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Kahoot! as a Tool to Improve Student Academic Performance in Business Management Subjects

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Abstract: The new framework for learning requires the use of new technologies, such as m-learning or game-based learning programs. Gamification using this type of applications has been implemented in higher education contexts, enhancing students' satisfaction, motivation, and class attendance. The present study refers to the introduction of new technologies and gamification through the use of the application Kahoot!, with the main objective being to analyze the relationship between the use of this gamification tool and the students' learning results, which are measured by their academic marks. The results show a positive relationship between students' results on the Kahoot! tests and the student's final mark. Additionally, we demonstrate that students' academic results improve when Kahoot! is used as an evaluation tool, taking into account improved student efficiency and a lower amount of failed grades.

Keywords: gamification; Kahoot!; higher education; academic performance; business management

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1. Introduction

The new framework for learning at all the different levels, and especially learning in higher education, is orientated towards a more active, student-centered learning, which includes several ways of learning and rewards students' achievement of competencies, both inside and outside the programs of studies. In this context, the *Horizon Report* 2017 [1] includes the tendencies and recommendations for a short-term period, as well as the design of mixed and collaborative learning or the learning process based on the use of mobile phones (m-learning) employing new technologies.

The expansion of new technologies requires significant changes in the education system [2]. Technological advancement and its continuous progress have transformed how activities are performed daily. The evolution of computer technologies, together with the increasing speed of Internet-based communications, has promoted the use of simulation software and serious games to enrich the learning experience in several areas [3].

In the context of education, especially as related to learning, educators now have the opportunity to introduce and integrate game-based learning activities via technology in their instruction [4]. The use of technology (computers, smartphones, and tablets) has been proven to foster and reinforce learning, improving learners' engagement and active participation in classrooms. The use of technology is also undoubtedly of great assistance to teachers in terms of helping increase motivation and students' participation in class, as well as evaluating students' overall comprehension and development. In addition, learners have the opportunity to engage themselves in their learning and monitor their own progress and understanding [5].

In recent years, one of the priority areas has been gamification, particularly, its implementation in higher education through the improvement of the existing educational

platforms and the creation of new game-based learning programs for use in open information and education environments [2,6]. Gamification in education refers to the introduction of game design elements and game-based experiences in the design of learning processes. It has been adopted to support learning in a variety of contexts and subject areas and to address related attitudes, activities, and behaviors, such as participatory approaches, collaboration, self-guided study, completing assignments, making assessments easier and more effective, integrating exploratory approaches to learning, and strengthening student creativity and retention [7]. Learning through digital media is currently considered a mixture of methodologies that aim to approach the reality of students to motivate them. Gamification emerges as one of the pedagogical methodologies on the rise in digital classrooms [8].

Thus, the combination of gamification and new technologies seems to offer teachers new possibilities for the teaching–learning process that, in many cases, are already being assumed as a source of innovation.

In this context, although several applications (Socrative, Quizizz, Google Forms, Brainscape, Cerebriti, etc.) favor the transition towards learning methodologies that are more active and innovative, Kahoot! is a free application that has increased in popularity among teachers thanks to its ease of use as well as its ability to create an active dynamic in the classroom [9]. Furthermore, this tool has several characteristics that make it suitable as a tool for learning and evaluation [8,10].

The present study refers to the introduction of new technologies and gamification through the use of the application Kahoot!, with the main objective being to analyze the relationship between the use of this gamification tool and students' learning results (academic performance), which are measured through academic marks in the scope of higher education.

Gamification is defined as "the use of game design elements and game thinking in non-game contexts" [11]. Gamification is defined as strategies and methodologies, outlined in the scientific literature, that encompass the approaches and possibilities of applying different types of games to teaching–learning processes [12,13]. With the use of tests, game rules, temporal limitations, punctuation, and many other elements of the game, teachers transform their classrooms into playful environments to stimulate motivation, action, and positive feedback of students [14–16].

