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Games in the classroom? Analysis of their effects on financial accounting marks in higher education

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A R T I C L E   I N F O

A B S T R A C T

The purpose of this study is to examine Kahoot! in higher education, specifically in subjects of financial accounting, and explore if its use means higher marks. We analyze the marks of 232 students of Financial Accounting of the Business and Management Degree of the University of Murcia (Spain). The sample comprises two groups of students, depending on whether or not games are used in the classroom, and the marks of the continuous assessment exercises, the final exam, and the final mark in the subject are compared to check if there are differences between groups. This means that we finally analyze a database of 794 marks. The results indicate that students who played get better academic results than those who did not use Kahoot! The current pandemic situation has changed the way of teaching and at university, it is mainly virtual, which can make teaching and learning more tedious and less motivating. For this reason, the use of gamification can be easily implemented in order to avoid all these inconveniences and positively affect the students' marks.

1. Introduction

Gamification is a methodology that refers to the use of games as learning activities (Faiella & Ricciardi, 2015). The use of game elements and techniques in non-game settings facilitates learning and increases the speed and efficiency of its use because gamification is effective for learning (Sailer & Homner, 2020). Several authors have shown that gamification can be a powerful motivator (Tan Ai Lin, Gonapathy & Manjet, 2018; Wang, 2015; Zainuddin et al., 2020) and a technique to increase the students' engagement (Hanus & Fox, 2015; Kuo & Chuang, 2016). Game-based learning (GBL) uses gameplay to enrich the acquisition of skills and knowledge (Kirriemuir & McFarlane, 2004; McFarlane et al., 2002; Nkhoma, Hkhoma & Thomas, 2018; Prensky, 2003). Furthermore, GBL enhances classroom dynamics and improves students' interactions with their teachers (Rosas et al., 2003).

The use of technology can help learners to better understand the materials and to increase motivation and participation in class, and also can help teachers to evaluate students' comprehension and development (Denham, 2015; Gee, 2003; Habgood & Ainsworth, 2011; Tan Ai Lin et al., 2018). There are some studies that discuss the online gamification platform in the form of students' response systems (Sawang, O'Connor & Ali, 2017; Wang, 2015; Wang & Lieberoth, 2016). However, it is not clear whether GBL improves student learning and retention, and how much can improve learning beyond traditional methods because it is mainly linked to the use of new technologies (Licorish et al., 2018).

Kahoot! is a digital game-based learning platform that allows teachers and students to interact through competitive knowledge

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games. It is a free web-based platform that allows users to create interactive quizzes and surveys. It contains points, a leader board, instant feedback, and a reward. Previous studies mainly investigate the use of Kahoot! and its effects on improving engagement and motivation but not on the students' grades and learning achievement. It is also scarce the theoretical background focused on learning achievements in higher education. As Kahoot! is not usually tested at the university, the objective of this paper is to examine its use in higher education and check if it affects and how, the official students' marks.

The remaining sections of this article are organized as follows. Following this introduction, we present the "Theoretical background" of this study and the hypotheses. The "Sample and Methodology" presents the research methods and procedures. In the "Results and Discussion" section we include the main results obtained, and finally, in the "Conclusions", findings are discussed, and limitations and implications to the study are considered.

2. Theoretical background

Several researchers show huge benefits in using Kahoot! in classroom teaching as a way to increase motivation and facilitate engagement (Iaremenko, 2017; Iwamoto et al., 2017; Johns, 2015; Licorish et al., 2017, 2018, pp. 89–91; Mekler et al., 2017; Plump & LaRosa, 2017; Wang, 2015; Wang & Lieberoth, 2016).

Despite strong evidence that Kahoot! increases student attention, motivation, and engagement, it remains unclear whether game-based learning leads to greater achievement than traditional methods (Méndez & Slisko, 2013; Plump & LaRosa, 2017; Randel et al., 1992). There are some studies that have analyzed the relationship between the use of GBL and students' achievement or learning, and they highlight a positive relationship (Liao et al., 2011; Miller et al., 2002; Sánchez-Martín et al., 2017; Tüysüz, 2009). Specifically, there are authors that study BGL as a tool of assessment when there is feedback and scores (Jurgelaitis et al., 2019; Ortiz-Rojas, Chiluiza & Valcke, 2019; Zainuddin et al., 2020). Some of these papers are based on the comparison between a game playing group and a control group and the largely obtained results find that gamification is effective in teaching (Connolly et al., 2012; Wang, 2015) but they do not explore the relationship between scores obtained from Kahoot! and official grades. They are not based on the use of Kahoot! and report on games across a range of subjects and curricular areas not mainly in higher education.

