δ
6. I think that the application of SRS could help students to pay more attention in the lectures	4.11	.782
7. I think that students would be more motivated in the lectures in which SRS is used	4.14	.784
8. SRS would make it possible to have a direct monitoring of the students (feedback)	3.80	.773
9. I estimate that SRS could help to better absorb the contents taught in the different modules	4.03	.800
10. I believe that with SRS it is possible to better remember the concepts developed by the teacher	3.92	.797
11. I think that the SRS has helped me reflect on the concepts taught about the topic tackled	3.89	.807
12. If the teachers used SRS, they would appear to be more in touch with the current digitalized world	4.24	.777
13. SRS would make it possible to have a greater academic interaction among the students themselves	3.90	.803

Table 2: Continued

Survey Question	$\bar{x}$	δ
14. I think that the use of SRS brings the formal learning/teaching context closer to the digital world	4.25	.729
15. I infer that SRS could contribute to improve the academic performance of the students	3.84	.789
16. SRS would offer students new possibilities for a more active learning	4.19	.706
17. With SRS the teacher/student interaction would improve	3.78	.852
18. I consider that SRS would offer every student a greater control over their learning process	3.93	.797
19. In general, I think that SRS could be useful for the learning process	4.34	.734

Note: n=472, number of student responses. Likert-type ratings (1–5) are percentages of students responding in each of the three categories; $\bar{x}$, Mean; δ, Standard deviation; SRS, *Socrative*-based Student Response System.

Association Analysis

The third objective of this study was to determine the aspects of the use of *Socrative* that were significantly related to the perception of satisfaction shown by the students (see Table 3 and Table 4). As the basic assumptions were fulfilled, Pearson's correlation coefficient was calculated for the variables analysed. After applying the test to obtain Pearson's correlation coefficient, it could be asserted, with a confidence level of 99% (p<0.01, n=472), that there is a moderated relationship between the high degree of satisfaction (item 5) and the following variables: ease of use (r=.614; item 1), motivational application on its own (r=.595; item 4), teachers with technological skills (r=.511; item 12), opening of formal learning (r=.529; item 14), active learning possibilities (r=.516; item 16) and usefulness of the application for the learning process (r=.585; item 18).

Table 3: Correlation between 'use of Socrative' and 'perception of satisfaction with SRS to gamify learning' (continue)

	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7	Item 8	Item 9
Item 1	,257**								
Item 2	,432**	.195**							
Item 3	,562**	.260**	.550**						
Item 4	,561**	.241**	.457**	.474**					
Item 5	,614**	,256**	,255**	,595**	,338**				
Item 6	,331**	,255**	,510**	,416**	,353**	,589**			
Item 7	,336**	,209**	,454**	,492**	,424**	,661**	,725**		
Item 8	,264**	,126**	,407**	,276**	,253**	,364**	,396**	,388**	
Item 9	,354**	,187**	,524**	,444**	,386**	,496**	,528**	,515**	,415**
Item 10	,342**	,185**	,565**	,485**	,364**	,462**	,542**	,498**	,397**
Item 11	,381**	,241**	,464**	,299**	,458**	,507**	,400**	,474**	,290**
Item 12	,364**	,236**	,440**	,389**	,511**	,454**	,413**	,397**	,346**
Item 13	,418**	,282**	,529**	,269**	,470**	,489**	,447**	,480**	,327**
Item 14	,236**	,138**	,417**	,316**	,529**	,421**	,507**	,457**	,396**
Item 15	,456**	,224**	,520**	,297**	,418**	,516**	,532**	,498**	,392**
Item 16	,223*	,232**	,359**	,308**	,516**	,346**	,336**	,301**	,410**
Item 17	,338**	,157**	,399**	,380**	,320**	,369**	,325**	,308**	,384**
Item 18	,387**	,214**	,545**	,420**	,585**	,582**	,568**	,567**	,375**

Note: n=472, *p<.05, **p<.01. Keys: see Table 1 and Table 2

Table 4: Correlation between 'use of Socrative' and 'perception of satisfaction with SRS to gamify learning

