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Is digital breakout an effective educational tool for basic life support training?

¿Es efectivo un breakout digital como herramienta para la enseñanza de soporte vital básico?

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ABSTRACT. To promote the population's motivation to acquire knowledge in basic life support, dynamic and attractive teaching tools are necessary. A quasi-experimental study was conducted comparing pre- and post-breakout training results versus instructor-led in-person classroom training. And the participants who received training based on digital breakout showed a significant increase in self-confidence in the management of cardiac arrest and the use of the semi-automatic external defibrillator and an increase in the same post-training, with a large effect size (Cohen's d = > .80). Additionally, participants who received digital training showed comparable knowledge and skills to those who received classroom training. Digital disruption is an effective educational resource for basic life support training with a lower economic, temporal and organizational cost than traditional instructor-led in-person training.

RESUMEN. Para fomentar la motivación de la población en adquirir conocimientos en soporte vital básico son necesarias herramientas didácticas dinámicas y atractivas. Se realizó un estudio cuasiexperimental comparando los resultados previos y posteriores de la capacitación mediante un breakout versus una formación presencial en el aula dirigida por instructor. Y los participantes que recibieron entrenamiento basado en breakout digital mostraron un aumento significativo en la confianza en sí mismos para el manejo del paro cardíaco y el uso del desfibrilador externo semiautomático y un aumento en la misma post-entrenamiento, con un tamaño del efecto grande (d de Cohen = > .80). Además, los participantes que recibieron capacitación digital mostraron conocimientos y habilidades comparables a los que recibieron capacitación en el aula. La ruptura digital es un recurso educativo eficaz para la formación en soporte vital básico con un coste económico, temporal y organizativo menor que la formación presencial tradicional dirigida por un instructor.

KEYWORDS: Basic life support, Cardiopulmonary resuscitation, Educational technology, Health education, Self-study.

PALABRAS CLAVE: Soporte vital básico, Reanimación cardiopulmonar, Educación tecnológica, Educación sanitaria, Autoaprendizaje.

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1. Introduction

Cardiac arrest is a time-dependent process, and therefore, its prognosis can change favorably if basic cardiopulmonary resuscitation (CPR) maneuvers are initiated within the shortest possible time. Based on the results of studies carried out, it has been concluded that the start of early CPR performed by bystanders in the first few minutes after out-of-hospital cardiac arrest (OHCA) increases the chances of survival of victims (Cummins et al., 1991; Eisenberg et al., 1991; Holmberg et al., 2000; Koike et al., 2011; Iglesias-Llaca et al., 2013). In fact, the slogan for World Cardiac Arrest Day for 2018, 2019, 2021, and 2022 was "Every citizen of the world can save a life," referring to the importance of the bystander as a first responder.

For the bystander of an OHCA to be able to act in the first minutes, it is necessary for them to know the sequence of steps that will allow them to detect the absence of breathing in the victim and, consequently, activate emergency services and initiate CPR maneuvers. Several studies have demonstrated a direct relationship between citizens' education levels, awareness, and attitude toward cardiac arrest and the number of bystanders performing resuscitation maneuvers (Kuramoto et al., 2008; Strömsöe et al., 2010; Wissenberg et al., 2013; Ristagno et al., 2014; Lee et al., 2018).

The results of descriptive studies carried out in Spain to determine the state of basic life support (BLS) training of the population have shown that despite the increase in recent decades, the percentages of lay persons who have received CPR training are markedly lower than those of other European countries including Slovenia (70%), Germany (83.8%), and Norway (90%).

Although training the general population can facilitate successful bystander intervention in the event of an OHCA, this raises the question of how to train in such a way that the greatest number of people can be reached at the lowest economic and organizational cost. It is also essential to ascertain the motivation and willingness of the population to acquire this knowledge as this will assure the success or failure of any BLS training program. The technological advancements in the last decades have incorporated new methods to BLS training, sometimes allowing to mitigate the time and economic barriers of face-to-face BLS training. The increasing accessibility of the Internet and digital technologies has facilitated the expansion of education beyond physical classrooms, allowing students to learn at their own pace and in their own comfort zone through self-instruction programs (Piernas et al., 2023). The self-instruction methods studied have proven to be valid and economical training alternatives. However, most of them fall short owing to the need for commitment and motivation on the part of the student (Trinidad, 2020). Innovative teaching methods such as gamification, in which game elements are incorporated, can overcome this limitation of distance learning (Arufe-Giraldez et al., 2022). An example of such methods are digital breakouts, where students learn by solving riddles to decipher codes, which favors their motivation, reflection, and critical thinking (Sailer et al., 2017; Ortiz-Colón et al., 2018; Álvarez et al., 2022; Fuentes, 2019; Del Carmen Llorente Cejudo et al., 2022; Pérez-López et al., 2023).