There are studies concretely focused on Kahoot! that analyze the positive effects of its use on motivation exploring students' perceptions through surveys, interviews or other qualitative tools (Aktekin, Celebi & Aktekin, 2018; Cárdenas-Mancada et al., 2020; Esteves et al., 2018; Minton & Bligh, 2021; Plump & LaRosa, 2017; Tan Ai Lin et al., 2018; Yapici & Karakoyun, 2017). Other previous papers include grades in the analysis, such as Guardia et al. (2019), but they do not establish the relationship between the use of Kahoot! and the official marks got by the students. They compare the scores of Kahoot! with the results of a test carried out as a reflection of the traditional evaluation method, but not considered as official marks and conclude that Kahoot! is an evaluation method that improves performance (Guardia et al., 2019).

We have only found a study that checks if there is an influence of the use of Kahoot! on the marks got by the students. In this paper, Ares et al. (2018) compare two groups of students depending on if they use or do not Kahoot! and their academic results, as marks of the partial and final exam. They include as questions of the exams some of the ones previously answered in the Kahoot! games to try to establish this positive influence. Although they check that marks of the exams are better thanks to games in the classroom they also conclude that is necessary to perform more exhaustive research (with different courses and subjects) in order to verify this hypothesis.

Bearing in mind this existing background, the purpose of this paper is to examine the use of the application Kahoot! in higher education and explore if it increases the real achievement of students. Specifically, our objective is to test the effectiveness of the use of Kahoot! at the University and to examine how this technology affects the grades got by the students. Kahoot! is not usually tested at the university, and it is necessary to understand how such a tool is received by university students and it can affect the other official students' marks. Overall, our purpose is to understand how students experienced the use of Kahoot! at the University through the improvement of their different official marks. So, in our study, we addressed the following hypotheses:

H1. Using games in the classroom (Kahoot!) affects the continuous assessment mark.

H2. Using games in the classroom (Kahoot!) affects the final exam mark.

H3. Using games in the classroom (Kahoot!) affects the subject mark.

3. Methodology and methods

In this paper, we analyze the marks of 232 accounting students on the Business and Management Degree of the University of Murcia. In this sample, we have two groups of students from the same subjects, but in two consecutive academic courses: 2017/18 and

Table 1
Number of students included in the sample.

Nº students		No Kahoot!	Kahoot!	Total
Subject	Financial Accounting	80	38	118
	Advanced Accounting	54	60	114
	Total	134	98	232

Note: Own elaboration.

2018/19. The students of the first of the two academic courses did not play with Kahoot! while the students of the more recent academic year did (Table 1).

We obtain all the marks for these students, bearing in mind the different exercises of continuous assessment, the final exam, and the final mark of the subject, in order to check if there are differences in all these marks between the group that played with Kahoot! and the group that did not. Those students who have played Kahoot! during the semester have done at least one quiz randomly each month.

The design of quizzes on Kahoot! is very simple and it can be intuitively done to try Kahoot! in classes. The application has to be freely downloaded by the lecturer. Then it is necessary to be registered using the free option of academic or teaching use. These quizzes have been designed by each lecturer with 10/15 short questions of four answers' options and only one right answer. The app limits the number of characters in the question and the answers but it is not a disadvantage because it makes quick each quiz and easy to read and understand for all the students. The app also allows to include images or photos. Another important advantage of the app is that the standard time to answer each question is 20 s. Then the lecturer can expand it, for example, if it is necessary to calculate something, but it means that it takes a short time to solve a 10-questions Kahoot! quiz in the class time and that students will pay all their attention to the game. It is also important to point out that students don't have to download the app to play Kahoot! They only have to go into Kahoot! using their mobile phones and to enter with the code that the lecturer switches on and add a nickname to can be identified to get the marks (they are asked for writing as nickname the number of their national identity document).

