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USE OF *KAHOOT!* AND *JAMBOARD* FOR THE REALIZATION AND ORGANIZATION OF CREATIVE SCHOOL ACTIVITIES DURING THE COVID-19 PANDEMIC

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Abstract. This mixed study analyzes the students' perception about the use of *Kahoot!* and *Jamboard* in the teaching–learning process about the English language during the COVID-19 pandemic through data science. *Kahoot!* is a web tool that facilitates and promotes the participation between the educator and students through the realization of digital games and *Jamboard* is a virtual wall that allows the active role through the dissemination of information and exchange of ideas. The participants are 30 students of Design and Visual Communication who took the English Language course in the distance modality at the National Autonomous University of Mexico, Mexico, during the 2020 school year. The results of the machine learning technique indicate that the realization of digital games in *Kahoot!* and the dissemination and exchange of information in *Jamboard* positively influence the motivation, assimilation of knowledge and participation of the students during the *Verbs Unit*. Data science identified 6 predictive models on the use of these technological tools in the educational process about the English language through the decision tree technique. Finally, educators have the opportunity to create new virtual spaces and promote the active role of the students by incorporating *Kahoot!* and *Jamboard* in the school activities during the COVID-19 pandemic.

Keywords: COVID-19 pandemic, data science, English language, *Jamboard*, *Kahoot!*.

Introduction

Actually, educational institutions seek to update the learning process and promote the active role through the use of digital tools and web platforms (Fouche & Andrews, 2022; Lee et al., 2022; Jiménez-Becerra & Segovia-Cifuentes, 2020). For example, the incorporation of technological advances such as digital games, virtual walls and social networks in the activities increased the participation between the educator and students during the English Language (EL) courses (Rivera-Trigueros & Sánchez-Pérez, 2020). Also, teachers are using

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Kahoot! and *Jamboard* in order to allow the communication at any time and interaction from anywhere (Llerena Medina & Rodríguez Hurtado, 2017; Recuero Virto & Blasco López, 2020).

Information and communication technologies (ICTs) allow the organization and realization of the student-centered activities (VanLeeuwen et al., 2020; Zhang & Yu, 2021). Consequently, educators build new virtual spaces to develop the students' abilities and facilitate the acquisition of knowledge through technological tools (Celebi & Eraldemir-Tuyan, 2022; Tomás-Cámara, 2020). In particular, *Kahoot!* is a web tool that facilitates and promotes the participation through the realization of digital games and *Jamboard* is a virtual wall that allows the active role through the dissemination of information and exchange of ideas.

The needs and demands of students cause that universities update the courses in the distance modality (Alawadhi & Abu-Ayyash, 2021; Recuero Virto & Blasco López, 2020). Consequently, teachers rely on technological tools such as web applications to organize and carry out creative activities from anywhere (Lu, 2020; Paľová & Vejačka, 2022).

During the COVID-19 pandemic, Mexican universities trained teachers by giving courses about the use of technology and pedagogical models in order to adapt the school activities in the distance modality. For example, the National Autonomous University of Mexico (NAUM) offered the Innovation in University Teaching diploma to improve educational conditions during the 2020 school year. In particular, the teacher of the EL course incorporated *Kahoot!* and *Jamboard* in the school activities during the *Verbs Unit*. The research questions are:

- How the use of *Kahoot!* and *Jamboard* influences the motivation, assimilation of knowledge and participation during the *Verbs Unit*?
- What are the predictive models on the incorporation of *Kahoot!* and *Jamboard* in the educational field about the English language?
- What is the students' perception about *Kahoot!* and *Jamboard* during the COVID-19 pandemic?

1. Use of *Kahoot!* and *Jamboard* in the teaching–learning process

Today, teachers use new digital tools to update the activities of the courses (Bamoallem & Altarteer, 2022; Licorish et al., 2018; Martínez Navarro, 2017). For example, the incorporation of *Kahoot!* and *Jamboard* in the educational field facilitated and promoted the active role (Llerena Medina & Rodríguez Hurtado, 2017; Recuero Virto & Blasco López, 2020).

Kahoot! is a technological tool that facilitated the learning process and active role in the courses of Anatomy (Aktekin et al., 2018), Public Relations (PR) (Rodríguez-Fernández, 2017), EL (Llerena Medina & Rodríguez Hurtado, 2017), and Information Systems Strategy (ISS) (Licorish et al., 2018). In the EL course, the *Kahoot!* games facilitated the comprehension of vocabulary topics and developed the oral skills (Llerena Medina & Rodríguez Hurtado, 2017). Also, this web application improved the educational quality and facilitated the interaction between the teacher and students in the ISS course (Licorish et al., 2018).

In the Anatomy course, the students of medicine understood the topic about the parts of the human body, increased their motivation and actively participated in the classroom through *Kahoot!* (Aktekin et al., 2018). Similarly, the students of PR course used mobile devices to participate in the classroom through this web application (Rodríguez-Fernández, 2017).

On the other hand, *Padlet* and *Jamboard* allow students to communicate and participate during the teaching–learning process (Recuero Virto & Blasco López, 2020). At the Complutense University of Madrid, Spain, the use of *Jamboard* allowed the realization of the collaborative activities, increased the motivation and facilitated the learning about commerce and tourism (Recuero Virto & Blasco López, 2020).

The advantages of virtual walls are the organization of new spaces for learning, active role and realization of collaborative activities (Pardo-Cueva et al., 2020). In fact, virtual walls increased the motivation and satisfaction of the participants during the courses of Administration (Pardo-Cueva et al., 2020), EL (Abdul Rashid et al., 2019), Pedagogy (DeWitt et al., 2015), and Accounting (Pardo-Cueva et al., 2020).

Finally, *Kahoot!* and *Jamboard* allow that teachers update the school activities of the courses, create new educational virtual spaces and plan creative activities (Licorish et al., 2018; Martínez Navarro, 2017; Abdul Rashid et al., 2019; Recuero Virto & Blasco López, 2020).

2. Use of information and communication technology to carry out creative activities

Educators seek to organize and carry out creative activities that facilitate the understanding of school content during the COVID-19 pandemic (Çevik & Bakioğlu, 2022; Lee et al., 2022). To achieve this educational challenge of the 21st century, technological tools play a fundamental role during the planning of courses and construction of virtual spaces (Alawadhi & Abu-Ayyash, 2021; Celebi & Eraldemir-Tuyan, 2022). In fact, ICTs such as *Kahoot!* and *Jamboard* are revolutionizing the interaction and communication between educators and students in distance education (Alawadhi & Abu-Ayyash, 2021; Zhang & Yu, 2021).

Web applications allow covering the educational needs caused by the SARS-CoV-2 virus because students consult and use the information of the courses from anywhere (Bamoallem & Altarteer, 2022; Çevik & Bakioğlu, 2022; Lee et al., 2022). According to Llerena Medina and Rodríguez Hurtado (2017), *Kahoot!* is an ideal technological tool to design creative virtual activities such as question and answer games. The COVID-19 pandemic caused students to develop their digital skills (Çevik & Bakioğlu, 2022; Fouche & Andrews, 2022). For example, students and teachers actively participate and discuss topics in *Kahoot!* during virtual classes through video-conference systems (Paľová & Vejačka, 2022). According to Zhang and Yu (2021), *Kahoot!* allows transforming a traditional class into an entertaining class that increases the student motivation. Therefore, educators have the opportunity to facilitate the learning process and encourage the discussion in the distance modality through the incorporation of *Kahoot!* in the activities (Alawadhi & Abu-Ayyash, 2021; Paľová & Vejačka, 2022; Zhang & Yu, 2021).