This way, system designers take the motivational properties of games and apply them to other learning activities, thereby catching students' attention. The aspect of engagement makes gamification relevant to the higher education context and a device for engaging students. Furthermore, whenever a gamified system positions users as the key element in its design, it can facilitate the development of a learner-centered learning environment, leading to desirable outcomes [17]. This is because the higher education system as a social system requires coping with the environment in which it is operating. We need to consider that what has been changed is the environment in which universities operate. This is extremely important in the context of the 4th industrial revolution [18] and with the new students' generation, the millennials. Millennials, or Generation Y, are those people who were born in the period of 1982–1994; there is no common consensus regarding the exact dates, as some people consider the beginning of the millennial generation to be 1980, and the period can be extended until the year 2000; millennials are considered a generation that grew up involved in a technological environment with the culture atmosphere that was developed between 1980 and 2000; consequently, they are people who are familiar with technology.

In the last decade, this innovative technology has been implemented in education to increase students' participation in classroom activities and to make the learning process more attractive for learners. However, it is important to note that gamification in higher education is not directly associated with knowledge and skills; rather, it influences students' behavior, increasing their commitment and motivation and, thus, helping them to improve their knowledge and skills. It uses traditional characteristics of games such as prizes or loyalty programs [2]. In this sense, gamification in higher education promises increasing

motivation and autonomy, but may also produce a clash within a student because of the pedagogical paradigm shift, as not all students like playing games. In any event, gamification is an opportunity to provide rich and motivational experiences that can increase students' involvement and, hence, their depth of learning [19].

Engaging students in learning is becoming a priority for many educators and approaches. Educational gamification may be a means of offering a user-centered, autonomous, and flexible learning environment, encouraging users to pursue their own goals and engage in deeper-level activities more persistently. It requires the adoption of motivational properties of games into teaching and learning, considering the human desire to communicate and share accomplishments as a means of motivating students to learn. If this is successful, it can result in a long-term and deeper engagement among learners [17].

Therefore, the ubiquitous presence of technology in classrooms has inspired a shift from traditional classroom lectures to integrated digital learning environments. These interactive learning environments present the opportunity to evolve the teaching process through the incorporation of game elements that have been shown to capture user attention, motivate the pursuit of goals, and promote competition, effective teamwork, and communication [20]. In this sense, game-based learning tools such as Kahoot! supplement pedagogical practices with new technological solutions.

Learning games such as Kahoot! are channels to evaluate whether learning objectives have been achieved. Kahoot! (https://getkahoot.com) (accessed on 1 September 2020) is an online platform developed in 2013 by Professor Alf Inge Wang (Norwegian University of Science and Technology). It is a free platform (Kahoot! has a free version and a premium one, the free version is enough for us) that provides teachers with the opportunity to (1) create their own quizzes and surveys or (2) use existing quizzes and surveys made accessible for public use. Scores are displayed at the end of each game and teachers can save the information in a digital document. As for the learners (players), they are not required to register for a Kahoot! account and are instead provided with a game PIN prior to joining a specific game at https://kahoot.it/#/ (accessed on 1 September 2020) as directed by their teacher (game host) [4].

As a digital game-based student response system, Kahoot! allows teachers and learners in classroom settings to interact through competitive knowledge games using the existing infrastructure [4]. Authors such as Wang, Zhu, and Sætre [21] pointed out that Kahoot! represents a new generation of student response systems that focuses on student motivation and engagement through gamification. This platform is apt for increasing motivation and engagement (which promotes learning) and for assessing students' understanding of a lesson.

Gamification in Higher Education and Results

A systematic review of gamified learning in higher education revealed several key findings showing that the influence and acceptance of gamification and game-based learning in education is growing. Research in this field has increased in recent years, with benefits in higher education settings becoming more established and recognized. Gamified learning in higher education has received attention only since 2013, but has grown rapidly thereafter. The successful implementation of gamification and game-based learning provides a reason to be enthusiastic about their application in higher education across various country/student cultures, subjects, and formats. A systematic literature review identified several benefits of using gamified learning, such as improved student engagement, motivation, confidence, attitude, perceived learning, and performance. Improved student attitudes, engagement, and performance were the most significant benefits of using gamification and game-based learning applications [20].