	Item 10	Item 11	Item 12	Item 13	Item 14	Item 15	Item 16	Item 17	Item 18
Item 10	,616**								
Item 11	,451**	,505**							
Item 12	,417**	,469**	,365**						
Item 13	,492**	,484**	,655**	.394**					
Item 14	,460**	,567**	,378**	,381**	,397**				
Item 15	,529**	,539**	,517**	,400**	,455**	,506**			
Item 16	,389**	,434**	,363**	,565**	,304**	,420**	,470**		
Item 17	,396**	,473**	,348**	,401**	,409**	,511**	,570**	,401**	
Item 18	,546**	,573**	,516**	,582**	,407**	,591**	,497**	,539**	,582**

Note: n=472, *p<.05, **p<.01. Keys: see Table 1 and Table 2

Analysis of the group interviews

This part of the results is related to the fourth objective of the study and aims to delve into the perspective of the participants in the technical, didactic and methodological aspects of the *Socrative* application, as well as into the

influence of this tool on the teaching and learning processes. Specifically, student testimonies were analysed in seven areas of interest: 1) the use of the *Socrative* application; 2) student satisfaction with the use of *Socrative*; 3) motivation in the students' learning with the use of *Socrative*; 4) the influence of *Socrative* in the learning process; 5) effects of *Socrative* in academic performance and its usefulness in learning; 6) interaction between classmates and between the students and the teacher; and 7) how *Socrative* improves the teaching methodology of the teacher.

The use of the Socrative application

With respect to this first question, the students answered, unanimously, that the use of the *Socrative* application was easy and intuitive compared to other digital tools that they had used throughout the course. Thus, from the access to the tool, which was available as a software application (app) and online, to the very use of this application to carry out different assessments in the classroom, only basic knowledge was required from the participants.

> "We were born with informatics in our hands and, therefore, it is a lot easier for our generation to learn through mobile devices than using books" (Focus group 1).

Although the use of the *Socrative* tool did not pose any difficulties to the students, its application in certain activities of the classroom was somewhat difficult at the beginning, since they had to adapt to the completion of these using mobile devices.

One of the reasons why this application was easy to use was the fact that the teacher informed them clearly about the steps that should be followed to ensure its adequate operation. In view of this situation, the students had several sessions to rehearse and adapt to the use of this tool. In addition, the interface of the application had a friendly and intuitive design that made interaction easier, which was another helpful factor. The use that the students made of this application was simple, since the tasks consisted in selecting different answers according to the questions asked by the teacher. In short, the use of *Socrative* did not require any technical knowledge.

> "It's quite interactive, easy to use and it doesn't have many things to be done; clicking a button is all it takes, that´s it" (Focus group 13).

However, several circumstances were mentioned in which the students identified drawbacks in the use of this application in the classroom. The first case was described by students who attended a lecture without their mobile devices or with very low battery level. The second case was that of a mobile device that froze due to technical issues, whose user did not know how to solve. A preventative solution to this problem was getting the students to work in pairs, as a methodology for the practical lectures. A third case, infrequent, was the Wi-Fi connection failure, or the low connection speed, although these problems were solved with the use of mobile data.

> "We had this problem that the connection failed and the application didn´t count the scores; so, we had to start from the beginning and that put us in a disadvantaged position" (Focus group 2).

Student satisfaction with the use of Socrative

Regarding the satisfaction they felt with the use of *Socrative* in the classroom, most of the participants stated that they were satisfied for several reasons. One of the reasons was the fact that it is an innovative tool, which they were not used to handle in the university classrooms.

> "It is an innovative method that transcends the traditional methodology used by most of the teachers in this university" (Focus group 22).

Moreover, some participants pointed out that the application was fun, which enlivens the learning process. Therefore, *Socrative* acted as a resource that stimulated and promoted the receptive attitude of the students throughout the lecture. In short, the use of *Socrative* in the classroom made the learning process of the participants more attractive, helping them to assimilate the theoretical contents.

> "It´s different; it´s a more entertaining way of learning" (Focus group 7).

Motivation in the students' learning with the use of Socrative

The students stated that *Socrative* proved to be a motivating tool in their learning process. The use of *Socrative* in the classroom generated new scenarios for learning that converged in a different, dynamic and novel process. One of the reasons that led to this consideration was the fact that its use in the classroom is not included in the dynamics that the students are familiar with, which are generally traditional teaching methodologies by which the teachers provide information and the students take notes. Furthermore, the students commented that the practical lectures with *Socrative* were very entertaining and that they learned while having fun.