Distance education allowed continuing and improving the teaching–learning process during the COVID-19 pandemic through the use of digital tools, mobile applications and web platforms (Bamoallem & Altarteer, 2022; Ploj Virtič et al., 2021). As mentioned by Recuero Virto and Blasco López (2020), mobile devices such as tablets and smartphones allow the active participation and communication at any time through *Jamboard*. In fact, students share

images and information of the courses on virtual walls such as *Jamboard* in order to facilitate the learning from anywhere (Pardo-Cueva et al., 2020; Recuero Virto & Blasco López, 2020).

The reorganization of school activities caused teachers to use technological advances (Fouche & Andrews, 2022; Voloshyna et al., 2022). For example, educational institutions can create new spaces for the exchange of ideas through *Kahoot!* (Paľová & Vejačka, 2022; Zhang & Yu, 2021) and *Jamboard* (Ploj Virtič et al., 2021; Recuero Virto & Blasco López, 2020). In fact, these technological tools allow the realization of creative school activities where students have the main role during the teaching–learning process (Paľová & Vejačka, 2022; Recuero Virto & Blasco López, 2020). Finally, the incorporation of ICTs in universities and high schools has facilitated the transition from face-to-face classes to virtual classes (Celebi & Eraldemir-Tuyan, 2022; Çevik & Bakioğlu, 2022; Voloshyna et al., 2022).

3. Data science

Nowadays, data science is changing the way of analyzing information for decision making (Kofi Nti et al., 2022; Shardlow et al., 2022). For example, the machine learning technique allows knowing the relationship between the dependent and independent variables through linear regression (Shardlow et al., 2022; Tian et al., 2022). According to Tian et al. (2022), this data science technique allows evaluating and predicting the aspects that influence the construction of buildings. Likewise, machine learning has been used to analyze the phenomena related to learning and teaching (Kofi Nti et al., 2022; Shardlow et al., 2022).

In the educational field, the machine learning technique allows analyzing the impact about the incorporation of technological tools in the teaching–learning process (Shardlow et al., 2022). For example, Salas-Rueda (2021) used this data science technique to analyze the use of the flipped classroom and ICTs in the Basic Mathematics course.

On the other hand, the decision tree technique allows identifying the conditions that influence the relationship between the independent and dependent variables (Kofi Nti et al., 2022; Salas-Rueda, 2021). In the educational field, the decision tree technique was used to analyze the relationship between the use of social networks and academic performance considering the characteristics of the students (Kofi Nti et al., 2022).

Finally, the use of machine learning and decision tree techniques in the educational field allows the identification, evaluation and classification of the information about the use of digital tools in the teaching–learning process (Kofi Nti et al., 2022; Shardlow et al., 2022).

4. Research

4.1. Method

The particular aims of this mixed study are (1) analyze how *Kahoot!* and *Jamboard* influence the motivation, assimilation of knowledge and participation of the students through the machine learning technique; (2) identify the predictive models on *Kahoot!* and *Jamboard* through the decision tree technique, and (3) analyze the students' perception about the use of *Kahoot!* and *Jamboard* in the *Verbs Unit*.

4.2. Participants

The participants are 30 students of Design and Visual Communication (DVC) who took the EL course in the distance modality at the NAUM during the 2020 school year.

4.3. Procedure

During the COVID-19 pandemic, the NAUM offered the Innovation in University Teaching diploma to facilitate the organization and implementation of the educational process through the incorporation of digital tools and the use of pedagogical model called *Classroom of the Future* (see Figure 1).

Therefore, the teacher of the EL course decided to incorporate *Kahoot!* and *Jamboard* in the *Verbs Unit* under the distance modality. The objectives of this unit are (1) understand and describe situations using *have to* verb; (2) understand and describe situations using *should* verb, and (3) understand and describe situations using *must* verb.

At home, the students consulted the contents about the rules of *have to*, *should* and *must* verbs. The use of *Kahoot!* and *Jamboard* allow the realization of creative activities remotely through video-conferencing systems. In the EL course, the educator used *Zoom Video Communications* to share the screen where the *Kahoot!* questions are displayed. Subsequently, the students answer the questions in this web game and start the discussion about the answers. Similarly, this teacher used *Zoom Video Communications* to display the questions of *Jamboard* and comment the responses of the students on this virtual wall (see Figure 2).

To analyze the relationship between the independent and dependent variables, this study used the model about the use of *Kahoot!* and *Jamboard* (see Figure 3).

The incorporation of ICTs in the educational field improves the teaching–learning conditions and facilitates the active role (Atencio et al., 2021; Paľová & Vejačka, 2022; Tomás-Cámara, 2020). Therefore, the hypotheses on the incorporation of *Kahoot!* in the educational field are:

– Hypothesis 1 (H1): The realization of digital games in *Kahoot!* positively influences the assimilation of knowledge during the *Verbs Unit*;

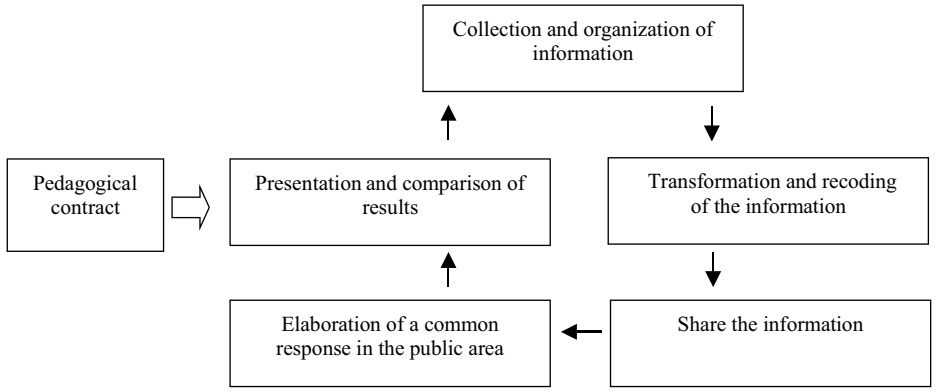


Figure 1. Innovation in University Teaching diploma: analysis of the *Classroom of the Future* (source: created by authors)