In this sense, several empirical studies consider that the use of gamification in higher education has grown, with results showing positive outcomes from these types of games [22,23] and the most improvement in attendance, participation, and motivation [24–26]. Moreover, the use of gamification has been extended in some fields of learning

such as business and marketing. Notwithstanding this, other empirical studies conclude the concern that gamification can lead to excessive complexity or competition [27–29], creating different "statuses" of students: those proactive and engaged, who always win (achievers), those who start strong and lose interest along the way (disheartened), and those with low levels of participation, the least engagement, and poorer performance (underachievers) [30].

The different innovative experiences implemented in higher education schools coincide with the incorporation of the ingredients of recreational scenarios, proposing to the students to solve problems, elaborate projects, and complete diverse missions or activities following certain milestones [31]. In other words, students must adopt the mechanisms of conventional games and establish levels that must be achieved together with the assignment of scores for each challenge successfully met [26]. These experiences guarantee an increase in both the extrinsic and intrinsic motivation of students and encourage immersion in the proposed tasks [14,32]. Ultimately, it is hoped that these experiences will help individuals to develop work skills and address the psychological needs of skills, independence, and relationships and, therefore, increase the motivation of students in work or learning contexts [33,34].

Empirical studies conclude that Kahoot! is a good tool to be implemented in class, helping to increase the participation of students, who perceive it as a game. Moreover, it improves the social relationship among students and class attendance.

Most of the previously mentioned studies relate gamification in higher education to the feedback that is received from students to analyze motivation, cooperation, engagement, competition, attendance, participation, etc. However, to the best of our knowledge, up to this moment, there has been no research in the field of higher education that relates gamification and the use of Kahoot! with the academic results of students in the area of Business Management. When students learn by playing, they are more satisfied, better retain what they have learned, and are stimulated to continue learning [6,8,35]. In this context, our objective focuses on the assessment of whether the use of this tool, apart from generating more participative dynamics in classes, allows students to better retain what they have learned, being thereby reflected in better academic results. We propose the following research hypotheses:

Hypothesis 1 (H1). *There is a positive relationship between the results that are obtained on the Kahoot! tests and the final mark that is obtained in the subject for each student.*

Hypothesis 2 (H2). *Students' academic results improve in the year in which Kahoot! is used as an assessment tool compared to the year in which it is not used.*

2. Materials and Methods

The experience of the use of Kahoot! as an evaluation system was implemented in eight subjects related to Business Management. These subjects were taught by the researchers of this paper in different bachelor's courses in both summer and winter terms of the academic year 2018–2019.

The methodology that was used can be summarized as follows. For all subjects, at the end of the different lessons, a Kahoot! game was played to check the extent of assimilation of concepts by the students. The list of questions was designed by the teachers and related to the contents and learning results of each lesson. According to the extent of difficulty of both the statement and the response options of the questions, a reasonable response time was estimated, ranging from 20 to 60 s.

The number of Kahoot! tests for the different subjects was not the same, because, as previously indicated, this depended on the number of lessons to evaluate. Notwithstanding this, all tests presented the same 10-question structure to facilitate the results evaluation. The group of participant students was relatively small, thereby helping to make the implementation of the activity easier. To be precise, the whole sample of participants for all subjects comprised 414 students. From them, 286 students (69.08%) attended classes

regularly and participated in this gamification experience. The distribution of this sample across the different subjects and bachelor's programs is reflected in Table 1.

Table 1. Students' distribution by bachelor's programs and subjects.

Bachelor Program	Subject/Year	Number of Students	Number (and Percentage) of Students Who Completed Kahoot! Tests
Business Administration (BA)	Strategic Management II/4th	87	43 (49.42%)
	Financial Management II/3rd	97	63 (64.95%)
	Production Management/3rd	63	53 (84.13%)
Law and Business Administration (L&BA)	Strategic Management II/5th	32	26 (81.25%)
Statistics and Management (S&M)	Strategic Management of Innovation, Quality, and Technology/4th	16	15 (96.75%)
Finance and Accounting (F&A)	Management Accounting I/2nd	43	23 (53.49%)
	Human Resources Management/2nd	33	28 (84.85%)
Labor Relations and Human Resources (HR)	Business Administration/1st	43	35 (81.39%)

