Use of Kahoot! to keep students' motivation during online classes in the lockdown period caused by Covid 19

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ARTICLE INFO

ABSTRACT

COVID 19 lockdown forced a general move of teaching activities from their on-site mode to remote producing different negative consequences for students. In this work, the use of Kahoot! platform was studied to keep students' interest during online teaching. For this, Kahoot! games were carried out for the different topics of a university subject. The data analysis revealed that a high participation implies an improvement in the final marks. Additionally, questions response time was also extracted serving as a reference for remote exams. On the other hand, two surveys were carried out in which the students showed that the transfer from face-to-face to remote teaching had produced a general decrease in interest that can be mitigated by performing Kahoot! games.

1. Introduction

On 31 December 2019, the Wuhan Municipal Health Commission (China) reported a conglomerate of pneumonia cases in the city (Lu et al., 2020) that were later determined to be caused by a new coronavirus known as SARS-CoV-2. On 13 January 2020, was officially confirmed the first case of COVID-19 registered outside of China, specifically in Thailand. The quick transmission of the virus throughout the planet causes that on 11 March 2020 the World Health Organization (WHO) declare COVID-19 as a pandemic (Ratten and Jones, 2020). As a consequence, a large part of the world's population was forced to partially or totally confine themselves to their homes, causing tremendous repercussions in all sectors of society (Gambin et al., 2021; Nicola et al., 2020). The education sector was also affected by the COVID-19 crisis at all levels from preschool to university and also caused the cancellation of numerous academic congresses (Ali et al., 2021; Alkhowailed et al., 2020; Impey, 2020). Confinement brought the complete closure of schools and educational facilities and forced suddenly to change the teaching to online form (Ross et al., 2020; Sharp et al., 2021). On 25 May 2020 there were 990 million students affected in the world (56.6 % of the total number of students enrolled) and schools had been forced to close in 130 countries (UNESCO, 2020).

Spain lockdown lasted about 3 months (between 15 March 2020 and 21 June 2020) and with the start of the new school year in September 2020 most schools reopened. However, the universities continued providing most of their teaching in online mode with the impact this might entail.

Although digital technologies have been present in higher education in last two decades, teaching was predominantly in face to face mode and most of the teachers are not ready for online teaching and learning (Scherer et al., 2020). The physical closure of educational institutions suddenly forced the digitization of teaching. Consequently, teachers faced the unexpected challenge of teaching exclusively online (Daumiller et al., 2021). Many obstacles appeared due to the need to redesign teaching activities, along with uncertainty, difficult time management, maintenance of student interest, and increased cheating in online exams (Ahmed et al., 2020). In addition, some studies found that online education produced stress in students (Chaturvedi et al., 2020) that should be avoided.

In an effort to avoid the stress and loss of interest from students that can result in a reduction of learning outcomes due to online teaching, the use of interactive educational tools was considered. The Student engagement is essential to quality learning. Regular formative assessment tasks can support positive student engagement attitudes and behaviors towards learning (Hughes et al., 2020). A tool that has been usually used with this purpose in other contexts is Kahoot! platform. (Wang and Tahir, 2020).

Kahoot! is a game-based learning platform used to review students' knowledge, for formative assessment or as a break from traditional classroom activities (Wang and Tahir, 2020). In 2019 it had more than 250 million users from 200 countries (Vick, 2019). During 2020, due to the transition from schools to distance education due to the pandemic

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caused by Covid 19, the use of Kahoot increased rapidly in Spanish-speaking regions, such as Spain and Latin America and climbed more than 100 positions in the lists of educational applications reaching number 16 in Spain.

Boredom in a computer learning environment can cause a lower level of learning (O. L. Liu et al., 2012). Kahoot!'s success is due to the fact that its main objective is to make learning fun through a game-based learning platform (Wang, 2015). Kahoot! rewards students who answer correctly with higher scores and brings them to the top of the ranking list, so it also works to stimulate student participation. On the other hand, sometimes, it is difficult to find a game or an application that suits the topic of a class, regardless of whether it is a group of higher or basic education being one of the main advantages of Kahoot! that anyone can create content for the game. Using Kahoot! is simple: teachers create tests and students access them through their mobile phones or computers.

Since its released in 2013, numerous studies have been conducted on its use in educational centers showing good learning effects (Hung, 2017; Iwamoto et al., 2017; Wang et al., 2016). However, since there is no precedent for a global online education situation, the studies published to date are mainly based on the use of Kahoot! during ordinary face-to-face teaching (Chaiyo and Nokham, 2017; Kocakoyun, 2018; Licorish et al., 2018; Plump and LaRosa, 2017) and to the best knowledge of the authors its use has not been evaluated for online teaching.

In this work, the use of regular quizzes to increase the interest of the students in online teaching during the September-November period was evaluated in a theoretical subject in the chemical engineering degree taught in a Spanish University. The platform chosen to carry out the questionnaires was Kahoot!. Due to the pandemic situation, all the lectures were held online and Kahoot! games were carried out after each topic. The results obtained in the Kahoot! games were related to the results obtained in the exam (carried out in onsite mode). Additionally, the results were also compared with those obtained in the previous course in onsite teaching in which Kahoot! was not used. On the other hand, to know the point of view of the students, two surveys were carried out based on the usefulness of Kahoot! and the students' perception of online teaching and how this change has affected them.