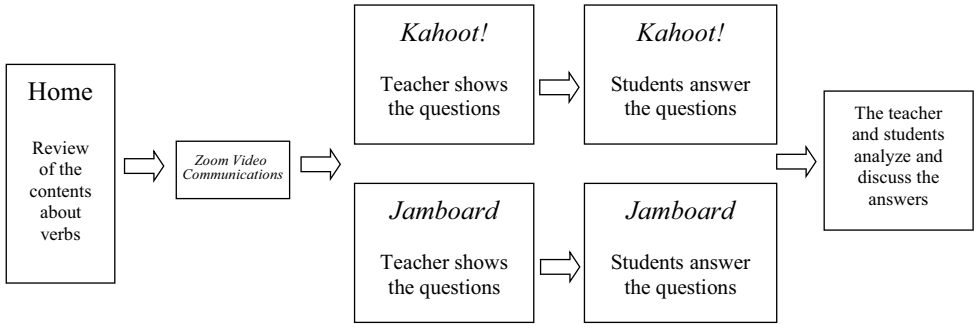


Figure 2. Creative activities about the use of *Kahoot!* and *Jamboard* (source: created by authors)

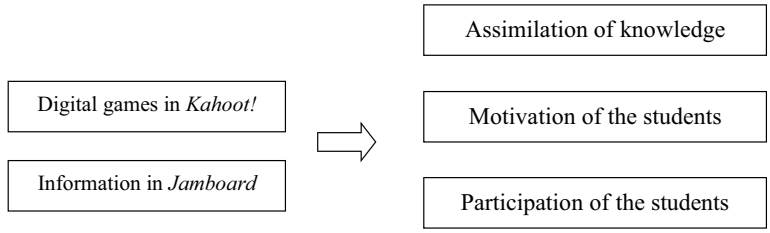


Figure 3. Model about the use of *Kahoot!* and *Jamboard* (source: created by authors)

- Hypothesis 2 (H2): The realization of digital games in *Kahoot!* positively influences the motivation of the students during the *Verbs Unit*;
- Hypothesis 3 (H3): The realization of digital games in *Kahoot!* positively influences the participation of the students during the *Verbs Unit*.

Likewise, the use of technological tools improves the participation and facilitates the realization of collaborative activities (Atencio et al., 2021; Llorens-Largo et al., 2021; Tomás-Cámara, 2020). Therefore, the hypotheses on the incorporation of *Jamboard* in the educational field are:

- Hypothesis 4 (H4): The dissemination and exchange of information in *Jamboard* positively influence the assimilation of knowledge during the *Verbs Unit*;
- Hypothesis 5 (H5): The dissemination and exchange of information in *Jamboard* positively influence the motivation during the *Verbs Unit*;
- Hypothesis 6 (H6): The dissemination and exchange of information in *Jamboard* positively influence the participation during the *Verbs Unit*.

The decision tree technique allows establishing six predictive models about the incorporation of *Kahoot!* and *Jamboard* in the *Verbs Unit*:

- Predictive model 1 (PM1) on *Kahoot!* and assimilation of knowledge;
- Predictive model 2 (PM2) on *Kahoot!* and motivation;
- Predictive model 3 (PM3) on *Kahoot!* and participation;
- Predictive model 4 (PM4) on *Jamboard* and assimilation of knowledge;
- Predictive model 5 (PM5) on *Jamboard* and motivation;
- Predictive model 6 (PM6) on *Jamboard* and participation.

4.4. Data collection

Table 1 shows the questionnaire used to collect the information about *Kahoot!* and *Jamboard*. The values of composite reliability (> 0.890), Cronbach's alpha (> 0.840), and load factor (> 0.620) allow validating the measurement instrument about *Kahoot!* and *Jamboard* (see Table 2).

Table 1. Questionnaire about *Kahoot!* and *Jamboard* (source: created by authors)

No.	Variable	Dimension	Question	Answer	Frequency	%
1	Students profile	Age of the student	1. Indicate your age	19 years	2	6.67%
				20 years	20	66.67%
				21 years	6	20.00%
				22 years	2	6.67%
		Sex of the student	2. Indicate your sex	Man	8	26.67%
				Woman	22	73.33%
2	Use of *Kahoot!*	Digital games	3. The realization of digital games in *Kahoot!* facilitates the learning process	Very much (1)	19	63.33%
				Much (2)	8	26.67%
				Little (3)	3	10.00%
				Very little (4)	0	0.00%
		Assimilation of knowledge	4. *Kahoot!* facilitates the assimilation of knowledge during the *Verbs Unit*	Very much (1)	17	56.67%
				Much (2)	10	33.33%
				Little (3)	3	10.00%
				Very little (4)	0	0.00%
		Motivation of the students	5. *Kahoot!* facilitates the motivation of the students during the *Verbs Unit*	Very much (1)	19	63.33%
				Much (2)	8	26.67%
				Little (3)	1	3.33%
				Very little (4)	2	6.67%
		Participation of the students	6. *Kahoot!* facilitates the participation of the students during the *Verbs Unit*	Very much (1)	15	50.00%
				Much (2)	14	46.67%
				Little (3)	1	3.33%
				Very little (4)	0	0.00%
3	Use of *Jamboard*	Dissemination and exchange of information	7. The dissemination and exchange of information in *Jamboard* facilitate the learning process	Very much (1)	8	26.67%
				Much (2)	17	56.67%
				Little (3)	3	10.00%
				Very little (4)	2	6.67%
		Assimilation of knowledge	8. *Jamboard* facilitates the assimilation of knowledge during the *Verbs Unit*	Very much (1)	10	33.33%
				Much (2)	11	36.67%
				Little (3)	7	23.33%
				Very little (4)	2	6.67%

End of Table 1

No.	Variable	Dimension	Question	Answer	Frequency	%
3		Motivation of students	9. *Jamboard* facilitates the motivation of the students during the *Verbs Unit*	Very much (1)	4	13.33%
				Much (2)	17	56.67%
				Little (3)	7	23.33%
				Very little (4)	2	6.67%
		Participation of the students	10. *Jamboard* facilitates the participation of the students during the *Verbs Unit*	Very much (1)	11	36.67%
				Much (2)	13	43.33%
				Little (3)	4	13.33%
				Very little (4)	2	6.67%
4	Perception of the students	*Kahoot!*	11. What are the benefits about the use of *Kahoot!* in the *Verbs Unit*?	Open	–	–
		Jamboard	12. What are the benefits about the use of *Jamboard* in the *Verbs Unit*?	Open	–	–

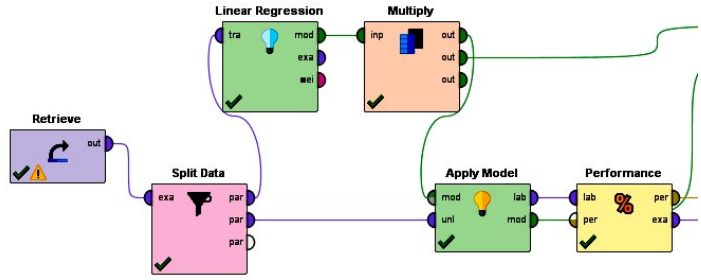
Table 2. Validation of the measurement instrument about *Kahoot!* and *Jamboard* (source: created by authors)

Variable	Dimension	Load factor	Cronbach's alpha	Average variance extracted	Composite reliability
Use of *Kahoot!*	Digital games	0.857	0.845	0.686	0.895
	Assimilation of knowledge	0.877			
	Motivation	0.920			
	Participation	0.629			
Use of *Jamboard*	Dissemination and exchange of information	0.881	0.921	0.809	0.944
	Assimilation of knowledge	0.944			
	Motivation	0.880			
	Participation	0.892			

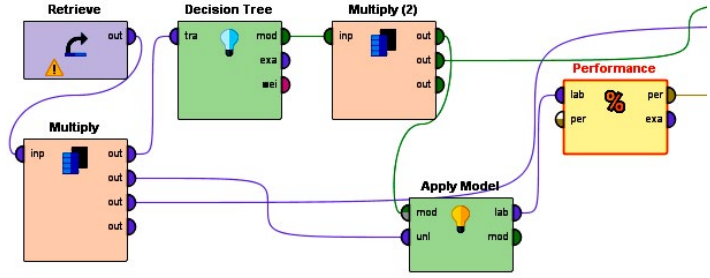
4.5. Data analysis

This study used the *RapidMiner* application to calculate the machine learning technique (linear regressions) and build the predictive models about *Kahoot!* and *Jamboard* through the decision tree technique (see Figure 4).