One should also consider the fact that in five subjects (Human Resources Management (F&A), Business Administration (HR), Management Accounting I, Financial Management II, and Strategic Management of Innovation, Quality, and Technology (BA)), the results of the Kahoot! tests were considered part of the final mark for the subject, as they were included in the summative–formative assessment. More specifically, this mark is considered in the attendance and participation section. However, for the other three subjects, the results of the Kahoot! tests were not considered for the final mark, being thus considered merely as an auto-evaluation tool.

To test our hypotheses, we used quantitative methods. Specifically, we collected information about students' performance. More specifically, we collected data from the results of the Kahoot! tests and the academic results of two different courses: 2017–2018 (without gamification) and 2018–2019 (with gamification). We compared the results of the first official evaluation taken by the students.

To run the analysis of the data obtained from our study, the statistical program SPSS (version 19) was used. The discussion of the results consists of an analysis of the descriptive statistics (frequency, mean, standard deviation . . .) of the marks from the different Kahoot! tests that were given. Additionally, we present several tables from the contingency chi-squared tests, as well as a regression analysis to empirically assess whether the marks from the Kahoot! tests and the final marks for the subjects are significantly related to each other.

3. Results

To begin, we will expose in detail the number of Kahoot! tests that were proposed for each subject, also indicating the number of students who participated in those tests. This way, the subjects of Strategic Management II (in both BA and L&BA) were the ones with the largest number of tests; more specifically, seven tests. The next one is Human Resources Management (F&A) with six tests, followed by Business Administration (HR) with five tests during the semester. Three subjects (Management Accounting I (F&A), Strategic Management of Innovation, Quality, and Technology (S&M), and Production Management (BA)) included four tests each. Lastly, in Finance Management II (BA), only two tests were performed, as the syllabus of the subject is formed by two large blocks of content.

The extent of students' participation in the tests is reflected in Table 2 and Figure 1, where we present the percentage of completed tests by the students. In this regard, the subject with a greater percentage of students who regularly attended classes and showed

a high level of participation in the Kahoot! tests is Strategic Management of Innovation, Quality, and Technology. This is an optional subject in the Bachelor in Statistics and Management (S&M). The reason may be because this is an optional subject; students voluntarily choose to study that subject, thereby justifying the greater extent of participation and attendance. The next subject with a high level of participation is Finance Management II, although for this subject we must be cautious, as only two Kahoot! tests were run. Finally, as more representative, we can highlight that the group of students in the second year of the Bachelor in Finance and Accounting (F&A) showed a considerably high extent of attendance of classes and participation in the proposed Kahoot! tests.

Table 2. Level of attendance according to the extent of participation in *Kahoot!* Tests [1].

Subjects Percentage of Kahoot! Tests Taken	SM II (BA)	SM II (L&BA)	HRM (L&A)	BA (HR)	MA I (L&A)	SMIQT (S&M)	PM (BA)	FM II (BA)
100	37.21	34.61	75.00	48.57	65.22	100	49.06	85.71
85.71	27.90	19.23						
83.33			10.71					
80				40.00				
75					30.43		41.51	
71.42	16.28	19.23						
66.67			7.15					
60				8.57				
57.14	16.28	11.54						
50							7.55	14.29
42.86	2.32	7.69						
40				2.86				
33.33			3.57					
28.57		7.69						
25					4.35		1.89	
16.67			3.57					

[1] SM II: Strategic Management II; HRM: Human Resources Management; BA: Business Administration; MA I: Management Accounting I; SMIQT: Strategic Management of Innovation, Quality, and Technology; PM: Production Management; FM II: Finance Management II.

