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BYOD as a gamification tool for improving learning of an experimental subject in Chemistry Degree

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Abstract

Given the impact of smartphones in all areas of society, the education at the university should not be conceived without the use of technological tools inside classrooms. The present study examines the use of "Bring Your Own Device-BYOD" using Kahoot! as a gamification tool to explore possible benefits in learning and continuous assessment of an experimental subject in the Degree of Chemistry. An empirical analytical methodology was used among different groups of students: one in which Kahoot! was used daily in laboratory lessons and other groups in which it was not employed as a training before final subject evaluation. The aim was to measure the extent to which the students´ knowledge had developed. The academic results has shown that the use of BYOD has had overall positive effects on the academic results. Thus, student's learning and grades have been improved, particularly, those who have achieved a better score using Kahoot!

Keywords: *BYOD; Experimental subject; Kahoot!; University students; Chemistry; Gamification.*

1. Introduction

Tecnological advances respond to the society on continuos move and constant needs as for example access to information and communication. The widespread use of Information and Communication Technologies can also affect to learning (Carneiro & Díaz, 2012). Interactivity and collaboration inside classrooms can be improved using technology (Gros & Contreras, 2006) and university must integrate it as a new types of learning and transmission of knowledge. Educational institutions should pursue training autonomous, creative and motivated students who must be prepared to face the society changing in the current climate. One innovation increasingly used is taking advantage of mobile devices (tablets, smartphones or laptops) in the classroom (Ali *et al.*, 2017) to explore its employment in teaching as rethinking of methodologies, modernization of instructional designs and communication with students (Ng & Nicholas, 2013). Bring Your Own Device (BYOD), is a massive trend, where people bring their personal mobile devices to use in their workplace. This can be implemented in education environment to engage learners and enhance teaching-learning process (Umezu & Onwodi, 2015). Mobile devices provide applications to be used in experimental and theorical lessons, being this a valuable complement to the student's training and learning. The virtual atmospheres created by BYOD model allows acces to information and promotion of new communication models with immediate feedback. In a similar fashion, it is possible to set up previous and continuous evaluations and to increase motivation and participation, making the student have an active role in the learning process. Gamification can be applied with mobile devices and it is understood as the use of mechanisms and thinking in order to draw students attention and motivate them, encouraging action, promoting learning and solving problems (Murillo-Zamorano, 2021; Rodríguez-Fernández, 2017). One of the most popular and user-friendly gamification tools among teachers following their simplicity is *Kahoot!*. This application is based on creating questionnaires by teachers and students will answer them using their own mobile devices. Teachers ensure that all students participate and receive information on their progress and can perform an automatic analysis of the answers. By the same token, students can receive feedback about the right answer, leading to a collaborative environment in the classroom. These entertaining activities allow teachers to face two vital challenges (Hussein, 2015): (i) Being able to follow the student's learning process in a real and continuous way and guarantee that they are achieving the specific knowledge and the proposed competences; (ii) Having constant and agile information on the level of global knowledge and skills of the group so that teachers can detect student' strengths and weaknesses and thus be able to give feedback to influence, review or highlight those aspects. In this sense, the present work proposes the study of the influence of using BYOD and specifically *Kahoot!* application as a gamification tool. Our aim is to boost the student's learning and the implementation of this project as an evaluation

instrument in an experimental subject of analytical chemistry within the Degree in Chemistry at the University of Valladolid. An empirical methodology was used among three different groups of students. In Groups 1 and 2, ones in which *Kahoot!* was not used daily in laboratory practices and in the third one it was employed. The difference between the first and second one is that only one of them (Group 2) was aware of the existence of the final partial exam at the end of the practical sessions. The aim was to study the potential benefits associated with the use of this tool and measure the extent to which the students' knowledge had developed.

2. Objectives and Hypotheses

2.1. Objectives

The main goal set in this project is introducing a new pedagogical approach using gamification as a teaching-learning tool based on the *Kahoot!* application. It has been applied for an experimental analytical subject of the second course of the Degree in Chemistry. This approach is considered as an alternative method of teaching and evaluation of an experimental subject with respect to traditional methods which are usually employed. In order to fulfill this general objective, the following secondary objectives have been proposed:

- Compare the learning results using BYOD in relation to traditional methods in experimental laboratory classes.
- Promote the use of new technologies and digital games in teaching-learning processes via *Kahoot!* in experimental subjects.
- Encourage an entertaining and attractive learning environment that captures the attention, interest and motivation of the students.
- Facilitate the self-assessment of the student for knowing daily progress of their learning and its evolution.
- Obtain feedback of the learning process of the students and allow teachers adapt and redesign the development of experimental classes and place greater emphasis on the points where the students find it more difficult or consider that the explanations should be more extensive.
- Improve the understanding of the *Kahoot!* application in order to use it as an evaluation tool in experimental subjects included in the Degree of Chemistry.