In the machine learning technique, the training section with 60% (n = 18), 70% (n = 21), and 80% (n = 24) of the sample allows calculating the linear regressions to evaluate the research hypotheses and the evaluation section with 40% (n = 12), 30% (n = 9), and 20% (n = 6) of the sample allows identifying the accuracy of these linear regressions by means of the squared error. The independent variables are digital games in *Kahoot!* and information



(a) Machine learning technique



(b) Decision tree technique

Figure 4. Use of the *RapidMiner* application (source: created by authors)

in *Jamboard*. Also, the dependent variables are assimilation of knowledge, motivation and participation.

On the other hand, the decision tree technique allows building six models about the student's profile, *Kahoot!* and *Jamboard*. The objective variables are assimilation of knowledge, motivation and participation.

5. Results

The realization of digital games in *Kahoot!* facilitates very much (n = 19, 63.33%), much (n = 8, 26.67%), and little (n = 3, 10.00%) the learning process (see Table 1). Likewise, the dissemination and exchange of information in *Jamboard* facilitate very much (n = 8, 26.67%), much (n = 17, 56.67%), little (n = 3, 10.00%), and very little (n = 2, 6.67%) the learning process.

The results of the machine learning technique indicate that the realization of digital games in *Kahoot!* and the dissemination and exchange of information in *Jamboard* positively influence the assimilation of knowledge, motivation and participation during the *Verbs Unit* (see Table 3).

Table 3. Results of the machine learning technique (source: created by authors)

Hypothesis	Training	Linear regression	Result	T-value	P-value of	Squared error
H1: *Kahoot!* → assimilation of knowledge	60%	y = 0.859x + 0.362	Accepted: 0.859	6.469	0.000	0.410
	70%	y = 0.872x + 0.319	Accepted: 0.872	7.305	0.000	0.531
	80%	y = 0.779x + 0.428	Accepted: 0.779	5.562	0.000	0.446
H2: *Kahoot!* → motivation	60%	y = 0.979x + 0.194	Accepted: 0.979	5.317	0.000	0.469
	70%	y = 0.914x + 0.212	Accepted: 0.914	4.978	0.000	0.452
	80%	y = 0.818x + 0.333	Accepted: 0.818	4.343	0.000	0.409
H3: *Kahoot!* → participation	60%	y = 0.208x + 1.322	Accepted: 0.208	0.984	0.339	0.244
	70%	y = 0.202x + 1.244	Accepted: 0.202	1.005	0.327	0.190
	80%	y = 0.155x + 1.285	Accepted: 0.155	0.813	0.424	0.156
H4: *Jamboard* → assimilation of knowledge	60%	y = 0.717x + 0.572	Accepted: 0.717	2.887	0.010	0.327
	70%	y = 0.749x + 0.500	Accepted: 0.749	3.449	0.002	0.409
	80%	y = 0.797x + 0.463	Accepted: 0.797	4.015	0.001	0.396
H5: *Jamboard* → motivation	60%	y = 0.615x + 0.871	Accepted: 0.615	2.666	0.016	0.386
	70%	y = 0.552x + 1.000	Accepted: 0.552	2.693	0.014	0.499
	80%	y = 0.608x + 0.942	Accepted: 0.608	3.254	0.003	0.521
H6: *Jamboard* → participation	60%	y = 0.487x + 0.829	Accepted: 0.487	2.016	0.060	0.583
	70%	y = 0.506x + 0.750	Accepted: 0.506	2.276	0.034	0.707
	80%	y = 0.492x + 0.826	Accepted: 0.492	2.341	0.028	0.756

6. Use of *Kahoot!*

Kahoot! facilitates very much (n = 17, 56.67%), much (n = 10, 33.33%), and little (n = 3, 10.00%) the assimilation of knowledge during the *Verbs Unit* (see Table 1). The results of the machine learning technique with 60% (0.859, t = 6.469, p = 0.000), 70% (0.872, t = 7.305,

p = 0.000), and 80% (0.779, t = 5.562, p = 0.000) of training show that H1 is accepted (see Table 3). Hence, the realization of digital games in *Kahoot!* positively influences the assimilation of knowledge during the *Verbs Unit*.

Figure 5 shows 6 conditions of the PM1 about the use of *Kahoot!* with an accuracy of 80.00%. For example, if the student considers that the realization of digital games in *Kahoot!* facilitates very much the learning process, has an age > 20.5 years and is a woman then *Kahoot!* facilitates very much the assimilation of knowledge during the *Verbs Unit*.

The sex determines 2 conditions of the PM1. For example, if the student considers that the realization of digital games in *Kahoot!* facilitates very much the learning process, has an age > 20.5 years and is a man then *Kahoot!* facilitates much the assimilation of knowledge during the *Verbs Unit*.

Also, the age determines 5 conditions of the PM1. For example, if the student considers that the realization of digital games in *Kahoot!* facilitates much the learning process and has an age > 21 years then *Kahoot!* facilitates very much the assimilation of knowledge during the *Verbs Unit*.

Kahoot! facilitates very much (n = 19, 63.33%), much (n = 8, 26.67%), little (n = 1, 3.33%), and very little (n = 2, 6.67%) the motivation of the students during the *Verbs Unit* (see Table 1). The results of the machine learning technique with 60% (0.979, t = 5.317, p = 0.000), 70% (0.914, t = 4.978, p = 0.000), and 80% (0.818, t = 4.343, p = 0.000) of training show that

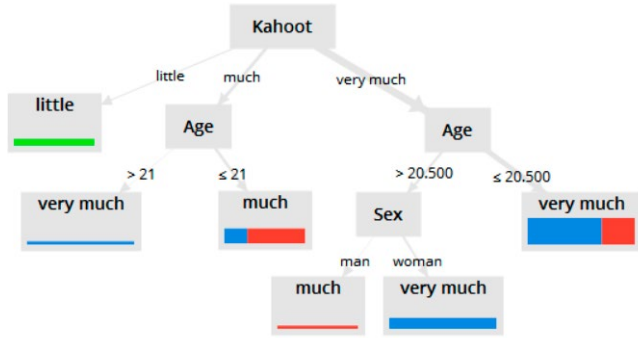


Figure 5. Predictive model 1 about *Kahoot!* (source: created by authors)