> "[…] you take it as an interactive game where everybody plays and I think this is much more motivating than answering questions in an exam" (Focus group 4).

Another reason was the fact that the use of *Socrative* involved including the mobile devices in a very simple way in the classroom, thus the students related this positively in the completion of certain individual and group practical activities. They made this valuation in the context of assessments, such as the tests in which the students had to confirm that they acquired the knowledge of the subject. The fact that the use of smartphones was not fully integrated yet, let alone generalised in the different subjects of the degree, was perceived by the students as an innovative method. As a consequence of this type of experience, some students did not discard the possibility of using *Socrative* in their future career as teachers.

> "Above all, it is the change of methodology; that´s already a motivation, the fact that we´re doing something different" (Focus group 26).

The influence of Socrative in the learning process

Socrative was a tool that provided some dynamism to the learning process of the students, while making the practical activities more entertaining and fun in the way these were developed and carried out, as some of the students pointed out:

> "It makes you pay more attention in the classroom and remember the terminology taught, because you´re using it yourself" (Focus group 17).

This type of activity made it possible for the students to reflect on the contents taught in the lecture, sharing their opinions with their classmates and with the teacher.

Some students valued these experiences satisfactorily, since in each practical lecture they had the chance to know their level of mastery in the subject matter, when facing questions of increasing difficulty, giving them the opportunity to delve into those concepts that they had not learned properly. They also stated that when they knew in advance that they would use *Socrative* in the classroom, they had the option of studying the subject matter or the topic in a more ordered and continued manner.

> "If you have some concept that you got wrong, you realise that, and you can modify it" (Focus group 9).

Furthermore, its use encouraged the more competitive students to study the subject matter with the motivation to succeed in the next activity. In short, *Socrative* was useful for the participants in their learning, facilitating in this process the acquisition of significant concepts and terminology taught in the classroom, which would be assessed in a future evaluation test.

Effects of Socrative in academic performance and its usefulness in learning

The students relied on the hope that the use of *Socrative* would have a positive effect on their academic performance. Moreover, achieving the educational goal pursued in the type of activity that was carried out in the classroom was reinforced by an additional compensation that could benefit them in the evaluation of the subject.

> "Motivation helps you learn and remember the subject matter much more efficiently" (Focus group 1).

During the course of the subject, different activities were carried out with *Socrative*. The students believed that, undoubtedly, these practical activities would help them study the subject matter for the exam, since these allowed them to focus on those questions which they understood were more significant for the topics taught. Another reason why the students considered that the use of *Socrative* would improve their academic performance was the fact that, somehow, it forced them to study the subject matter with more determination. Since activities were carried out regularly, the participants had to previously revise the syllabus in order to obtain optimal results in the test. Therefore, they considered it useful for studying the subject, since while performing the activities with *Socrative* they could revise and assimilate some of the concepts that were included in the exam. In short, this encouraged the students to be more involved in the subject.

> "It is a new way of studying. First, we prepare the subject matter; then, we check if we really got it […] it is a way of anticipating to the exam and know if you really understood everything" (Focus group 7).

The students considered that the *Socrative* platform was useful for their learning and it also gave them the chance to familiarise with a tool that they could use in the future in their lectures as teachers. Moreover, they added that the use of mobile technology in the classroom could be a common practice in the future; therefore, gaining knowledge and experience in this type of tools would be very useful for them.

Interaction between classmates and between the students and the teacher

The interviewed participants stated that the use of *Socrative* in the classroom improved quantitatively and qualitatively the interaction between the classmates. The approach through which the proposed activities were carried out allowed the students to create more cooperative work environments among them, since the practical lectures promoted direct communication through discussion, enquiry processes and decision-making to reach consensus in the answer selected

by the group of students. Therefore, these practical activities showed the importance of sharing the knowledge acquired by different people, and how essential it is to work on competences related to teamwork.

> "Sometimes you do it in groups and that makes you talk to the classmates you have, in order to answer" (Focus group 3).

Likewise, getting to know the classmates with whom they had to make the different work groups that were set for each practical lecture contributed, to some extent, to a better socialisation in the classroom.