Since in the years prior to the crisis caused by COVID19, a growing increase in students enrolled in online education activities was observed (Allen and Seaman, 2017; Juan, 2021), it seems obvious that already outside the pandemic situation the transition to online education its necessary (Haslam, 2021). Therefore, understanding the nature of the change to online classes will be useful not only because of the possibility that there are new lockdowns but it may also be suitable for future education addressing some of the pre-existing challenges (Moser et al., 2021).

It is important to bear in mind that this study was carried out for a limited number of students, so its conclusions must be taken with care. However, the authors think that it may be a representative sample that can be taken into account in a global situation of online education. The main limitation of this study is that it was carried out for a single subject of theoretical nature, and the conclusions could be very different in other subjects with a more practical nature where the use of the Kahoot platform might not be applicable.

2. Methodology

2.1. Quiz design

The game-based student response system (Kahoot!) was used as a regular quiz system in a theoretical subject of a four-year degree on chemical engineering in the first semester of 2020 (between September and November). Due to the pandemic situation caused by Covid 19, the teaching was held online being the Kahoot! games carry out in the last minutes of each class when a new topic is finished. In order to give extra motivation to the students and encourage participation, it was decided to grant an extra 0.1 point in the final subject mark to the students who obtained the first position in the ranking of each of the Kahoot!

Through the Kahoot! website, different Kahoot! games were created for 4 of the 5 topics of the subject. Because all the students were part of the same group, a control group was not made to avoid discrimination, using instead topic 3 as a control. Thus, for topic 3, Kahoot! was not created. In order to have a valid control, this topic was taught in a completely similar way to the rest of the topics being a topic of similar difficulty and nature as the others and the students were informed that Kahoot was not carried out due to this research but that the topic was just as important as the rest. The number of questions for each Kahoot! was 10 and for the longer topics, 2 different Kahoot! were created at intermediate points. Questions of both, Quiz type (4 answers being only one correct) and true-false type (T/F) were created, establishing maximum response times of 60 and 30 s, respectively. The questions were prepared from the information extracted from the slides presented in the teaching sessions in a similar way to how it is done in the final exams. The Kahoot! games were played in classic teach mode in which each student played individually in real time during the last minutes of synchronous classes. The Kahoot! duration was typically of 10 min and the total number of students enrolled in the subject was 39. The number of participants in this study can be considered not very large, it represents all the students enrolled in a subject in which each one of them has different personal conditions, so we consider that the results can be similar to those obtained if it were used a larger sample.

Once the Kahoot games were made, the data was extracted from the server and imported into Excel type files where data was processed through simple mathematical operations.

2.2. Surveys design

In order to know the students opinion on the use of Kahoot!, a survey with 6 questions was carried out once the subject was finished but before the exam. Since the students were already familiar with the use of Kahoot!, it was decided to carry out the survey using this tool. With this purpose, Quiz type questions were created being the possible answers in all the questions: Strongly agree, agree, disagree and strongly disagree. In this case, the Kahoot! game was carried out in Assign mode in which the students were able to do the survey individually within a week. To avoid conditioning the students answers Kahoot!'s scoring system was disabled. Despite this, it is necessary to bear in mind that the way in which the questions are formulated may condition the response of the students and the results may not be totally true (Sinkowitz-Cochran, 2013).

On the other hand, it was performed another survey to the students with questions related to how the transition to online lectures due to the pandemic affected them, both in general and in this specific subject in which Kahoot! games were carried out. The structure followed by this survey was similar to that followed in the survey explained above.

2.3. Final exam

The final exam of the subject was carried out in onsite mode but using the computer through the platform enabled by the university (moodle). The exam consisted of multiple choice questions with four possible answers and only one correct (similar to Kahoot!'s Quiz questions). Incorrect answers were penalized with -25 % of the question value. The total duration of the exam was 50 min estimating a maximum time of 1 min for each question in a similar way to what had been done in the Quiz questions in the Kahoot! games. To facilitate the comparison of the exam results with those obtained in the Kahoot! games, the exam was divided into 5 blocks of 10 questions each corresponding to one of the topics. In order to be able to compare the results obtained with those of the previous course, the questions asked were similar, but not the same, to those made in the exam of the previous course, which had also consisted of a multiple choice exam of 50 questions. For this same

reason, true/false questions were not proposed in the exam since the previous course had not been used.