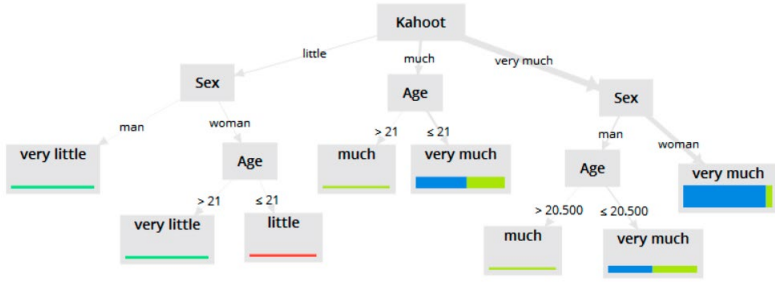


Figure 6. Predictive model 2 about *Kahoot!* (source: created by authors)

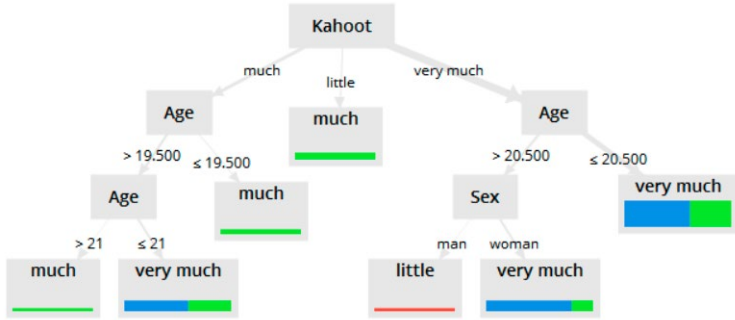


Figure 7. Preditive model 3 about *Kahoot!* (source: created by authors)

H2 is accepted (see Table 3). Hence, the realization of digital games in *Kahoot!* positively influences the motivation during the *Verbs Unit*.

Figure 6 shows 8 conditions of the PM2 about the use of *Kahoot!* with the accuracy of 76.67%. For example, if the student considers that the realization of digital games in *Kahoot!* facilitates very much the learning process, has an age ≤ 20.5 years and is a man then *Kahoot!* facilitates very much the motivation during the *Verbs Unit*.

The sex determines 6 conditions of the PM2. For example, if the student considers that the realization of digital games in *Kahoot!* facilitates very much the learning process and is a woman then *Kahoot!* facilitates very much the motivation during the *Verbs Unit*.

The age determines 6 conditions of the PM2. For example, if the student considers that the realization of digital games in *Kahoot!* facilitates much the learning process and has an age ≤ 21 years then *Kahoot!* facilitates very much the motivation during the *Verbs Unit*.

Kahoot! facilitates very much (n = 15, 50.00%), much (n = 14, 46.67%), and little (n = 1, 3.33%) the participation of the students during the *Verbs Unit* (see Table 1). The results of the machine learning technique with 60% (0.208, t = 0.984, p = 0.339), 70% (0.202, t = 1.005, p = 0.327), and 80% (0.155, t = 0.813, p = 0.424) of training show that H3 is accepted (see Table 3). Hence, the realization of digital games in *Kahoot!* positively influences the participation during the *Verbs Unit*.

Figure 7 shows 7 conditions of the PM3 about the use of *Kahoot!* with the accuracy of 73.33%. For example, if the student considers that the realization of digital games in *Kahoot!* facilitates very much the learning process, has an age > 20.5 years and is a woman then *Kahoot!* facilitates very much the participation during the *Verbs Unit*.

The sex determines 2 conditions of the PM3. For example, if the student considers that the realization of digital games in *Kahoot!* facilitates very much the learning process, has an age > 20.5 years and is a man then *Kahoot!* facilitates little the participation during the *Verbs Unit*.

The age determines 6 conditions of the PM3. For example, if the student considers that the realization of digital games in *Kahoot!* facilitates much the learning process and has an age > 21 years then *Kahoot!* facilitates much the participation during the *Verbs Unit*. Table 4 presents the Pearson correlation coefficients about *Kahoot!*.

Table 4. Pearson correlation coefficients about *Kahoot!* (source: created by authors)

	Realization of digital games	Assimilation of knowledge	Motivation	Participation
Realization of digital games	1	–	–	–
Assimilation of knowledge	0.708	1	–	–
Motivation	0.737	0.733	1	–
Participation	0.313	0.396	0.524	1

7. Students' perception about the use of *Kahoot!*

Educational institutions use ICTs to create virtual spaces that favor the teachinglearning process at any time. For example, *Kahoot!* allowed the realization of the fun school activities during the COVID-19 pandemic:

> "Learning becomes much more fun" (Student 4, woman, 20 years);
>
> "I can learn in a fun way" (Student 22, woman, 21 years).

The teacher of the EL course used *Kahoot!* to facilitate the learning process through digital games about questions and answers. According to the students of DVC, *Kahoot!* facilitated the assimilation of knowledge because the questions in this game must be answered in a certain time:

> "It's quite dynamic, it's a fun game" (Student 8, man, 20 years);
>
> "It excites me because it seems more like a game than a school activity" (Student 25, woman, 20 years).

Likewise, *Kahoot!* favored the active role through the realization of digital questionnaires in the distance modality. In fact, this technological application improved the interaction between the participants during the teaching–learning process:

> "We can participate at the same time" (Student 3, man, 20 years);
>
> "Being a competition; I try to do my best to learn, so that I can be in the first place" (Student 19, man, 20 years).

Finally, technological advances such as digital games favor the teaching process at any time. In particular, *Kahoot!* improved the learning process in the *Verbs Unit* through the question and answer game:

> "I have a certain time to answer; it makes me think quickly" (Student 11, woman, 20 years);
>
> "It helps me to think quickly. When an answer is correct, it motivates me" (Student 15, woman, 21 years).

8. Use of *Jamboard*

Jamboard facilitates very much (n = 10, 33.33%), much (n = 11, 36.67%), little (n = 7, 23.33%), and very little (n = 2, 6.67%) the assimilation of knowledge during the *Verbs Unit*

(see Table 1). The results of the machine learning technique with 60% (0.717, t = 2.887, p = 0.010), 70% (0.749, t = 3.449, p = 0.002), and 80% (0.797, t = 4.015, p = 0.001) of training show that H4 is accepted (see Table 3). Hence, the dissemination and exchange of information in *Jamboard* positively influence the assimilation of knowledge during the *Verbs Unit*.

Figure 8 shows 8 conditions of the PM4 about the use of *Jamboard* with the accuracy of 76.67%. For example, if the student considers that the dissemination and exchange of information in *Jamboard* facilitate very much the learning process and is a woman then *Jamboard* facilitates very much the assimilation of knowledge during the *Verbs Unit*.

The sex determines 6 conditions of the PM4. For example, if the student considers that the dissemination and exchange of information in *Jamboard* facilitate very much the learning process and is a man then *Jamboard* facilitates much the assimilation of knowledge during the *Verbs Unit*.