As a mark for Kahoot! we have calculated the average of all of them, which did not count for the mark in the subject. Another feature of Kahoot! that is valuable for its use in education is that it is available in an excel file with the scores obtained by every gamer and so the right and wrong answers. All the other marks counted for the subject mark. The marks obtained in the continuous assessment exercises are 30% of the subject mark, and the final exam mark is the remaining 70%, as specified in the official guide of the subject and the official degree document. This means that in the sample there are three marks for each student, which gives a final database of 794 marks.

In terms of methodology, the descriptive analysis was made with the following tools:

- The descriptive statistics of the whole sample and also segmenting the sample according to the use or not of Kahoot!
- The average marks (Kahoot!, continuous assessment, final exam, and of the subject) for the whole sample and also for the segmented sample.
- Pearson chi-square in order to check the relationship between the different marks and using or not using Kahoot! Then we analyze contingency tables in the cases in which the obtained relationship was statistically significant. To use these statistical tools, it was necessary to recode the marks as qualitative variables, classifying them according to the average in the two groups, over the average or below the average.
- T statistic to check the equivalence of mean for independent samples bearing in mind all the marks depending on the segmented sample: players or non Kahoot! players. We try to check if the means are significantly different depending on the use or not of Kahoot!

In the second part of the methodology, we propose six regression models. These models include as dependent variables the different marks: continuous assessment, final exam, and subject. The independent variables are in every model the average mark of Kahoot! and the subject, which is included in the model as a dummy for Financial Accounting, because the other subject (Advanced accounting), is included in the constant to avoid multicollinearity. The first three models include the whole sample and then the second three the segmented sample. The proposed models are included in expressions (1), (2), (3) and they will be estimated twice.

$$\text{Continous assessment mark}_i = \beta_0 + \beta_1 \text{ Financial accounting}_i + \beta_2 \text{ Average mark of Kahoot!}_i + \varepsilon_{it} \tag{1}$$

$$\text{Final exam mark}_i = \beta_0 + \beta_1 \text{ Financial accounting}_i + \beta_2 \text{ Average mark of Kahoot!}_i + \varepsilon_{it} \tag{2}$$

$$\text{Subject mark}_i = \beta_0 + \beta_1 \text{ Financial accounting}_i + \beta_2 \text{ Average mark of Kahoot!}_i + \varepsilon_{it} \tag{3}$$

We want to check if marks in the group of students that played with Kahoot! are different from those of the other group.

Table 2
Descriptive statistics of the marks of the whole sample and the segmented sample.

		N	Minimum	Maximum	Mean	Standard Deviation
Whole sample	Average mark Kahoot!	98	0	9.73	3.12	2.44
	Continuous assessment mark	68	0	8.82	2.94	2.72
	Final exam mark	36	0.27	9	3.98	2.35
	Subject mark	203	0	9.28	3.62	2.45
Students who played Kahoot!	Average mark Kahoot!	98	0	9.73	3.12	2.44
	Continuous assessment mark	47	0	8.82	3.71	2.7
	Final exam mark	32	0.27	9	3.79	2.43
	Subject mark	86	0	9.28	3.35	2.76
Students who did not play Kahoot!	Continuous assessment mark	21	0	6	1.19	1.86
	Final exam mark	41	5	6	5.50	0.582
	Subject mark	17	0	8.42	3.82	2.19

Note: Own elaboration.

4. Results

4.1. Descriptive analysis of the marks depending on the use of Kahoot!

The analysis of the descriptive statistical depending on the use of gamification reveals (Table 2) that students who played with Kahoot! obtained higher maximum marks and those who did not get higher marks average in the final exam and the subject mark, as also obtained Ares et al. (2018) in the marks of the partial and final exam. It is also remarkable that the standard deviation of the marks is smaller when the students did not play Kahoot! It means that their marks are more similar than when they played.