3. Results

3.1. Surveys

With the aim of knowing the opinion of the students on both, the use of Kahoot and on how the pandemic has affected them in their studies, two surveys were carried out. Fig. 1 shows the responses obtained regarding the use of Kahoot! games. After analyzing the answers provided by the students, it can be seen that 93 % of the students think that the use of Kahoot! has helped them to establish the concepts learned in class, and a 96 % of the students think that the contents collected in the Kahoot! are adjusted to those seen in class (corroborating the great versatility of Kahoot! to adapt to any content). Furthermore, 77 % of the students would strongly agree on the use of Kahoot! in other subjects and another 17 % would agree. On the other hand, all students agreed that the use of Kahoot! is a good tool for learning and 94 % considered that it had helped them to increase their interest in the subject. Finally, the students were questioned about the difficulty of the Kahoot! questions an a medium difficulty value was obtained. As a summary of this survey, it can be said that the students consider that the use of regular quizzes, and specifically the use of Kahoot! in a positive way and helped them maintain interest during the online teaching and thus improve the degree of learning achieved. It is important to note that the questions were asked in a positive way so that the interviewees could be slightly conditioned to answer in a positive way. However, since the results obtained were so positive, it can be said that the conclusions reached are valid and that the friendly and entertaining interface of the Kahoot! platform is liked by the students. The opinions of the students reflected in this survey are similar to those obtained in the study carried out by Zainuddin et al. where the students claimed that they felt more emotionally engaged in learning through a game-like system – such as a gamification quiz – and experienced feelings of fun, enjoyment, interest, enthusiasm, and curiosity (Zainuddin et al., 2020).

In Fig. 2 it can be seen the responses of the students on topics related to the pandemic. Only a 41 % of students consider that the pandemic situation had negatively affected them in their studies, although, however, 69 % of students consider that their learning is lower in online teaching. At this point, it is important to note how, 93 % of the students thought that the online teaching had not diminished their degree of learning in this particular subject and all of them agreed that the use of Kahoot! had contributed to it. Similar responses to those obtained in the question about whether the pandemic had affected students in their studies were found in the question of whether the use of online teaching had decreased the interest of students, which seems to indicate that the main educational problem derived from the pandemic situation has been the realization of remote teaching. As stated by 93 % of the students, interest can be improved with the use of Kahoot!. As a summary of this survey, it can be said that a large part of the students think that the pandemic has affected their studies in both the degree of learning obtained and their interest due mainly to the realization of online teaching that could be improved with the use of Kahoot!.

3.2. Data analysis

Once all the Kahoot! games were performed, the analysis of the data was carried out. It was observed a high participation with values of 90, 82, 85, 79, 69 and 82 % for topics 1−1, 1−2, 2−1, 2−2, 4, and 5 respectively being 81 % the average participation. Although generally participation remained quite high during all lectures, it is important to note that when lectures were held on Thursday afternoons, the average participation was 85 %, while when lectures were held Friday afternoon the average participation down a 9%.

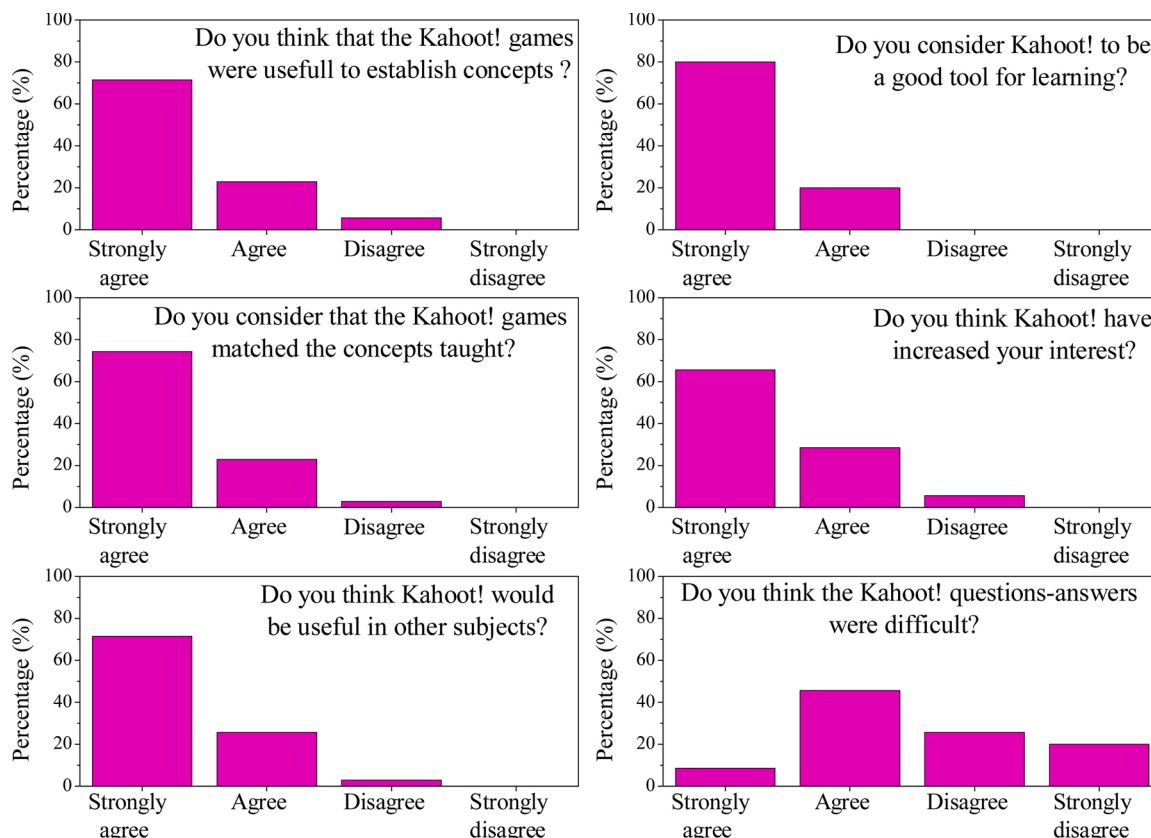Regarding the percentage of correct answers, values of 56, 57, 62,