Despite the recently increasing use of didactic tools such as virtual breakouts in education, only a few studies have applied them to BLS training. Thus, there are still many unresolved questions, including whether the breakout can be an effective educational resource for training in this subject in distance education and with results comparable to instructor-led classroom training.

Along these lines, the present study aims to compare the competencies acquired (in terms of knowledge, skills, and self-confidence for the management of OHCA and the use of AEDs) from two different training methodologies: self-training through a digital breakout versus face-to-face training.

2. Methodology

2.1. Research design

A comparative study with pre–post evaluation was carried out to analyze the increase in CPR and AED

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competencies utilizing digital training through a breakout versus traditional face-to-face training. The protocol was approved by the Ethics Committee of the Balearic Islands with code IB 4642/21 PI.

2.2. Study population

The sample was obtained from the students of four Free Time Monitor courses held in the Balearic Islands, Spain, between 2022 and 2023. The results of our study include a final sample of 85 participants. Participation in the study was offered to all students in the aforementioned courses, without excluding participants who, prior to the study, had received some type of training in first aid, CPR, AED handling, or similar. The participants signed the informed consent form.

2.3. Intervention

By accidental sampling, using the natural groups of class attendance, the participants were assigned to one of the two training branches. Thus, 47.7% (n=41) received traditional training (TTG) and 52.3% (n=44) received training through the proposed digital breakout (BTG).

The members of the TTG group received a 60-minute instructor-led theoretical–practical classroom session. The expository–demonstrative method was realized through three steps: (1) The instructor disseminated the content of the training by means of a master lesson; (2) The instructor performed a demonstration without verbal explanation of such performance at a "normal speed" on a CPR torso (Laerdal Little Anne) and with the AED training device (Trainer AED Plus Zoll); 3) The instructor repeated the previous step explaining each performance simultaneously with the demonstration.

The content of this training was designed to teach participants the algorithms for action in five clinical situations: (1) conscious victim, emphasizing scene safety and EMS (emergency medical service) activation; (2) unconscious victim with breathing, in which the lateral safety position is emphasized; (3) unconscious victim without breathing, in which CPR is introduced; (4) victim in OHCA and availability of an AED, where its operation is explained. (5) Victim of conscious choking, where interscapular clapping and Heimlich maneuver are taught.

After the master class, the demonstration part was carried out, using the "four-step method" recommended in official courses. However, due to the large number of participants, only the first two steps were performed: (1) the instructor performed the operations, simultaneously explaining the specific technical knowledge required while the student observed; (2) the instructor repeated the previous step verbally explaining each of the actions performed simultaneously with the manikin and the AED.

The participants of the BTG branch individually accessed the proposed digital breakout through a computer device (mobile phone, tablet, or laptop). All participants completed this training simultaneously and in person in the same classroom.

The breakout used in this study was designed by a group of CPR experts. Prior to this study, a pilot test was carried out to determine the correct functioning, validity, and points for improvement of this educational resource. The breakout, titled "Save the Ship", was contextualized inside a spaceship, inside which the participant was when it was kidnapped.

To return to Earth and survive, the breakout user had to complete five missions (each corresponding to one of the clinical situations previously mentioned) from which the user obtained five digits that allowed the user to recover the ship and return home by entering them in a control command. In each mission, the participant was confronted with the system's questions and issues. The same images and algorithms were used for both the TTG slide presentation and the digital breakout content.

2.4. Data collection instrument and procedure

An ad-hoc questionnaire was administered to collect sociodemographic data (age and sex), previous training, and self-assessment of knowledge (excellent, good, fair, poor or very poor) in CPR and AED.

As there are no validated CPR competency scales, an ad-hoc questionnaire of 14 multiple-choice questions was created for this study. The questions were divided into two dimensions, one corresponding to the sequence of actions (SA), in which the participant was asked about the algorithms of actions to be performed in a given clinical situation of a victim and the other theoretical–conceptual (TC), in which the participant was asked about the maneuvers and/or techniques to carry out these actions.

A Likert-type scale 0–5 (where "0" and "5" correspond to no confidence and total confidence, respectively) based on a validated scale (Pascual et al., 2019) was used to determine the self-confidence of the students to carry out the proposed actions in a real emergency context. To interpret the results of the level of self-perceived confidence, these were categorized into low level [0, 2), medium level [2, 4), and high level [4, 5).