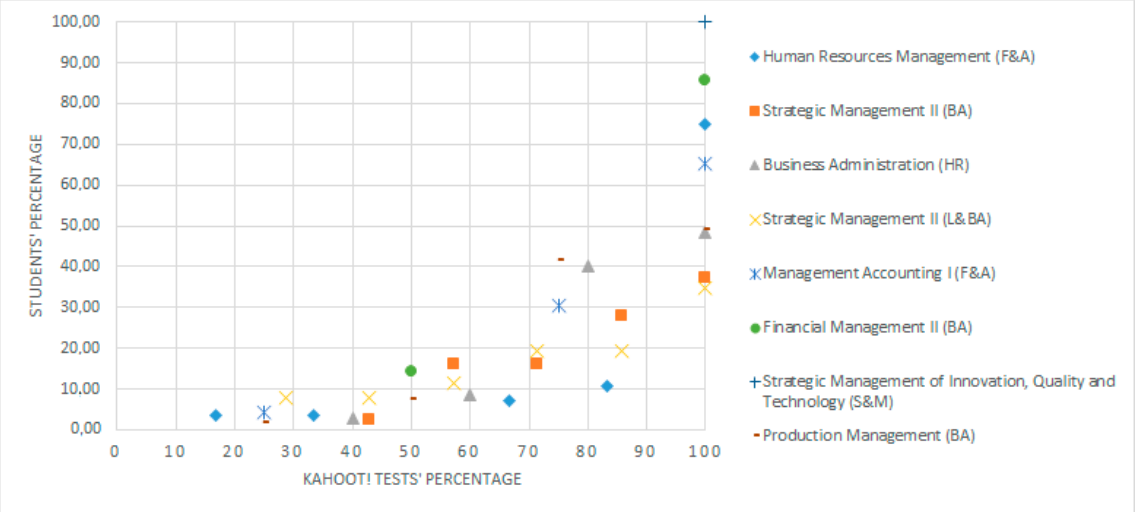

Figure 1. Levels of attendance and participation in Kahoot! tests.

Regarding the tests' marks, as previously indicated, the Kahoot! tests included 10 questions and had a value of 10 points. Thus, irrespective of the valuation that the program automatically yields (according to the number of correct and incorrect answers and the time of response for the questions), the evaluation of the different subjects considered only the number of correct answers. Then, Table 3 shows for each subject the mean mark obtained by the students in the different Kahoot! tests, as well as the maximum and minimum marks.

Table 3. Mean, minimum, and maximum marks for the Kahoot! tests.

Mark for the Kahoot! Tests Subjects	Mean	Minimum	Maximum
Human Resources Management (F&A)	8.02	3	10
Strategic Management II (BA)	3.78	1	10
Business Administration (HR)	5.51	1	9
Strategic Management II (L&BA)	5.54	2	10
Management Accounting I (F&A)	4.96	1	8
Financial Management II (BA)	4.83	1	8
Strategic Management of Innovation, Quality, and Technology (S&M)	8.13	4	10
Production Management (BA)	6.77	1	10

As we can see in Table 3, the students of Financial Management II (BA) are the ones with the lowest marks, and those of Strategic Management of Innovation, Quality, and Technology are the ones with the highest marks.

Another way to present and analyze the mean mark in the different Kahoot! tests is to group them into the following categories: Failed (0–4.9), Passed (5–6.9), Remarkable (7–8.9), and Outstanding (9–10). In this way, Table 4 presents the total number of students whose mean mark for the Kahoot! tests belongs to any of the aforementioned categories.

Table 4. Number of students according to their mean mark in the Kahoot! tests.

Mean Mark in the Kahoot! Tests Subjects	Failed	Passed	Remarkable	Outstanding	Total
Human Resources Management (F&A)	0	1	22	5	28
Strategic Management II (BA)	38	5	0	0	43
Business Administration (HR)	10	23	2	0	35
Strategic Management II (L&BA)	7	17	2	0	26
Management Accounting I (F&A)	10	13	0	0	23
Financial Management II (BA)	30	30	3	0	63
Strategic Management of Innovation, Quality, and Technology (S&M)	0	0	13	2	15
Production Management (BA)	11	19	14	9	53

This information shows that the students in the third and fourth course in the Bachelor in Business Administration (BA), in the subjects of Financial Management II and Strategic Management II, are the ones with more failed Kahoot! tests. Conversely, the subjects in which students achieved better marks were Strategic Management of Innovation, Quality, and Technology (S&M) and Human Resources Management (F&A).