2.2. Hypothesis

Taking into account the conclusions reached in a previous work related to a different theoretical subject of the Degree in Chemistry (Ares, 2018), this study embarks upon a series of initial hypotheses:

- Using BYOD methodology gives students autonomy and confidence to carry out the laboratory experimental practices.
- *Kahoot!* facilites students' study process owing to it contributes to improvement in memorising concepts.
- Learning through gamification allows get better results with students more motivated and involved in teaching-learning process.
- Frequency of questionnaires is paramount for the learning process by virtue of the feedback and additional explanations given by teachers
- The scores of students who have participated in the *Kahoot!* quizzes are higher than those of students who have been attenting in conventional classes.

3. Methodology

The present study approaches using BYOD methodology for searching information and using gamification applications as a learning and evaluation tool in the university laboratory classroom. An empirical-analytical methodology is applied, utilizing *Kahoot!* questionnaires on every single day of the laboratory experimental lessons as a continuous training before doing the final exam. The contents of this test are the same as the questionnaire perform in the last practical session. Three groups of students are evaluated with two types of teaching methodologies: using or not BYOD and gamification. The groups were similar ages, conditions and background scores in other subjects of the Degree in Chemistry. Teachers described the same laboratory experiences for all groups involved using the same methodology. Using the blackboard, they explained the theoretical contents and the steps to carry out the laboratory practices before doing the experimental application. One group (Group 1; 10 students) did not played *Kahoot!*, and it was not informed about a final partial exam. In contrast, the other two (Group 2; 7 students and Group 3; 9 students) were previously notified that it would be a partial exam in the last day of experimental sessions. Plus, only in Group 3, *Kahoot!* was used as an evaluation tool during the laboratory lessons. Additionally, this group had the opportunity to use the mobile devices to search for information and compare their own results with bibliographic pages recommended by the teacher. For the learning and evaluation via *Kahoot!*, the developed work plan was as follows:

- *Kahoot!* questionaries were done every day at the beginning of the lessons for reviewing the practices carried out on the previous day. The total number of experiments in this subject was 8 (30h / 6 days).
- The teachers designed several multiple-choice questionnaires (four possibilities or true/false choice) related to the rationale, the methodology and the calculations of each laboratory practice in the Experimental Chemistry I subject. The number of

questions was between 8 and 10. Duration of each question was between 30-90 seconds, which depended on the difficulty.

- Day by day, the students accessed the questionnaire with their own mobile devices and selected the corresponding quiz through a code provided by the teacher. Later, they logged in with their names/last names. When all the students were registered in the virtual game, the teacher projected the questions in the blackboard with the help of a projector.
- Once the time for each question was over, the correct answer was shown, and students got points if they have chosen the right option. The faster you answered correctly, the more score you received.
- Next, the teacher briefly debated with the students each question and gave them a short feedback.
- Once the test is finished, each student receives on their mobile device the number of right and wrong answers and the position in the ranking according to the rest of participants. In parallel with that, the application creates an Excel file with an accurate summary of the questionnaire for each student.

To verify if *Kahoot!* contributed positively to learning outcomes, a partial test (10 questions with four options) was done by the three groups of students at the end of the experimental laboratory lessons.

4. Results and Discussion

The use of *Kahoot!* allows teachers to get immediate feedback on the students progress and correct concepts that were not clear much faster than if the teacher did not use this methodology or applied a traditional one. At the same time, when the *Kahoot!* game finishes, the students receive their scores and allow them to identify the strengths and weaknesses points to prepare properly for the final exam. The results of a partial exam and the subject final score were compared between Group 1 (*Kahoot!* was not used; students did not know about the final partial exam), Group 2 (*Kahoot!* was not applied; students knew about a final partial exam) and Group 3 (*Kahoot!* was used daily; students knew about a final partial exam) in order to assess the evolution of the students' academic performance. Likewise, an evaluation of the students' final grades for the subject has been checked. It should be clarified that the partial and final theoric exam in both groups were rather similar in terms of topic and difficulty of the proposed questions. As can be observed in **Figure 1**, students' overall scores were the highest in Group 3 in which *Kahoot!* questionnaires were employed, and they were also more prevalent among students who had achieved a better *Kahoot!* performance. Conversely, the scores were significantly better in Group 2 than Group 1 in which difference between them is the knowledge (Group 2) or not (Group 1) of the final partial exam at the end of the practices. The average of the scores

obtained in all cases were 3.3, 4.3 and 7.0 for Group 1, 2 and 3, respectively. The difference could be explained by the knowledge about the final exam (Group 1 vs Group 2), and/or the use of BYOD model and *Kahoot!* quizzes (Group 3 vs Group 1/2) for learning and assimilation of concepts.