The different averages of the marks depended on the subject: Financial Accounting or Advanced Accounting, regardless of the use of Kahoot! (Table 3). For the continuous assessment, marks are higher on average in the subjects in the first year (Financial Accounting), while the opposite occurs with the final exam mark. This implies that the average mark of the subject is also higher for Financial Accounting because the higher mark in the final exam is not enough to compensate for the low mark of the continuous assessment on the other courses. Marks of the continuous assessment are always higher when students played Kahoot! so it seems to be a tool to include in the continuous assessments to positively impact on the final marks as this relationship is previously checked (Fresneda & Sagredo, 2019; Santos et al., 2018; Pudaruth et al., 2013; Sanz-Pérez, 2019).

Gamification during the semester has got a direct effect on continuous learning and so on these marks, regardless of the subject. If Kahoot! has got a positive effect on continuous assessment results it will positively impact all the other marks. On the opposite side, if students do not pay attention to everyday learning, the good marks obtained in the final exam are not reflected in the subject mark. Despite having analyzed two different subjects, the significant distinction between categories is caused by gamification as happens in other previous studies pointed out by Connolly et al. (2012).

While there seem to be no differences in the marks of the two subjects depending on the use of Kahoot!, its use does determine the different marks which count for the subject mark (Table 4). These results have been obtained checking if there is a relationship between the use of Kahoot! and all the official marks: continuous assessment, final exam, and subject. A statistically significant relationship was found between the use of Kahoot! and the three different kinds of marks.

It seems that when the students play Kahoot! they get higher marks in the continuous assessment than the average (90% of the highest average marks in the continuous assessment are in the group of students that play Kahoot!, Table 5). The same occurs in the final exam mark (Table 6, 77.8% of the average final exam marks are higher when playing Kahoot!). This means, a priori, that for the sample analyzed the use of gamification in the classroom leads to better use of the continuous assessment exercises, which leads to better results and marks in the final exam. Nevertheless, the opposite occurs for the subject mark, with the marks mainly higher than the average when the students did not use Kahoot! (67% of the marks above the average for the subject are obtained in the group which did not use Kahoot!, Table 7). These results may be because the higher mark in the continuous assessment and in the final exam when the students play Kahoot! is not enough to get higher mark in the subject.

The results with chi-square are the same as those obtained in T with a hypothesis of equivalence of means in the different marks with a segmented sample (Table 8). These coincident results show that the three marks included in the official mark - continuous assessment, final exam, and subject - are significantly different depending on whether the students used Kahoot! So, before the explanatory analysis, we can accept the research hypotheses established in this paper.

4.2. Explanatory analysis of the use of Kahoot! and its effect on the continuous assessment mark, the final exam mark, and the subject mark

In the last part of our analysis, we propose six regression models previously described in the methodology section. The three kinds of marks studied are included in the models as dependent variables in the first three models, which include the whole sample. Afterward, we repeat the three same models but only for the segmented sample, bearing in mind only the students who played with Kahoot! All the models (Table 9) are statistically significant, regardless of whether it is the whole sample or the segmented sample, which shows a relationship between the different kinds of marks and the ones with Kahoot! The mark got playing determines the mark got in the continuous assessment, in the final exam, and the subject. Besides this, this relationship is closer for the continuous

Table 3
Average marks by the subject of the whole sample and the segmented sample.

		Financial Accounting	Advanced Accounting
Whole sample	Average mark Kahoot!	3.05	3.16
	Continuous assessment mark	4.14	0.24
	Final exam mark	3.31	5.7
	Subject mark	4.18	3.17
Students who played Kahoot!	Average mark Kahoot!	3.05	3.16
	Continuous assessment mark	4.52	0.33
	Final exam mark	3.31	5.83
	Subject mark	3.92	3.11
Students who did not play Kahoot!	Continuous assessment mark	2.56	0.17
	Final exam mark	–	5.5
	Subject mark	4.29	3.25

Note: Own elaboration.

Table 4
Pearson Chi-square of marks and using Kahoot!

Pearson Chi-square			
	Value	Df	Sig. (bilateral)
Continuous assessment mark	10.967	1	0.001***
Final exam mark	4.50	1	0.034***
Subject mark	8.405	1	0.004***

Note: Own elaboration *p < 0.1 **p < 0.05 ***p < 0.01.

Table 5
Contingency table between continuous assessment mark and using Kahoot! with total by rows.

(%)		No Kahoot!	Kahoot!	Total
Continuous assessment mark	<average	47.4	52.6	100
	>average	10	90	100

Note: Own elaboration.