The age determines 4 conditions of the PM4. For example, if the student considers that the dissemination and exchange of information in *Jamboard* facilitate much the learning process, is a man and has an age > 20.5 years then *Jamboard* facilitates much the assimilation of knowledge during the *Verbs Unit*.

Jamboard facilitates very much (n = 4, 13.33%), much (n = 17, 56.67%), little (n = 7, 23.33%), and very little (n = 2, 6.67%) the motivation of the students during the *Verbs Unit* (see Table 1). The results of the machine learning technique with 60% (0.615, t = 2.666, p = 0.016), 70% (0.552, t = 2.693, p = 0.014), and 80% (0.608, t = 3.254, p = 0.003) of training show that H5 is accepted (see Table 3). Hence, the dissemination and exchange of information in *Jamboard* positively influence the motivation of the students during the *Verbs Unit*.

Figure 9 shows 7 conditions of the PM5 about the use of *Jamboard* with the accuracy of 80.00%. In particular, if the student considers that the dissemination and exchange of information in *Jamboard* facilitate very much the learning process and has an age ≤ 21.5 years then *Jamboard* facilitates much the motivation during the *Verbs Unit*.

The sex determines 3 conditions of the PM5. For example, if the student considers that the dissemination and exchange of information in *Jamboard* facilitate much the learning process and is a woman then *Jamboard* facilitates much the motivation during the *Verbs Unit*.

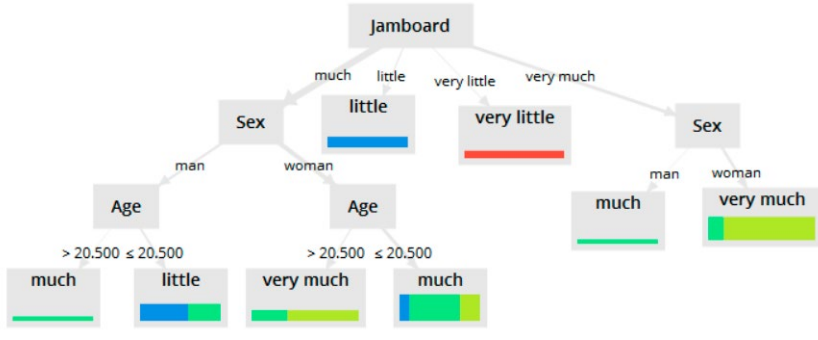


Figure 8. Predictive model 4 about *Jamboard* (source: created by authors)

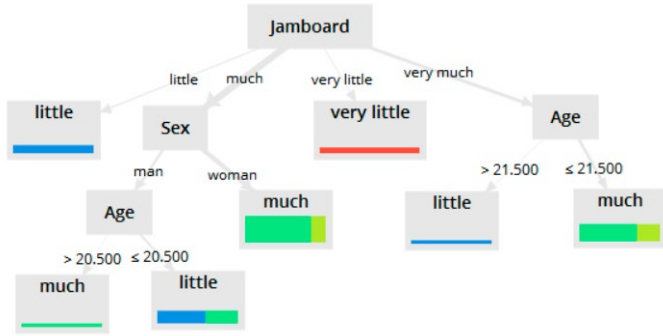


Figure 9. Predictive model 5 about *Jamboard* (source: created by authors)

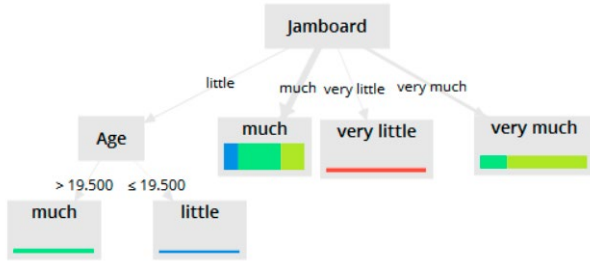


Figure 10. Predictive model 6 about *Jamboard* (source: created by authors)

The age determines 4 conditions of the PM5. For example, if the student considers that the dissemination and exchange of information in *Jamboard* facilitate very much the learning process and has an age > 21.5 years then *Jamboard* facilitates little the motivation during the *Verbs Unit*.

Jamboard facilitates very much (n = 11, 36.67%), much (n = 13, 43.33%), little (n = 4, 13.33%), and very little (n = 2, 6.67%) the participation of the students during the *Verbs Unit* (see Table 1). The results of the machine learning technique with 60% (0.487, t = 2.016, p = 0.060), 70% (0.506, t = 2.276, p = 0.034), and 80% (0.492, t = 2.341, p = 0.028) of training show that the H6 is accepted (see Table 3). Hence, the dissemination and exchange of information in *Jamboard* positively influence the participation of the students during the *Verbs Unit*.

Figure 10 shows 5 conditions of the PM6 about the use of *Jamboard* with the accuracy of 63.33%. In particular, if the student considers that the dissemination and exchange of information in *Jamboard* facilitate very much the learning process and then *Jamboard* facilitates very much the participation during the *Verbs Unit*.

The age determines 2 conditions of the PM6. For example, if the student considers that the dissemination and exchange of information in *Jamboard* facilitate little the learning process and has an age ≤ 19.5 years then *Jamboard* facilitates little the participation during the *Verbs Unit*. Table 5 presents the Pearson correlation coefficients about *Jamboard*.

Table 5. Pearson correlation coefficients about *Jamboard* (source: created by authors)

	Dissemination and exchange of information	Assimilation of knowledge	Motivation	Participation
Dissemination and exchange of information	1	–	–	–
Assimilation of knowledge	0.783	1	–	–
Motivation	0.674	0.805	1	–
Participation	0.718	0.802	0.690	1

9. Students' perception about the use of *Jamboard*

Universities use web applications to facilitate the interaction between the educators and students. For example, *Jamboard* allowed the realization of creative activities that favor the learning process in the distance modality:

> "I see the comments of my colleagues and read their ideas. It helps me to know new words" (Student 9, woman, 20 years);
>
> "It's good to see the comments because I can learn" (Student 18, woman, 20 years).

During the COVID-19 pandemic, educational institutions seek to facilitate the teaching–learning process through technological tools. In particular, *Jamboard* encouraged the active role in the EL course:

> "We can participate and see the comments of others" (Student 5, woman, 20 years);
>
> "I can share multiple ideas in the same space. It is easy to read the information" (Student 11, woman, 20 years).

According to the students of DVC, the incorporation of *Jamboard* in the *Verbs Unit* facilitated the assimilation of knowledge in the distance modality:

> "I see the answers. It is very interactive" (Student 15, woman, 21 years);
>
> "It is a good way to share the ideas and review what was learned" (Student 29, man, 20 years).

ICTs allow the organization and execution of the educational process. In particular, *Jamboard* developed the students' skills:

> "It helps me with vocabulary and facilitates my participation" (Student 17, woman, 20 years);
>
> "I learn how to write correctly" (Student 22, woman, 21 years).