Regarding the interaction between the students and the teacher, most of the participants had a positive opinion. On the one hand, some students believed that the use of *Socrative* could improve the relationship between them and the teacher. They perceived the figure of the teacher as a professional whose methodology was different from the traditional practice, since they offered help throughout the course of the activity, providing tips to solve the problems or explaining the differences between the essential concepts. The participants also felt that there was a closer treatment, since the teacher addressed them with care, showing interest for their progress during the completion of the activities. Moreover, the teacher provided feedback about the answers to the questions, offering the corresponding justification for the correct answer, with the aim of making it easier for the students to learn the concepts.

> "The teacher is more involved in the relationship with the students; it´s a more direct treatment" (Focus group 19).

How Socrative improves the teaching methodology of the teacher

The students stated that the *Socrative* platform improved the methodology of the teacher, making it more entertaining, fun and dynamic; in short, less monotonous.

> "[…] it makes the students become more active and involved" (Focus group 9).

They also considered that such improvement was due to the fact that the teacher offered immediate feedback to the students, which would take several days, in the case of traditional exams or tests, for the students to get information about their marks. However, with *Socrative*, when the students completed the set of questions, they obtained the results immediately, since in the functioning of this application, one of the modules generated global and individual reports, which could be required by the teacher to promptly inform the students about their results. This information was used by the teacher throughout the course of the activity or at the end of it as feedback to guide the learning of the students.

> "[…] having a feedback, seeing if you got it right or wrong" (Focus group 27).

Thanks to the numerous entries performed by the platform, the teacher could analyse which concepts were learned by the students and, separately, know which of these were more difficult to assimilate, which allowed him/her to delve into these concepts. In this sense, the most difficult questions were solved once the students immediately showed their doubts about them. This procedure in which the teacher guided the students about the fundamental concepts was a method that facilitated the learning process of the students.

In conclusion, *Socrative* was not only a tool with great potential for the teacher regarding the interaction with the students through immediate feedback about the activities carried out in the classroom; it was also very helpful, since the practical lectures —when these were properly organised— allowed informing about the results immediately after their completion. The interviewed students commented that they would use this application to consolidate knowledge, perform continuous evaluation and not only a final exam, change the traditional methodology and identify which topics, or aspects of a topic, are the most interesting ones for their future students.

Discussion

Within the last few years, a significant number of research studies have been focused on the influence of the use of applications based on mobile devices in the learning process within the university classroom (Odabasi et al., 2019). Previous studies, mainly carried out from a quantitative approach, on the use of student response systems and their educational implications have shown an increasing trend. The present study takes a mixed methods approach to analyse the perceptions of university students who have experienced the use of the SRS systems in gamified learning activities and knowledge assessments.

Consistent with earlier findings (Balta et al., 2018; Balta & Tzafilkou, 2019; Hanus & Fox, 2015), it is worth mentioning the role played by this type of applications, offering students new and attractive educational scenarios that provide opportunities to make them feel more motivated and satisfied, as was demonstrated in this study. Therefore, *Socrative* acts as a resource that stimulates and promotes the receptive attitude of the students throughout the lecture (Klarić et al., 2019). In short, the efficient use of *Socrative* in the classroom makes the learning process of the participants more attractive, allowing teachers to achieve important educational goals.

Regarding the results of the qualitative questions, and as other studies have already confirmed (Fabian & Topping, 2019; Feraco et al., 2020; Hegarty & Thompson, 2019; Munir, et al., 2020; Rahmahani & Pranowo, 2020; Talan, 2020; Turan & Meral, 2018), the participants generally mentioned that using *Socrative* in the classroom help students to increase their academic engagement with their learning and improve their academic performance, motivation and satisfaction from the course. In addition, the students believed that, undoubtedly, *Socrative* would help them study the subject matter for the exam, since it allowed them to focus on those questions which they understood were more significant for the topics taught. Moreover, they added that the *Socrative* application provided a personalised learning experience, in which the students were involved in the monitoring of their learning through a programmed set of questions, which posed cognitive challenges, encouraging them to actively commit to their academic formation.