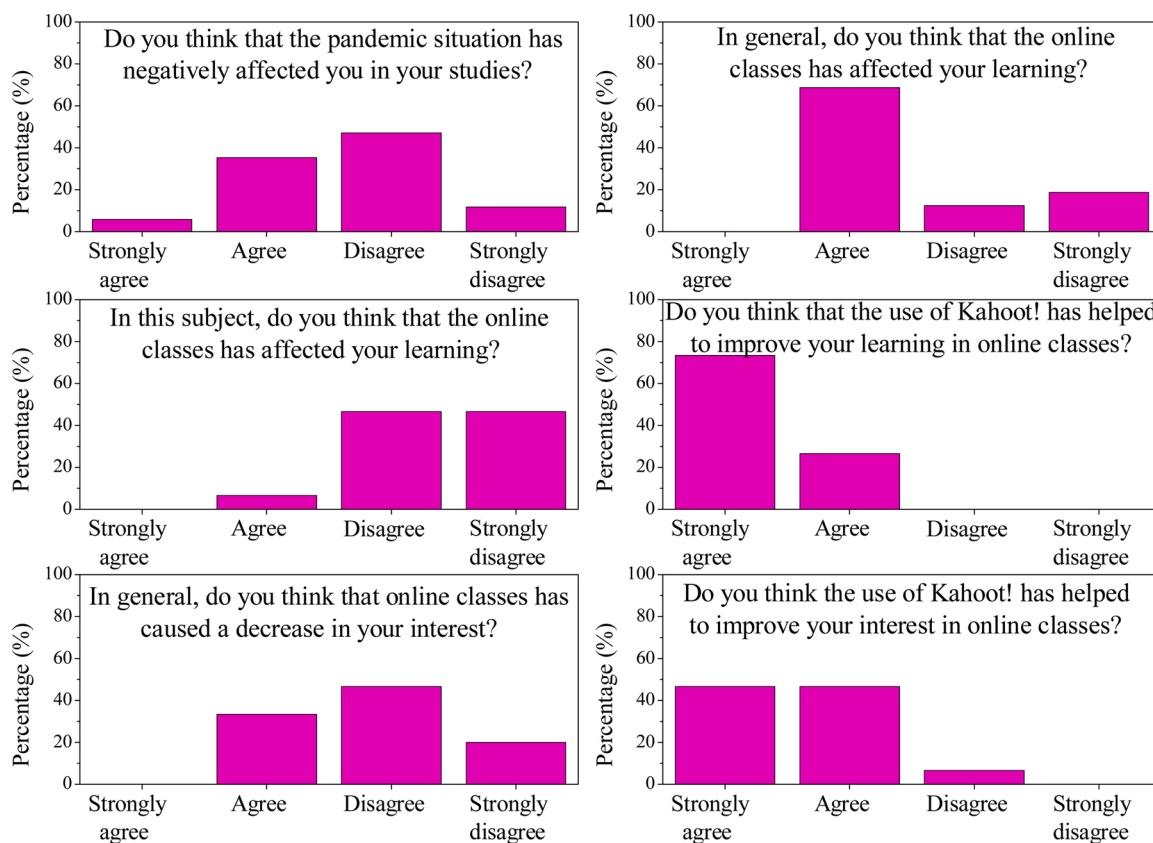**Fig. 1.** Survey conducted with students on aspects related to the use of Kahoot!.

Fig. 2. Survey conducted with students on aspects related to the online teaching due to pandemic.

74, 64 and 65 for topics 1−1, 1−2, 2−1, 2−2, 4, and 5 respectively were obtained, being the mean 66 %. In this case, no significant differences were found between the Kahoot! games carried out on Thursdays or Fridays, indicating that students who participated showed the same attention degree in both days. On the other hand, it can be observed that the percentage of correct answers is significantly lower for the first Kahoot! being attributed to the lack of experience of the students with the use of the Kahoot! platform. The high percentages of correct answers obtained can be correlated with the surveys where the students stated that they had found the questions posed of medium-easy difficulty.