Discussion

Technological advances such as web applications allow updating the school activities during the COVID-19 pandemic (Atencio et al., 2021; Bamoallem & Altarteer, 2022; Llorens-Largo et al., 2021). For example, the incorporation of *Kahoot!* in the educational field facilitates the planning, organization and execution of creative activities such as the game of questions

and answers (Aktekin et al., 2018; Llerena Medina & Rodríguez Hurtado, 2017). Analysis showed that the realization of digital games in *Kahoot!* facilitates very much (n = 19, 63.33%) the learning process. According to the students, this game allowed the realization of the fun school activities about the English language during the COVID-19 pandemic. Also, 33.33% of the students think *Kahoot!* facilitates much the assimilation of knowledge during the *Verbs Unit*. Consequently, most of the participants have a favorable opinion about this tool.

According to Recuero Virto and Blasco López (2020), the use of *Jamboard* improved the teaching conditions and promoted the active role. Also, 56.67% of the students think that the dissemination and exchange of information in *Jamboard* facilitate much the learning process. In fact, this virtual wall allowed the realization of creative activities that favor the learning process in the distance modality. In addition, the dissemination and exchange of information in *Jamboard* facilitate very much (n = 8, 26.67%) the learning process. Consequently, most of the participants have a favorable opinion about this tool.

Use of *Kahoot!* in the teaching–learning process

Similar to Aktekin et al. (2018), the *Kahoot!*'s games provoked that the classes were fun and dynamic. The results of the H1 are higher than 0.770. Consequently, the realization of digital games in *Kahoot!* positively influences the assimilation of knowledge during the *Verbs Unit*. The students of DVC think that *Kahoot!* facilitated the understanding of school subjects because the questions in this game must be answered in a certain time. Data science identified 6 conditions for the PM1. In this predictive model, the age and sex of the students determine how the realization of digital games in *Kahoot!* influences the assimilation of knowledge. The age determines five conditions and sex determines two conditions.

According to Rodríguez-Fernández (2017), the use of *Kahoot!* in the school activities increased the motivation and facilitated the discussion of ideas. The results of the H2 are higher than 0.810. Consequently, the realization of digital games in *Kahoot!* positively influences the motivation of the students during the *Verbs Unit*. Likewise, this tool favored the active role through the realization of digital questionnaires about the English language. Data science identified 8 conditions for the PM2. In this predictive model, the age and sex of the students determine how the realization of digital games in *Kahoot!* influences the motivation. The age determines six conditions and sex determines six conditions.

Some of the benefits about the *Kahoot!* games are the development of abilities, participation and exchange of ideas (Llerena Medina & Rodríguez-Hurtado, 2017; Paľová & Vejačka, 2022). The results of the H3 are higher than 0.150. Consequently, the realization of digital games in *Kahoot!* positively influences the participation of the students during the *Verbs Unit*. Also, this tool improved the interaction between the educator and students through the discussion of English topics during the virtual classes. Data science identified 7 conditions for the PM3. In this predictive model, the age and sex of the students determine how the realization of digital games in *Kahoot!* influences the participation. The age determines six conditions and sex determines two conditions.

Finally, colleges and high schools can plan creative activities from anywhere through *Kahoot!* because this tool enables the discussion of ideas and interaction during the COVID-19 pandemic.

Use of *Jamboard* in the teaching–learning process

Similar to Recuero Virto and Blasco López (2020), *Jamboard* improved the understanding of the school subjects from anywhere. The results of the H4 are higher than 0.710. Consequently, the dissemination and exchange of information in *Jamboard* positively influence the assimilation of knowledge during the *Verbs Unit*. For example, this tool allowed the realization of creative activities such as the dissemination and discussion of topics about the English language in the distance modality. Data science identified 8 conditions for the PM4. In this predictive model, the sex and age of the students determine how the dissemination and exchange of information in *Jamboard* influence the assimilation of knowledge. The age determines four conditions and sex determines six conditions.

Various authors (*e.g.*, DeWitt et al., 2015; Pardo-Cueva et al., 2020; Abdul Rashid et al., 2019) explain that the use of virtual walls increases the motivation of the students. The results of the H5 are higher than 0.550. Consequently, the dissemination and exchange of information in *Jamboard* positively influence the motivation of the students during the *Verbs Unit*. In particular, this tool encouraged the active role in the EL course by disseminating images and information about the use of verbs. Data science identified 7 conditions for the PM5. In this predictive model, the age and sex of the students determine how the dissemination and exchange of information in *Jamboard* influence the motivation of the students. The age determines four conditions and sex determines three conditions.

The use of virtual walls in educational institutions allows that students actively participate and exchange ideas (DeWitt et al., 2015; Pardo-Cueva et al., 2020). The results of the H6 are higher than 0.480. Consequently, the dissemination and exchange of information in *Jamboard* positively influence the participation of the students during the *Verbs Unit*. In the EL course, the use of this tool allowed the development of grammatical skills from anywhere. Data science identified 5 conditions for the PM6. In this predictive model, the age of the students determines how the dissemination and exchange of information in *Jamboard* influence the participation of the students. The age determines two conditions.

Finally, *Jamboard* is an ideal technological tool to organize and carry out creative activities such as the discussion of ideas between the educator and students in the distance modality during the COVID-19 pandemic.

Conclusions

Technological advances are changing the interaction between the participants of the educational process. In particular, *Kahoot!* and *Jamboard* facilitated the distance learning and improved the teaching–learning conditions about the English language. The results indicate that the realization of digital games in *Kahoot!* and the dissemination and exchange of information in *Jamboard* positively influence the motivation, assimilation of knowledge and participation during the *Verbs Unit*.

This study recommends the use of *Kahoot!* and *Jamboard* because these technological tools promote the active role from anywhere. Even the incorporation of these web tools in the school activities facilitated the organization of creative school activities and virtual spaces that favor the learning process on the English language.

The limitations of this study are the sample size and analysis about the use of *Kahoot!* and *Jamboard* for the motivation, assimilation of knowledge and participation. Therefore, future research can analyze the impact of these web tools for the enthusiasm, development of skills and satisfaction during the teaching–learning process. Also, universities and high schools can incorporate *Kahoot!* and *Jamboard* together with social media and virtual reality in the English courses.

The implications of this study allow that universities and educators use *Kahoot!* to perform the digital games remotely and *Jamboard* to promote the dissemination of the information and exchange of ideas at any time.

In conclusions, *Kahoot!* and *Jamboard* allow the organization of creative school activities in the distance modality where students actively participate from anywhere. Also, these technological tools allow performing the teaching–learning process during the COVID-19 pandemic.

References

Abdul Rashid, A., Yunus, Md. M., & Wahi, W. (2019). Using *Padlet* for collaborative writing among ESL learners. *Creative Education*, *10*(3), 610–620. https://doi.org/10.4236/ce.2019.103044

Aktekin, N. C., Çelebi, H., & Aktekin, M. (2018). Let's *Kahoot!* anatomy. *International Journal of Morphology*, *36*(2), 716–721. https://doi.org/10.4067/S0717-95022018000200716

Alawadhi, A., & Abu-Ayyash, E. A. S. (2021). Students' perceptions of *Kahoot!*: An exploratory mixed-method study in EFL undergraduate classrooms in the UAE. *Education and Information Technologies*, *26*, 3629–3658. https://doi.org/10.1007/s10639-020-10425-8

Atencio, P., Sánchez-Torres, G., Iral Palomino, R., Branch Bedoya, J. W., & Burgos, D. (2021). Arquitectura conceptual de plataforma tecnológica de vigilancia epidemiológica para la COVID-19. *Campus Virtuales*, *10*(1), 21–34.