To evaluate the skills acquired after the training received, the participants were asked to simulate the sequence of steps to be performed in a clinical situation with the support of an adult manikin (Laerdal Little Anne), a mobile phone, and a training AED (Trainer 2 Zoll). The results of this simulation were collected by means of a checklist in which it was recorded whether the participant performed the actions and whether they were performed correctly. The actions evaluated and the method recorded as correct were (1) assessing consciousness by shaking the victim from the shoulders; (2) opening the airway using the forehead–chin maneuver; (3) detecting breathing through the see–hear–feel approach; (4) alerting EMS and recognizing the emergency number (1-1-2); (5) correct hand position for performing CT in the center of the chest; (6) turning on the AED; and (7) placing electrodes on the chest in the right infraclavicular and left inframammary position.

To avoid bias in the collection and evaluation of the actions, the same researcher recorded the checklist of all participants.

2.5. Data analysis

The data were analyzed with the SPSS 28 program. Assumptions of normality and the Kolmogorov–Smirnov test were checked. A univariate descriptive analysis was performed for each of the variables under study. For qualitative variables, the frequencies of the responses were calculated, and for quantitative variables, the mean and standard deviation were estimated. A bivariate association analysis was carried out if the assumption of normality and equality of variances was satisfied, using the chi-square test for categorical variables, and Student's *t*-test was conducted for the analysis between dichotomous and quantitative categorical variables for independent groups. If assumptions were not met, the Mann–Whitney U test was applied. The significance value for the analyses conducted in this study was set to .05.

The effect size was calculated using Cohen's d statistic. Cohen's d values below .20 indicate no effect; values between .21 and .49 indicate a small effect; likewise, values between .50 and .79 indicate a moderate effect, and values above .80 indicate a large effect. Risk estimates, such as the odds ratio, were also obtained.

3. Results

3.1. Sample characterization

The results of our study include a final sample of 85 participants. The mean age of the participants was homogeneous in both training branches (19.84±4.38 years for the BTG and 20.46±5.53 years for the TTG). Of all participants, 88.37% were female with a distribution between the two training groups of 72.7% (n=32) in the BTG and 68.3% (n=28) in the TTG.

Regarding the availability of CPR training, 54.5% (n=24) of the BTG and 46.3% (n=19) of the TTG had

not received training prior to the present study. Regarding AED, 88.6% (n=39) of the BTG and 87.8% (n=39) of the TTG had received no prior training in the subject.

3.2. Self-assessment of knowledge

All participants, regardless of whether they received training through the "Save the Ship" digital breakout (BTG) or through traditional face-to-face training (TTG), exhibited an improvement in their self-assessment of their CPR knowledge after the intervention. The self-assessment of their knowledge of AED handling also displayed a significant improvement and a very similar percentage in the two training groups (Table 1).

No significant relationship was observed in the self-assessment of post-training knowledge of participants who had already received training at the beginning of the study compared with those who had not received any prior training in this area (TTG: chi-square: 2.152; p=.541; BTG: Chi-square: 0.574; p=.750).

		BTG (n=44)		TTG (n=41)	
		Pre-T	Post-T	Pre-T	Post-T
CPR	Excellent and good	13.63% (n=6)	65.90% (n=29)	7.32% (n=3)	63.41% (n=26)
	Fair, bad, and very bad	86.36% (n=38)	34.09% (n=15)	92.68% (n=38)	36.58% (n=15)
	Significance (p)	.058		.172	
	Odds ratio (OR)	.605		.605	
AED	Excellent and good	4.54% (n=2)	65.90% (n=29)	4.87% (n=2)	60.97% (n=25)
	Fair, poor and very poor	95.45% (n=42)	34.09% (n=15)	95.12% (n=39)	39.02% (n=16)
	Significance (p)	.298		.246	
	Odds ratio (OR)	.643		.590	

CPR: cardiopulmonary resuscitation; AED: automated external defibrillator; BTG: breakout training group; TTG: traditional training group. Pre-T: pre-training; Post-T: post-training. *Statistical significance p<0.05; OR: Odds ratio.

Table 1. Self-assessment of CPR and AED knowledge pre–post of both training groups. Source: Self-made.

3.3. Self-confidence

The results obtained for each of the actions evaluated demonstrated a significant increase in all variables after receiving the training for both groups, except for the action corresponding to "Call the EMS" and "Report the emergency and respond to the EMS questions" (Table 2).

The mean obtained after the training was higher than 3 points (average level of self-perceived self-confidence) in all the variables evaluated in both training groups. However, this mean was higher for the participants who underwent the training through the proposed digital breakout (Table 2).