Focusing in the type of question used, in Fig. 3 can be seen that the T/F questions obtained a percentage of correct answers close to 70 %,

while the Quiz questions obtained a percentage of correct answers of 60 %. Although it represents a reduction of 10 %, the difference is not as significant as might be expected a priori, taking into account that Quiz type questions have double possible answers. In Fig. 4, it could be seen how the mean time used by the students to answer Quiz questions was approximately 15 s while the mean time used to answer T/F questions was approximately 7 s. It was observed that the time used to answer questions incorrectly was slightly higher than the time used to answer questions correctly due to possible doubts but not with a significant difference. It can be noted that the time used to answer Quiz questions was approximately twice that for T/F questions, which, according to the results observed in Fig. 1, seems to be related to the time it takes students
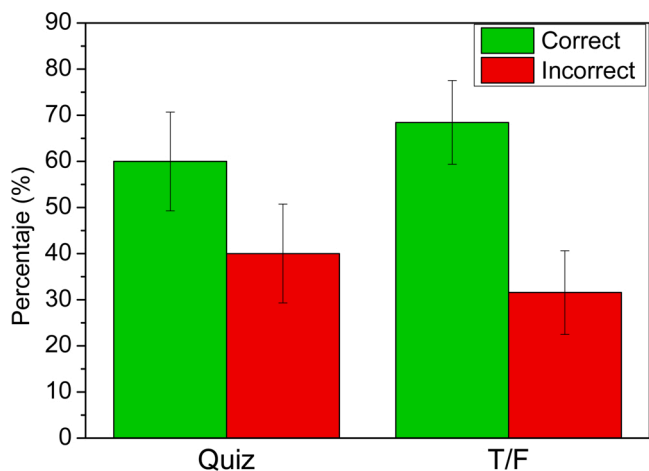

Fig. 3. Comparison of the percentage of correct and incorrect answers depending on the type of question.
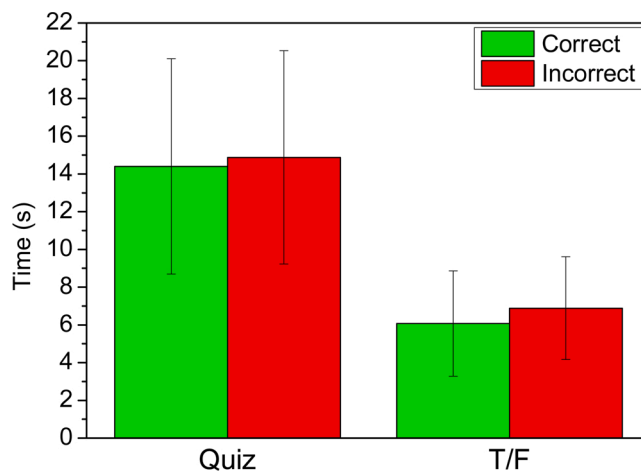

Fig. 4. Comparison of the time used to reply of correct and incorrect answers depending on the type of question.

to read the options and not with the difficulty of the question type. Although these figures only represent the average time used by the students, it is important to know that the Kahoot platform allows obtaining the time used by each student for each question. This information can be very useful for educators when it comes to detecting possible difficulties for a student.

During the pandemic period and the transition to remote teaching, most of the teachers were forced to take the evaluation tests online. One of the main problems raised when setting up the exams is to establish the time limit to answer each question since it should be enough to allow the student to complete it properly but not too long to prevent the possibility of copying. The results obtained in Fig. 4 are important as they offer an estimation of the time that students really need to correctly answer both Quiz and T/F questions that can be used as a reference for future assessment tests.

3.3. Relationship between using Kahoot! and marks in the final exam

The results obtained from the Kahoot! games were related to those obtained in the final exam. In Fig. 5 it can be observed how there is a direct relationship between the percentage of correct answers obtained in the exam and the percentage of correct answers obtained in the Kahoot! games for each of the topics. This result is interesting since it shows that carrying out Kahoot! games it is possible to identify, prior to the exam, where the students show learning difficulties and reinforce these topics.

On the other hand, Chang et al. observed that in online education during lockdown by COVID 19, students with greater participation and communication with teachers obtained better marks (Chang and Kim, 2020). In the specific case of the Kahoot! it was observed that in topic 3, where Kahoot! was not performed, the average percentage of correct answers obtained in the exam was 51.9 %, against an average percentage value of 70.4 % in the subjects in which Kahoot games were performed. This 18.5 % rise in correct answers when using Kahoot! demonstrates its great effectiveness in increasing the success rate of students, which could be mainly due to an increase in interest in following the subject and the daily review of the concepts acquired, as stated by the students in the surveys. This result, which had already been observed in other studies for face-to-face teaching (Liu and Chen Wang, 2017; Sarkar and Manzo, n.d.; Wang et al., 2019), is now also demonstrated for remote teaching.