As in other studies, it must be specially emphasized that the use of *Socrative* has direct motivational effects on social learning and it involves the teacher in a closer, more fluid and academically significant relationship with the student through immediate monitoring (Awedh et al., 2014; Dakka, 2015; Santos et al., 2019; Wang, 2018). Additionally, *Socrative* made it possible for the students to reflect on the contents taught in the lectures, sharing their opinions with their classmates and with the teacher. In short, it was useful for the participants in their learning, facilitating in this process the acquisition of significant concepts and terminology taught in the classroom, which would be assessed in a future evaluation test (Kim et al., 2020).

Moreover, using *Socrative* in the classroom improved quantitatively and qualitatively the interaction between the classmates. The approach through which the proposed activities were carried out allowed the students to create more cooperative work environments among them, since the practical lectures promoted direct communication through discussion, enquiry processes and decision making to reach consensus in the answer selected by the group of students (Costa et al., 2020; Dabbagh et al., 2019; Lim et al., 2019). Likewise, getting to know the classmates with whom they had to make the different work groups that were set for each practical lecture, contributed to some extent to a better socialisation in the classroom.

In pedagogical practice, *Socrative* is currently one of the technological resources used to support training in university classrooms, with significant consequences in methodology and evaluation. Thus, its use is not only improving participation and communication among educational agents, through active practices that facilitate gamified learning processes (McEnroe-Petitte & Farris, 2020; Parra-Santos et al., 2018), but it is conceiving evaluation as a permanent process of monitoring learning, which implies that the educational needs of students can be addressed more efficiently (Klimova, 2019; Petrucco, 2019). In this sense, spaces of interest related to the design of gamified activities supported by mobile devices are emerging, which will bring with them new challenges and future lines of research.

The students perceived the figure of the teacher as a professional whose methodology was different from the traditional practice, since they offered help throughout the course of the activity, providing tips to solve the problems or explaining the differences between the essential concepts. Furthermore, the use of mobile devices in the classroom, which gives support and functionality to this application, allows connecting to the digital world in which the students live within the formal university context in which they learn, usually considered a reluctant place toward the development of educational techniques with this kind of technologies.

Finally, this study reinforces the relationship between mobile technology and learning in the university classroom. The use of mobile devices in the classroom is not only giving coverage to the BYOD model, but it is also providing the teacher with the ability to generate new scenarios to benefit the learning process. The new educational experiences that are emerging thanks to the use of mobile devices are not only solving the problems that affect the management of the classroom, such as overcrowding, low participation rate and lack of motivation, but they also seem to be covering the needs of present-time students, known as digital natives (Blasco, 2016; Chicca & Shellenbarger, 2018).

Conclusions

The most relevant conclusions of this study are in line with the results obtained by Quiroga-Estévez et al. (2015), who support the implementation of *Socrative* as a system of learning and knowledge assessment in the teaching methodology due to their numerous benefits and pedagogical implications. In agreement with the results of other studies (Perera & Hervás-Gómez, 2019; Mohamad et al., 2019), the perception of the students toward the *Socrative* application is positive in all the analysed aspects (i.e., pedagogical, social and methodological), with outstanding and valuable usefulness in gamified learning activities.

Recommendations

Further research should be focused on the critical factors of success in the pedagogical use of *Socrative* with mobile devices. The reviewed studies show the need to delve, from a qualitative perspective, into the perceptions and valuations of students who have experienced the use of these SRS systems in learning activities and knowledge assessments, in order to identify new variables that foster the benefits of using these systems in educational contexts and determine the effects of new factors that develop the methodological potential of these tools.

The use of Socrative has a positive effect on the student's perception of pedagogical, social and methodological aspects. This circumstance could be used by teachers to integrate this mobile device-based application into the learning process in the university classroom. Furthermore, although Socrative has integrated the concept of gamification into its applications, teachers need to be creative with the design of the quizzes so that they can facilitate student learning and lesson evaluation.

Limitations

This study has some methodological limitations, two of which we highlight. First, it would have been necessary to have the participation of the teachers in order to know their assessment of their experiences with the use of Socrative in teaching. This new perspective would provide a complementary view of the students' opinions on the educational experience analyzed. Second, an experimental study would allow the comparison of control groups that would help to know the real effect of the intervention with respect to the variables analyzed.

However, although these issues should be considered in future studies, we believe that this work provides valuable results for teachers in higher education to use these technological tools in their syllabus because of the pedagogical benefits they have for student learning.

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