Table 6
Contingency table between final exam mark and using Kahoot! with total by rows.

(%)		No Kahoot!	Kahoot!	Total
Final exam mark	<average	–	100	100
	>average	22.2	77.8	100

Note: Own elaboration.

assessment mark, due to the degree of goodness of the models shown in the R^2 values. These results are coherent with those obtained in the literature which reports the direct and positive effects of the continuous assessment in the other type of tests included as marks (in our results the effect is also positive because of the positive coefficient obtained in Beta) (Ares et al., 2018; Santos et al., 2018; Fresneda & Sagredo, 2019; Pudaruth et al., 2013; Sanz-Pérez, 2019). If we study the coefficients of the relationship between the mark with Kahoot! and each of the other marks, it can be also observed that they are positive and that there is a direct relationship between the mark in the gamification activities and that in each one of the official exams. In absolute values, it is higher in the case of the final exam, which can be understood as continuously learning the subject, reflected in the random exercises done with games, led to a better mark in the final exam. The subject mark is calculated as 30% of the continuous assessment mark and 70% from the final exam mark, and so it is coherent that if the Kahoot effect is bigger on the final exam mark, so it will be bigger on the subject mark, as is shown in the Beta values. So, finally, we can accept all three research hypotheses of this paper.

5. Discussion and conclusions

After studying the effects of using Kahoot! on the different marks, we can conclude that Kahoot! in higher education, specifically in subjects of financial accounting, leads to better academic results than other students who do not use games like Kahoot! Although based on other platforms or game methodologies and subjects, our results are similar to the ones obtained by authors such as Jurgelaitis et al. (2019), Méndez and Slisko (2013), Ortiz-Rojas, Chiluiza & Valcke (2019), Plump and LaRosa (2017), Randel et al. (1992), Sánchez-Martín et al. (2017), and Tüysüz's (2009). Concretely based on the study of the use of Kahoot! and its effects on the marks of the partial and final exam, Ares et al. (2018) also check that students who play Kahoot! get better marks.

Bearing in mind all the different marks obtained by the students during the semester, it can be checked that those who played Kahoot! took more advantage of the continuous assessment and so it would be fine to incorporate Kahoot! for classroom assessment (Wang, 2015). Although Kahoot! scores have not been taken into account in these marks, these games are useful to increase the everyday students' achievement. We can point out that the use of Kahoot! has a positive influence on continuous assessment, which also has a significant influence on the final results, as other authors have checked the impact of continuous assessments on the final marks (Fresneda & Sagredo, 2019; Santos et al., 2018; Pudaruth et al., 2013; Sanz-Pérez, 2019) and as Kahoot! allows to provide feedback, it is an effective and efficient way to be used to increase the students' grades (Hernández, 2012; Nkhoma et al., 2018). As Zainuddin et al. (2020) affirm gamification is a good tool for innovative assessment and it should be included in the grading process.

Table 7
Contingency table between the subject mark and using Kahoot! with total by rows.

(%)		No Kahoot!	Kahoot!	Total
Subject mark	<average	46.8	53.2	100
	>average	67	33	100

Note: Own elaboration.

Table 8
T for independent samples.

		Levene for equality of variances		T for equality of means					T for equality of means confidence interval 95%d	
		F	Sig.	T	Df	Sig. (bilateral)	Dif. means	Dif. Standard error	Lower	Higher
Continuous assessment mark	Same variances	4.593	.036	−3.884	66	0***	−2.52	.65	−3.82	−1.23
	No same variances	–	–	−4.463	54.399	0***	−2.52	.57	−3.66	−1.39
Final exam mark	Same variances	3.664	.064	1.392	34	.173*	1.71	1.23	-.79	4.22
	No same variances	–	–	1.341	201	.003***	1.71	.52	.64	2.79
Subject mark	Same variances	9.058	.003	1.341	201	.181*	.47	.35	-.22	1.15
	No same variances	–	–	1.295	157.001	.197*	.47	.36	-.24	1.18

Note: Own elaboration *p < 0.1 **p < 0.05 ***p < 0.01.

Always supposing that there is feedback after each game in order to enrich the learning process.