If the results are evaluated for each student, a similar behavior is obtained. The students with the highest participation in the Kahoot! games were the students who obtain the best marks in the final exam
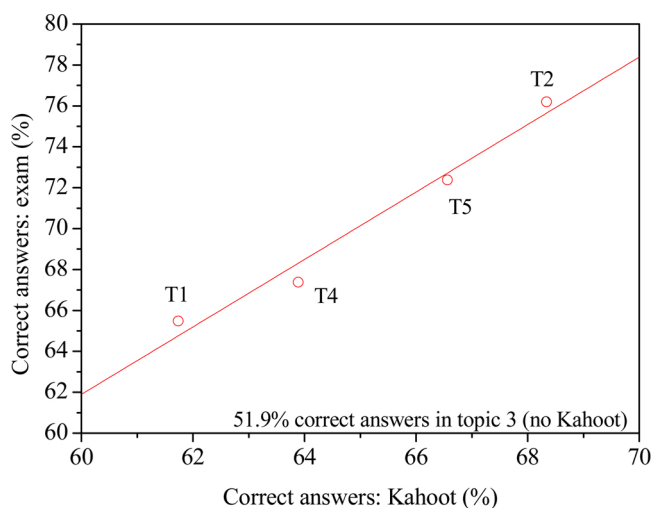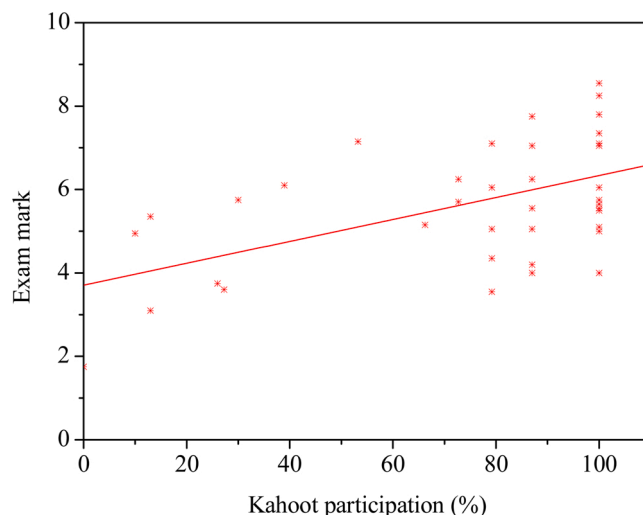
Fig. 6. Relationship between the mark obtained by the students in the exam and its participation in the Kahoot!.

(Fig. 6).

When the results of the exam are compared with those obtained in the previous year (Fig. 7), the percentage of correct answers achieved in the exam grew by 12 %, going from 55 to 67 % while the pass rate practically double its value standing at a very high value of 80 % when Kahoot! is used in the teaching methodology. In turn, the average mark rises from 4.56 to 5.72 while the maximum increases from 7.67 to 8.55. This improvement in results can be attributed to the improvement in learning manifested by students in the surveys when using the Kahoot! Platform. However, it is necessary to bear in mind that the previous year no regular monitoring system of the students' knowledge was implemented, and they faced the final exam directly. Therefore, the improvement in the results obtained can be attributed to the implementation of a regular questionnaire system that would not have to be just Kahoot!. A similar conclusion was obtained by Henning et al. in a study where they were able to observe a 7% improvement in results with the completion of regular quizzes compared to previous years where they were not conducted (Hennig et al., 2019). In any case, Kahoot demonstrated its great utility to implement this system of periodic questionnaires helping to maintain interest and improve student results.

4. Conclusions

The transfer of university lectures to remote due to the pandemic situation has been detrimental to students, producing a decrease in their

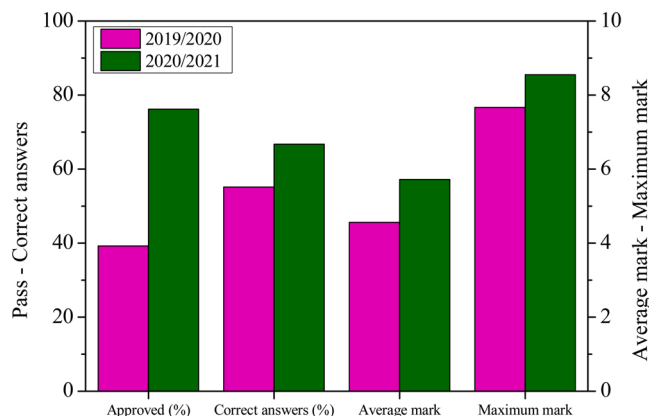**Fig. 5.** Relationship between the percentage of correct answers in the exam and the percentage of correct answers in Kahoot! for the different topics.

Fig. 7. Comparison of the results obtained in the exam with those of the previous course.

interest in studies and in their degree of learning. In this study, despite the small sample of students used, it was possible to verify how the use of regular quizzes, and specifically the Kahoot! platform greatly diminished these prejudices and a large number of students found the use of Kahoot! very useful and would recommend its use in other subjects.

Our experience also shows how the results extracted from the Kahoot! games were directly related to the marks obtained in the final exam. This finding suggests the use of regular quizzes to detect where students need reinforcement previously to the exam. It is also important to highlight that a greater participation in the Kahoot! games helped the students to obtain better marks in the final exam suggesting that to achieve a higher success rate during online education, student participation should be pursued by teachers.