Considering these marks, as we previously indicated in the theoretical background, we aim to analyze whether there is an empirically proven relationship between the marks obtained by students participating in the Kahoot! tests and the final mark attained by the students in the subject's official call. If this relationship is positive and statistically

significant, we can assume that these students with a better mark in the Kahoot! tests during the semester are the ones with higher final marks in the subjects.

To test that hypothesis, we ran a contingency test with a statistical test of the chi-squared distribution. The results of these tests are presented in Tables 5 and 6.

Table 5. Table of contingency mean marks in the Kahoot tests and the final marks in the official call.

		Final Mark in the Official Call				
		Failed	**Passed**	**Remarkable**	**Outstanding**	**Total**
Mean mark in the Kahoot! tests	Failed	34	41	20	11	106
	Passed	16	33	35	24	108
	Remarkable	2	11	34	9	56
	Outstanding	0	1	3	12	16

Table 6. Results of the chi-squared test.

	Value	**df**	**Asymptotic Significance (Two-Sided)**
Pearson's chi-squared test	80.408	9	0.000
Likelihood ratio	74.650	9	0.000
Linear-by-linear association	49.177	1	0.000
N of valid cases	286		

The relationship between both variables is completely statistically significant at 99.9%, indicating that, as expected, most of the students who failed the Kahoot! tests got the qualification of Failed or Passed, while those students with a qualification of Outstanding in the Kahoot! tests also achieved the same qualification in the subject. It can also be seen that in a few surprising cases, students with a Remarkable qualification in the Kahoot! tests failed the subject, or some students with a Passed qualification in the Kahoot! tests achieved an Outstanding qualification in the subject. Even under these circumstances, we can affirm that hypothesis 1, stating that there is a positive relationship between the results obtained in the Kahoot! tests and the final mark for the subject, is proved.

Additionally, we wanted to empirically prove whether other variables could be determinant, such as the percentage of Kahoot! tests run or the subject. In this case, we ran a stepwise (forward) regression in which the dependent variable is the final mark for the subject in the official call. As presented in Table 7, the final model showed an adjusted R squared of 0.321, thereby indicating that the model was relatively good. Furthermore, in all cases, the statistical significance was 0.000.

Table 7. Summary of regression analysis for variables predicting academic performance in 2018–2019 (n = 286) [1].

Variable	**Step 1**	**Step 2**	**Step 3**
Mean mark for the Kahoot! tests	0.627 ***	0.565 ***	0.536 ***
Percentage of Kahoot! tests taken		0.030 ***	0.029 ***
Subject			0.199 ***
F	86.347 ***	57.027 ***	45.902 ***
Adjusted R^2	0.230	0.282	0.321
R^2 change (%)		22.61	13.83
Mean mark for the Kahoot! tests	0.627 ***	0.565 ***	0.536 ***

[1] Note: *** $p < 0.001$.

Consequently, as shown by the model, we can conclude that the final mark obtained by the students in the official call is explained by the percentage of Kahoot! tests taken by each student, by the mean mark obtained for these tests, and by the subject in consideration, showing, in all of them, positive and statistically significant relationships.

Finally, to test our hypothesis 2, we compared the marks obtained in the subjects across two academic courses (2017–18 and 2018–19) considering that, except for the subjects Management Accounting I and Financial Management II, the teachers who taught each of the subjects were the same in the two courses and there were no changes in the content of the lessons for these subjects. Hence, the only difference between the two courses was the utilization of gamification with Kahoot!. Thus, this last test aimed to check whether the marks improved thanks to the utilization of Kahoot! in the classes.

To do so, we first compared the mean, standard deviation, and maximum and minimum marks for each of the subjects in the two academic courses. The results, presented in Table 8, show that, except for Strategic Management II (BA), the mean mark was higher in the academic course 2018–19, the one in which the Kahoot! was implemented. Moreover, both the minimum and the maximum marks improved or maintained invariant.

Table 8. Mean, minimum, and maximum final marks in the subjects in the official call.