Bamoallem, B., & Altarteer, S. (2022). Remote emergency learning during COVID-19 and its impact on university students perception of blended learning in KSA. *Education and Information Technologies*, *27*, 157–179. https://doi.org/10.1007/s10639-021-10660-7

Celebi, E., & Eraldemir-Tuyan, S. (2022). Transformative experiences of EFL lecturers' professional identity in online education. *European Journal of Educational Research*, *11*(2), 795–804. https://doi.org/10.12973/eu-jer.11.2.795

Çevik, M., & Bakioğlu, B. (2022). Investigating students' e-learning attitudes in times of crisis (COVID-19 pandemic). *Education and Information Technologies*, *27*, 65–87. https://doi.org/10.1007/s10639-021-10591-3

DeWitt, D., Alias, N., Ibrahim, Z., Kee Shing, N., & Meeze Mohd. Rashid, S. (2015). Design of a learning module for the deaf in a higher education institution using *Padlet*. *Procedia – Social and Behavioral Sciences*, *176*, 220–226. https://doi.org/10.1016/j.sbspro.2015.01.464

Fouche, I., & Andrews, G. (2022). "Working from home is one major disaster": An analysis of student feedback at a South African University during the COVID-19 lockdown. *Education and Information Technologies*, *27*, 133–155. https://doi.org/10.1007/s10639-021-10652-7

Jiménez-Becerra, I., & Segovia-Cifuentes, Y. (2020). Models of didactic integration with ICT mediation: Some innovation challenges in teaching practices. *Culture and Education*, *32*(3), 399–440. https://doi.org/10.1080/11356405.2020.1785140

Kofi Nti, I., Akyeramfo-Sam, S., Bediako-Kyeremeh, B., & Agyemang, S. (2022). Prediction of social media effects on students' academic performance using Machine Learning Algorithms (MLAs). *Journal of Computers in Education*, *9*(2), 195–223. https://doi.org/10.1007/s40692-021-00201-z

Lee, Y.-J., Davis, R., & Li, Y. (2022). Implementing synchronous online flipped learning for pre-service teachers during COVID-19. *European Journal of Educational Research*, *11*(2), 653–661. https://doi.org/10.12973/eu-jer.11.2.653

Licorish, Sh. A., Owen, H. E., Daniel, B., & Li George, J. (2018). Students' perception of *Kahoot!*'s influence on teaching and learning. *Research and Practice in Technology Enhanced Learning*, *13*. https://doi.org/10.1186/s41039-018-0078-8

Llerena Medina, E. G., & Rodríguez Hurtado, C. P. (2017). *Kahoot!* A digital tool for learning vocabulary in a language classroom. *Revista Publicando*, *4*(12), 441–449.

Llorens-Largo, F., Villagrá-Arnedo, C., Gallego-Durán, F., & Molina-Carmona, R. (2021). COVID-proof: cómo el aprendizaje basado en proyectos ha soportado el confinamiento. *Campus Virtuales*, *10*(1), 73–88.

Lu, J. (2020). The *WeChat* public platform: Strengthening HSS academics' global competitiveness in non-English speaking countries. *Culture and Education*, *32*(3), 609–620. https://doi.org/10.1080/11356405.2020.1785141

Martínez Navarro, G. (2017). Technologies and new trends in education: Learning by playing. *Kahoot!* case. *Opción*, *33*(83), 252–277.

Paľová, D., & Vejačka, M. (2022). Implementation of gamification principles into higher education. *European Journal of Educational Research*, *11*(2), 763–779. https://doi.org/10.12973/eu-jer.11.2.763

Pardo-Cueva, M., Magali Chamba-Rueda, L., Higuerey Gómez, Á., & Jaramillo-Campoverde, B. G. (2020). Las TIC y rendimiento académico en la educación superior: Una relación potenciada por el uso del *Padlet*. *Revista Ibérica de Sistemas e Tecnologias de Informação*, *28*(4), 934–944.

Ploj Virtič, M., Dolenc, K., & Šorgo, A. (2021). Changes in online distance learning behaviour of university students during the Coronavirus Disease 2019 outbreak, and development of the model of forced distance online learning preferences. *European Journal of Educational Research*, *10*(1), 393–411. https://doi.org/10.12973/eu-jer.10.1.393

Recuero Virto, N., & Blasco López, M. F. (2020). Lessons from lockdown: Are students willing to repeat the experience of using interactive smartboards? *International Journal of Emerging Technologies in Learning*, *15*(24), 225–231. https://doi.org/10.3991/ijet.v15i24.19327

Rivera-Trigueros, I., & Sánchez-Pérez, M. del M. (2020). Conquering the Iron Throne: Using classcraft to foster students' motivation in the EFL classroom. *Teaching English with Technology*, *20*(2), 3–22.

Rodríguez-Fernández, L. (2017). Smartphones and learning: Use of *Kahoot!* in the university classroom. *Mediterranean Journal of Communication*, *8*(1), 181–190. https://doi.org/10.14198/MEDCOM2017.8.1.13

Salas-Rueda, R.-A. (2021). Students' perceptions of the use of the flipped classroom during the educational process of linear functions. *Culture and Education*, *33*(3), 431–454. https://doi.org/10.1080/11356405.2021.1949109

Shardlow, M., Sellar, S., & Rousell, D. (2022). Collaborative augmentation and simplification of text (CoAST): Pedagogical applications of natural language processing in digital learning environments. *Learning Environments Research*, *25*, 399–421. https://doi.org/10.1007/s10984-021-09368-9

Tian, Ch., Ye, Y., Lou, Y., Zuo, W., Zhang, G., & Li, Ch. (2022). Daily power demand prediction for buildings at a large scale using a hybrid of physics-based model and generative adversarial network. *Building Simulation*, *15*, 1685–1701. https://doi.org/10.1007/s12273-022-0887-y

Tomás-Cámara, D. (2020). The classroom as a space of welcome: Exploration of the current challenges of teaching Spanish for refugees. *Culture and Education*, *32*(4), 776–795. https://doi.org/10.1080/11356405.2020.1819122

VanLeeuwen, Ch. A., Veletsianos, G., Belikov, O., & Johnson, N. (2020). Institutional perspectives on faculty development for digital education in Canada. *Canadian Journal of Learning and Technology*, *46*(2). https://doi.org/10.21432/cjlt27944

Voloshyna, V., Stepanenko, I., Zinchenko, A., Andriiashyna, N., & Hohol, O. (2022). Moderating the neuropsychological impact of online learning on psychology students. *European Journal of Educational Research*, *11*(2), 681–695. https://doi.org/10.12973/eu-jer.11.2.681

Zhang, Q., & Yu, Zh. (2021). A literature review on the influence of *Kahoot!* On learning outcomes, interaction, and collaboration. *Education and Information Technologies*, *26*, 4507–4535. https://doi.org/10.1007/s10639-021-10459-6