Regarding the results obtained from the Kahoot! games, it could be observed that the participation of the students was very high and, in general, the number of hits achieved as well. Average response times were obtained for Quiz type and T/F responses of approximately 15 and 7 s respectively, which can be very useful to use as a reference when calculating the time required for remote examinations.

Finally, it can be concluded when the results are compared with those of the previous year that despite the pandemic, carry out regular quizzes had a very positive effect on the students who were able to obtain better marks in the final exam.

Declaration of Competing Interest

The authors report no declarations of interest.

References

Ahmed, A., Niaz, A., Ikram Khan, A., 2020. Report on online teaching and learning amid COVID-19. Ssrn Electron. J. https://doi.org/10.2139/ssrn.3646414.

Ali, M., Allihyani, M., Abdulaziz, A., Alansari, S., Faqeh, S., Kurdi, A., Alhajjaji, A., 2021. What just happened? Impact of on-campus activities suspension on pharmacy education during COVID-19 lockdown – A students' perspective. Saudi Pharm. J. 29, 59–66. https://doi.org/10.1016/j.jsps.2020.12.008.

Alkhowailed, M.S., Rasheed, Z., Shariq, A., Elzainy, A., El Sadik, A., Alkhamiss, A., Alsolai, A.M., Alduraibi, S.K., Alduraibi, A., Alamro, A., Alhomaidan, H.T., Al Abdulmonem, W., 2020. Digitalization plan in medical education during COVID-19 lockdown. Inform. Med. Unlocked 20, 100432. https://doi.org/10.1016/j.imu.2020.100432.

Allen, I.E., Seaman, J., 2017. Distance Education Enrollment Report 2017. Babson Survey Research Group.

Chaiyo, Y., Nokham, R., 2017. The effect of kahoot, quizizz and google forms on the student's perception in the classrooms response system. In: 2nd Joint International Conference on Digital Arts, Media and Technology 2017. Digital Economy for Sustainable Growth, ICDAMT 2017, pp. 178–182. https://doi.org/10.1109/ICDAMT.2017.7904957.

Chang, H.M., Kim, H.J., 2020. Predicting the pass probability of secondary school students taking online classes. Comput. Educ. 164, 104110 https://doi.org/10.1016/j.compedu.2020.104110.

Chaturvedi, K., Kumar Vishwakarma, D., Nidhi, 2020. COVID-19 and its impact on education, social life and mental health of students: a survey. Child. Youth Serv. Rev. 121, 105866 https://doi.org/10.1016/j.childyouth.2020.105866.

Daumiller, M., Rinas, R., Hein, J., Janke, S., Dickhäuser, O., Dresel, M., 2021. Shifting from face-to-face to online teaching during COVID-19: the role of university faculty achievement goals for attitudes towards this sudden change, and their relevance for burnout/engagement and student evaluations of teaching quality. Comput. Human Behav. 106677. https://doi.org/10.1016/j.chb.2020.106677.

Gambin, M., Sękowski, M., Woźniak-Prus, M., Wnuk, A., Oleksy, T., Cudo, A., Hansen, K., Huflejt-Łukasik, M., Kubicka, K., Łyś, A.E., Gorgol, J., Holas, P., Kmita, G., Łojek, E., Maison, D., 2021. Generalized anxiety and depressive symptoms in various age groups during the COVID-19 lockdown in Poland. Specific predictors and differences in symptoms severity. Compr. Psychiatry 105, 152222. https://doi.org/10.1016/j.comppsych.2020.152222.

Haslam, M.B., 2021. What might COVID-19 have taught us about the delivery of Nurse Education, in a post-COVID-19 world? Nurse Educ. Today 97, 104707. https://doi.org/10.1016/j.nedt.2020.104707.

Hennig, S., Staatz, C.E., Bond, J.A., Leung, D., Singleton, J., 2019. Quizzing for success: evaluation of the impact of feedback quizzes on the experiences and academic performance of undergraduate students in two clinical pharmacokinetics courses. Curr. Pharm. Teach. Learn. 11 (7), 742–749. https://doi.org/10.1016/j.cptl.2019.03.014.

Hughes, M., Salamonson, Y., Metcalfe, L., 2020. Student engagement using multiple-attempt 'Weekly Participation Task' quizzes with undergraduate nursing students. Nurse Educ. Pract. 46, 102803 https://doi.org/10.1016/j.nepr.2020.102803.

Hung, H.T., 2017. Clickers in the flipped classroom: bring your own device (BYOD) to promote student learning. Interact. Learn. Environ. 25 (8), 983–995. https://doi.org/10.1080/10494820.2016.1240090.

Impey, C., 2020. Coronavirus: Social Distancing is Delaying Vital Scientific Research. March 18. https://theconversation.com/coronavirus-social-distancing-is-delaying-vital-scientific-research-133689.

Iwamoto, D.H., Hargis, J., Taitano, E.J., Vuong, K., 2017. Analyzing the efficacy of the testing effect using Kahoot™ on student performance. Turk. Online J. Distance Educ. 18 (2), 80–93.