	HRM (F&A)		SM II (BA)		BA (HR)		SM II (L&BA)		SMIQT (S&M)		PM (BA)	
	17/18	**18/19**	**17/18**	**18/19**	**17/18**	**18/19**	**17/18**	**18/19**	**17/18**	**18/19**	**17/18**	**18/19**
Mean	5.62	7.26	4.91	4.11	5.74	6.29	5.14	5.59	8.63	8.69	5.72	6.66
Standard deviation	1.59	1.29	2.01	2.20	1.47	2.10	1.72	1.94	1.11	0.86	3.07	2.40
Maximum	9.4	9.8	9.1	8	10	9.95	9	10	9.5	9.9	10	10
Minimum	2.3	4.4	1.8	0.2	1.8	2.5	1	1.6	7	7	0	1.5

Graphically, the improvement in the efficiency of the students can be easily observed thanks to the use of Kahoot! in the course where this application was implemented versus the course in which it was not used. Although not all of the subjects presented the same behavioral pattern, in most of them, there was a greater efficiency of students, as reflected by a lower percentage of failed qualifications. This is the case, for example, with Production Management (BA). As can be observed in Figure 2, the percentage of students who did not take the exam and those who got a Failed grade considerably decreased, while at the same time, there was an increased percentage of Passed and Remarkable grades.

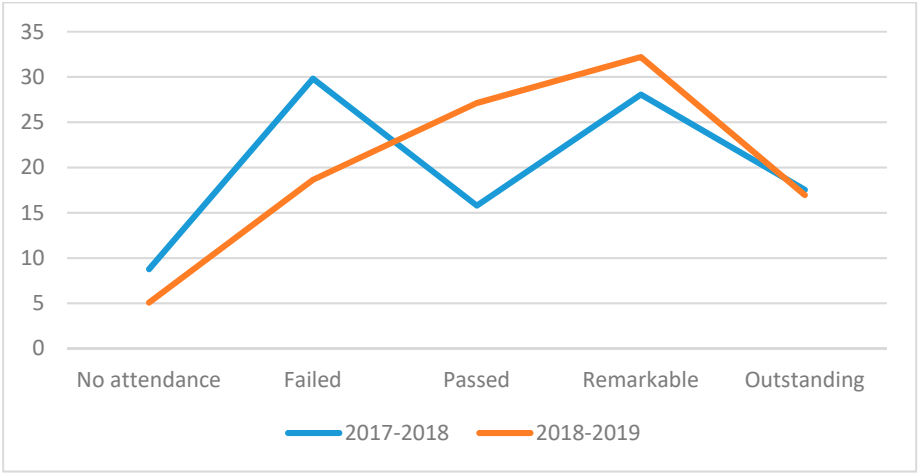

Figure 2. Final marks in the subject Production Management (BA).

Finally, taking into account these last results, we can affirm that our hypothesis 2 is also proved, with the use of Kahoot! considered an appropriate learning resource for improving academic efficiency of students.

4. Discussion

Gamification using Kahoot! has been an innovative teaching tool in Business Management subjects for both teachers and students. This experience has allowed us to make the most of the new technologies for our teaching, with more than acceptable results in terms of implication, participation, interest, and motivation, in accordance with previous studies in other fields of research [36]. There is no doubt about the positive emotional effects of gamification [7]. However, our aim went further, as we tested whether there is a significant relationship between the use of gamification with Kahoot! as an evaluation tool and the academic results of students from different bachelor's programs related to Business Management.

The first hypothesis questioned whether there is a positive relationship between the results that are obtained by the students in the Kahoot! tests and the final mark for the subjects. Results indicate that those students with higher marks in the Kahoot! tests during the semester are the ones who achieve better academic results regarding the final mark for the subject.

Regarding the second hypothesis, in which we indicated the possibility that the academic results in the present course were better than those of the previous course in which no gamification tools were adopted, we found that, although not all the subjects have the same behavior, in most of them, better student efficiency and a lower number of failed grades can be observed.