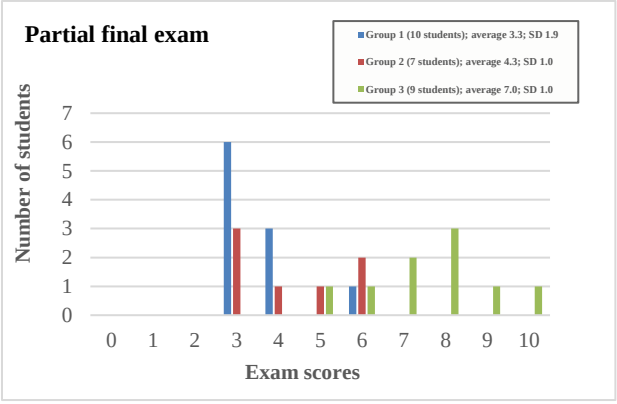

Figure 1. Comparison of the partial exam results of three groups of students.

The results can not be extrapolated to the final subject grade, as it is indicated in **Figure 2**, in which in Group 3 the average score is maintained but not for the case of the other two groups. This might be explained due to the fact that the results of gamification were shown in the short term and that the final exam took place one month after the laboratory practices.

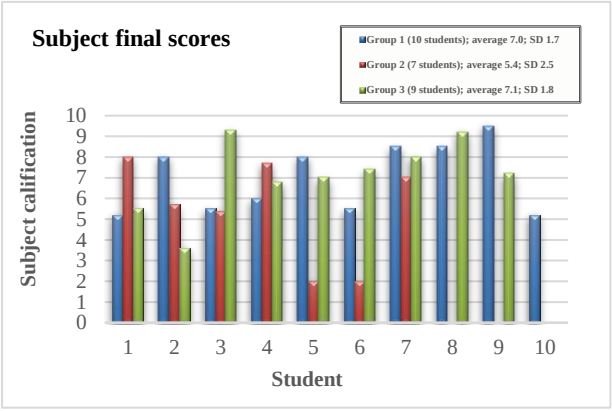

Figure 2. Comparison of the subject scores of three groups of students.

5. Evaluation by participants

At the end of the academic course, a satisfaction survey was carried out among the students of Group 3 to know their opinion regarding the methodology and the *Kahoot!* Application (see **Figure 3**). The most valued characteristics were that 100% of students: i) Thought Kahoot! application has been useful because its use had a positive impact on their learning; ii) Recommended to other teachers the use of *Kahoot!* application; iii) Considered *Kahoot!* breaks the routine dynamics of the conventional classes.

The only slight downside remarked by the students was the available time for answering the questions.

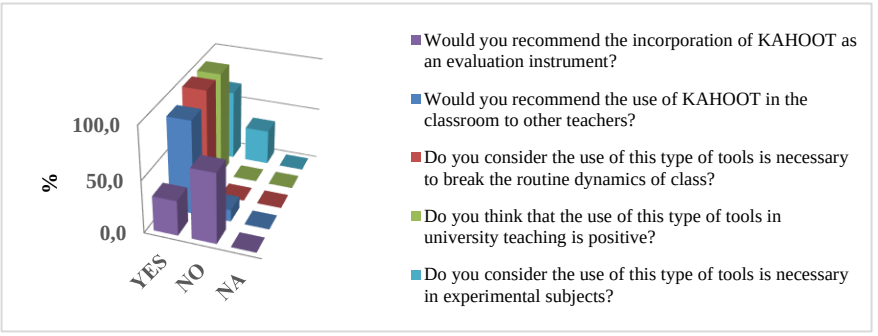

Figure 3. Comparison of the subject scores of three groups of students.

Among the most relevant findings, it could be stated that the degree of satisfaction with the application was high or medium-high for 100% of students. The 38% of students showed a degree of satisfaction high or medium-high with the procedure used to assimilate concepts and in learning the theoretical subject. Impressively, 100% of them considered that the use of the questionnaries via *Kahoot!* has helped them to get better results on the final test exam. Regardless of that, *Kahoot!* has vertiginously increased competition between students for 25%. Finally, yet importantly, all the teachers involved in the innovation activity considered that BYOD methodology raised the attention and motivation of the students, and it has helped to make classes more interactive as well as collaborative.

6. Proposal for the future

During the next academic course, the use of *Kahoot!* tool will be carried out together with the use of audiovisual material about theoretical-experimental aspects which will be provided to the students before starting the laboratory lessons. Still further, the main project goal will involve all the students of the subject (around 40 students) and arouse their motivation and desire to continue studying and improving their performance in the experimental subject.

7. Conclusions

The use of BYOD model using gamification in an experimental subject of the Degree in Chemistry, has had a significant and positive impact for the students. The results obtained in this teaching innovation project confirmed that the *Kahoot!* application was a valid and effective tool for evaluation processes continuous as it provides better academic results. This fact has been demonstrated comparing student groups using or not gamification during the experimental lessons. The degree of student satisfaction with the methodology used was medium-high (50%) or high (50%) and 100% of students considered positive *Kahoot!* application for their learning. Hence, it may be concluded that the objetives and hypotheses proposed were successfully achieved and verified. Be that as it may, it is pivotal to extend and obtain an exhaustive research with more students involved.

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