Juan, S., 2021. Promoting engagement of nursing students in online learning: use of the student-generated question in a nursing leadership course. Nurse Educ. Today 97, 104710. https://doi.org/10.1016/j.nedt.2020.104710.

Kocakoyun, S., 2018. Perceptions of students for gamification approach: kahoot as a case study. Int. J. Emerg. Technol. Learn. (IJET) 13 (02), 72–93. https://doi.org/10.3991/ijet.v13i02.7467.

Licorish, S.A., Owen, H.E., Daniel, B., George, J.L., 2018. Students' perception of Kahoot!'S influence on teaching and learning. Res. Pract. Technol. Enhanc. Learn. 13 (1), 1–23. https://doi.org/10.1186/s41039-018-0078-8.

Liu, X., Chen Wang, L.-C., 2017. Motivation, learning strategies, and language competency in a technology facilitated chinese as a second language classroom. EngagedScholarship.

Liu, O.L., Bridgeman, B., Adler, R.M., 2012. Measuring learning outcomes in higher education. Educ. Res. 41 (9), 352–362. https://doi.org/10.3102/0013189X12459679.

Lu, H., Stratton, C.W., Tang, Y.W., 2020. Outbreak of pneumonia of unknown etiology in Wuhan, China: the mystery and the miracle. J. Med. Virol. 92 (4), 401–402. https://doi.org/10.1002/jmv.25678. John Wiley and Sons Inc.

Moser, K.M., Wei, T., Brenner, D., 2021. Remote teaching during COVID-19: implications from a national survey of language educators. System 97, 102431. https://doi.org/10.1016/j.system.2020.102431.

Nicola, M., Alsafi, Z., Sohrabi, C., Kerwan, A., Al-Jabir, A., Iosifidis, C., Agha, M., Agha, R., 2020. The socio-economic implications of the coronavirus pandemic (COVID-19): a review. Int. J. Surg. 78, 185–193. https://doi.org/10.1016/j.ijsu.2020.04.018. Elsevier Ltd.

Plump, C.M., LaRosa, J., 2017. Using Kahoot! in the classroom to create engagement and active learning: a game-based technology solution for eLearning novices. Manag. Teach. Rev. 2 (2), 151–158. https://doi.org/10.1177/2379298116689783.

Ratten, V., Jones, P., 2020. Covid-19 and entrepreneurship education: implications for advancing research and practice. Int. J. Manag. Educ. 100432. https://doi.org/10.1016/j.ijme.2020.100432.

Ross, M.W., Newstrom, N., Coleman, E., 2020. Teaching sexual history taking in health care using online technology: a PLISSIT-Plus Zoom® approach during the COVID-19 Shutdown. Sex. Med. 9 (1), 100290. https://doi.org/10.1016/j.esxm.2020.100290.

Sarkar, N., & Manzo, C. (n.d.). Engaging Digital Natives Through Social Learning.

Scherer, R., Howard, S.K., Tondeur, J., Siddiq, F., 2020. Profiling teachers' readiness for online teaching and learning in higher education: who's ready? Comput. Human Behav. 118, 106675 https://doi.org/10.1016/j.chb.2020.106675.

Sharp, E.A., Norman, M.K., Spagnoletti, C.L., Miller, B.G., 2021. Optimizing synchronous online teaching sessions: a guide to the "new normal" in medical education. Acad. Pediatr. 21 (1), 11–15. https://doi.org/10.1016/j.acap.2020.11.009. Elsevier Inc.

Sinkowitz-Cochran, R.L., 2013. Survey design: to ask or not to ask? That is the question…. Clin. Infect. Dis. 56 (8), 1159–1164. https://doi.org/10.1093/cid/cit005.

UNESCO, 2020. School Closures Caused by Coronavirus (Covid-19).

Vick, I., 2019. Training Professionals from Three Countries Share Their Kahoot!'Ing Experience.

Wang, A.I., 2015. The wear out effect of a game-based student response system. Comput. Educ. 82, 217–227. https://doi.org/10.1016/j.compedu.2014.11.004.

Wang, A.I., Tahir, R., 2020. The effect of using Kahoot! for learning – a literature review. Comput. Educ. 149, 103818 https://doi.org/10.1016/j.compedu.2020.103818.

Wang, A.I., Zhu, M., Saetre, R., 2016. The effect of digitizing and gamifying quizzing in classrooms. Academic Conferences and Publishing International. https://ntnuopen.ntnu.no/ntnu-xmlui/handle/11250/2426374.

Wang, A.I., Sætre, R., Rydland, T., Dahl, Y., 2019. Evaluation of interactive and gamified approaches for teaching ict theory: a study of powerpoint, sembly, and kahoot. Proceedings of the European Conference on Games-Based Learning, 2019-October 784–792. https://doi.org/10.34190/GBL.19.168.

Zainuddin, Z., Shujahat, M., Haruna, H., Chu, S.K.W., 2020. The role of gamified e-quizzes on student learning and engagement: an interactive gamification solution for a formative assessment system. Comput. Educ. 145, 103729 https://doi.org/10.1016/j.compedu.2019.103729.