In addition to the results of our study, we would like to highlight some considerations that, although perhaps somewhat subjective, are worth mentioning. First, Kahoot! has proved to be a powerful tool that has improved our students' attendance and participation. This learning tool has favored both the continuous learning process and the engagement of students. Students not only attend more classes, but also study the subject on a more regular basis to obtain better results in each test. Even more, Kahoot! allows us to reinforce the main concepts of the subject, giving immediate feedback to students. One of the more didactic elements that we have perceived has been the pause after every question explaining the correct answer. This way, students can conduct an auto-evaluation, thereby understanding concepts more easily.

With the utilization of gamification with Kahoot!, we have incorporated m-learning, adapting our subjects to the increasing technological demands of the millennial generation. We have corroborated that if students learn by playing, they tend to better remember the concepts, thereby facilitating the learning process. Additionally, the dynamic of the game often leads to an increase in the student's motivation and self-esteem, especially when they see their names on the podium.

It is important to note that, as we have indicated in the mMthodology, in five subjects, we used a summative–formative assessment in such a way that the results of the Kahoot! tests were part of the final mark. This way, students had a better valuation of the utility of this tool, especially if some of the questions of the tests were repeated in the final exam.

Even more, we corroborated that lower marks in Kahoot! tests were in subjects without this summative–formative assessment. In these cases, Kahoot! test marks were not considered part of the subject's final mark. This led to students participating in the tests without making a great effort to provide the correct answer. Notwithstanding this, because this fact is not common to all the subjects in which the Kahoot! tests were not part of the final mark, we believe that it would be advisable to analyze this information considering the difficulty or easiness of both the subject itself and the questions. In fact, as we have shown in the Results section, the subject is a variable explaining the students' final performance. This is due to the higher difficulty of some of the analyzed subjects, such as Financial Management and Strategic Management.

However, we can also consider that it could depend on the extent of the students' previous knowledge, or even on their motivation and satisfaction with the learning process. However, all of the aforementioned issues are more subjective and, thus, difficult to treat.

5. Conclusions and Future Research

The main purpose of this paper was to test whether gamification improves students' performance and to research whether the results obtained by the students in the Kahoot! tests are related to the subject's final marks. This study was conducted in eight different management courses at the University of Jaen (Spain) during the 2018–2019 course.

The results corroborated our hypothesis. As a consequence, this paper supposes new evidence in favor of an increase in students' performance through gamification, integrating m-learning methods with traditional elements of the game.

We believe that this experience has been very fruitful, partly because the number of students in each course was not very high. For groups with a higher number of students, the results would not be as effective. A greater number of students implies more difficulties, both physical (classrooms with higher capacity) and technical (access to the application and failures related to access). We should also consider the responsible utilization that requires the use of gamification tools during the learning process. In particular, the use of Kahoot! is based on the idea that game-based education is the best option for education [37] and that mobile phone applications can improve the teaching and learning process; however, to do so, teachers need to give these tools the necessary importance [38]. Moreover, it is necessary for the organization of the classes to be based on a well-defined pedagogical scope, adopting a responsible use for these tools [39]. Under this responsible use, the application of gamification tools in our higher education teaching has generated a learning environment (in terms of attendance, engagement, and attitude) that is favorable for learning improvement in the sense that, as we have empirically proved, it has led to an improvement in the learning results of our students.

As a limitation of this work, we know that there were no control groups. This limitation, together with the relatively small size of our sample, conditions the external validity of the results. We should also mention that differences in performance between courses may be due to differences in exams or even in the students' characteristics, rather than the implementation of the gamification experience.

As a consequence of these limitations, and as future lines of research, we recognize that this study must be considered as an initial approach and must include more course data and more students' perceptions. Furthermore, future studies might focus on questionnaires evaluating students' satisfaction and self-assessment about the learning process. This would be a very interesting practical implication, as students could take responsibility for their own learning.

Finally, we believe that this study contributes to the theoretical understanding of gamification in the teaching–learning process and its effect on students' performance. As Hernández–Fernández et al. [8] have established, more research is needed to identify the objective effectiveness of gamification and its digital pedagogical possibilities that are effective and useful for the integral formation of the students of the 21st century.

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