So Kahoot! is a positive tool for the learning process and its results. Although there are numerous studies that show huge benefits in using Kahoot! to increase motivation and facilitate engagement (Iaremenko, 2017; Iwamoto et al., 2017; Johns, 2015; Licorish et al., 2017, 2018, pp. 89–91; Mekler et al., 2017; Plump & LaRosa, 2017; Wang, 2015; Wang & Lieberoth, 2016), this positive influence on learning cannot be directly included in the mark, as it is our case, because Kahoot! scores did not mean a percentage of the subject mark. But at the same time, this positive influence is indirectly translated as a higher mark in all the other official marks because all of them are related. We would highlight that using Kahoot! in higher education finally leads to enhanced performance and better academic results in the different exercises during the semester and in the final exam. The random use of Kahoot! also enforces the need to learn step by step because students want to win the game. It means that whenever it is played they must have studied the subject and be ready to answer the quiz quickly and rightly to be on the final podium. So, although the continuous assessment is valued as an official mark it is not enough, because its mark increases when students play Kahoot!

In this same line of research, we could include further studies to improve teaching in higher education, for example, larger samples and databases, more marks from more students, more subjects, semesters, and some different variables, such as gender of students. Comparisons between groups of students depending on the use or not of Kahoot!, using other statistical tools to draw significant conclusions could also be carried out. This research provides empirical evidence of the effects of this educational methodology on higher marks, which can be understood as effects also on learning and motivation but which could be related to better theoretical knowledge, but not directly to motivation. So, it would be necessary to complete this research by adding some other analysis such as quantitative information (for example, a survey using a Likert scale) and qualitative information (for example, asking students to write an essay explaining their perception regarding the use of this teaching and learning approach).

It is checked that the use of Kahoot! in higher education has taken to an improvement of all the other marks, mainly in the

Table 9
Regression models.

	Whole sample					
	Dependent variable					
	[1] Continuous assessment mark		[2] Final exam mark		[3] Subject mark	
	Beta (SE)	P	Beta (SE)	P	Beta (SE)	p
Constant	−0.200 (0.661)	.763	2.949 (1.189)	.019**	1.419 (0.454)	.002***
Financial Accounting	3.200 (0.769)	.000***	−1.681(0.921)	.078*	0.641 (0.568)	.262
Average mark Kahoot!	0.497 (0.144)	.001***	0.586 (0.179)	.003***	0.533 (0.104)	.000***
R² ajusted (%)	49		35.2		23.6	
Model	F(2) = 23.140***		F(2) = 9.403***		F(2) = 14.106***	
	Students who played Kahoot!					
	Dependent variable					
	[4] Continuous assessment mark		[5] Final exam mark		[6] Subject mark	
Constant	−0.200 (0.661)	.763	2.949 (1.189)	.019**	1.419 (0.454)	.002***
Financial accounting	3.200 (0.769)	.000***	−1.681 (0.921)	.078*	0.641 (0.568)	.262
Average mark Kahoot!	0.497 (0.144)	.001***	0.586 (0.179)	.003***	0.533 (0.104)	.000***
R² ajusted (%)	49		35.2		23.6	
Model	F(2) = 23.14***		F(2) = 9.403***		F(2) = 14.106***	

Note: Own elaboration *p < 0.1 **p < 0.05 ***p < 0.01 Standard errors are between brackets.

continuous assessment one. So, these results have important implications and usefulness for all the actors playing a role in the education universe where gamification should be included in the classroom and the only question should be how to do it (Groening & Binnewies, 2019). They can benefit from the use of this tool and it can be also easily used in virtual teaching, as has happened with the situation generated by COVID-19. Perhaps it should be thought to give a percentage of the mark to the results of Kahoot! quizzes, or to replace some type of assessment with some different Kahoots! periodically distributed during the semester as Ares et al. (2018) argue. These are some clues to bear in mind for those who can design the evaluation system in higher education, or other levels of education.

Author statement

Esther Ortiz-Martínez: Conceptualization, Methodology, Software, Formal analysis, Writing- Original draft preparation, Writing-Reviewing and Editing

Jose-Manuel Santos-Jaén: Data curation, Writing- Original draft preparation

Mercedes Palacios-Manzano: Resources, Writing- Original draft preparation

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