	BTG				TTG			
Items evaluated	**Pre-T**	**Post-T**			**Pre-F**	**Post-F**		
	Median±SD	**Median±SD**	**Significance (p)**	**Cohen's d**	**Median±SD**	**Median±SD**	**Significance (p)**	**Cohen's d**
Stay calm when faced with an emergency situation	2.64±.149	3.77±.152	<.001	.878	2.70±1.137	3.20±1.265	.004	1.038
Call EMS	4.30±.851	4.48±.731	.073	.657	3.98±1.025	4.30±.758	.022	.859
Report the emergency situation and answer the 112 questions	3.82±1.040	4.30±.795	<.001	.698	3.65± .975	4.00±.961	.037	1.027
Assess whether the person is conscious or unconscious	3.41±1.263	4.18±.947	<.001	1.075	3.05±1.085	4.05±.932	<.001	1.219
Determine whether an unconscious person is breathing or not breathing	3.57±1.043	4.14±.930	.001	1.108	3.23±1.291	4.00±.906	<.001	.974
Recognize when a person is in CRA	2.07±1.169	3.86±1.002	<.001	1.091	1.50±1.198	3.60±1.008	<.001	1.297
Perform CC on an adult person in CRA	2.16±1.430	3.36±1.241	<.001	1.173	1.60±1.297	3.23±1.121	<.001	1.372
Performing CC on a child in CPR	1.89±1.333	3.30±1.231	<.001	.996	1.25±1.171	3.03±1.097	<.001	1.209
Perform CC when the victim is a close family relative	2.18±1.498	3.43±1.149	<.001	1.260	1.65±1.312	3.18± .958	<.001	1.301
Maintain CC until ambulance arrives	2.59±1.530	3.73±1.227	<.001	1.091	2.03±1.609	3.38±1.102	<.001	1.578
Generally, I see myself capable of correctly performing CPR with CC	1.89±1.368	3.41±1.282	<.001	1.089	1.38±1.192	3.08±1.185	<.001	1.436

CPR: cardiopulmonary resuscitation; CRA: cardiorespiratory arrest; EMS: emergency medical services; BTG: breakout training group; TTG: Traditional training group. Pre-T: pre-training; Post-T: post-training. *Statistical significance p<0.05; SD: Standard deviation.

Table 2. Pre- and post-training self-confidence of both groups. Source: Self-made.

Along the same lines, a significant increase was observed for TTG and BTG in the mean obtained for post-training in the actions evaluated for AED handling compared with the baseline mean (Table 3). The post-training mean was higher than 3 in all the variables studied in both groups, with this mean being higher in the group that underwent training utilizing the digital breakout (Table 3).

	BTG (n=44)				TTG (n=41)			
Items evaluated	**Pre-T**	**Post-T**			**Pre-T**	**Post-T**		
	Median±SD	**Median±SD**	**Significance (p)**	**Cohen's d**	**Median±SD**	**Median±SD**	**Significance (p)**	**Cohen's d**
In general, I see myself capable of using an AED	1.61±1.543	3.61±1.017	<.001	1.381	1.00±1.414	3.40±1.033	<.001	1.446
Attach the AED electrodes to the patient's chest	2.16±1.697	4.05±1.099	<.001	1.603	1.45±1.501	3.78±1.209	<.001	1.607
Follow AED commands and push/press the shock button when instructed to do so by the device	2.64±1.480	4.00±1.057	<.001	1.366	2.13±1.453	4.00±.987	<.001	1.505
In general, I see myself capable of acting on an adult person with conscious FBAO	2.64±1.241	3.80±1.002	<.001	.963	2.13±1.223	3.55±.986	<.001	1.196
In general, I see myself capable of acting on a child with FBAO, even consciously	2.48±1.320	3.68±1.029	<.001	1.069	2.10±1.277	3.20±1.091	<.001	1.297

AED: automated external defibrillator; FBAO: foreign body airway obstruction; BTG: breakout training group; TTG: traditional training group. Pre-T: pre-training; Post-T: post-training. *Statistical significance p<0.05; SD: standard deviation.

Table 3. Pre- and post-training results of self-confidence for AED handling in a real OHCA context. Source: Self-made.

Noteworthily, in most of the variables evaluated, the TTG participants, with no prior knowledge, presented higher post-training self-confidence average than those with prior training. However, in the BTG, the post-training mean was lower in those who had started the study without having received any prior training in this subject compared with the participants who already started the study with prior knowledge.

3.4. Theoretical-conceptual knowledge

The results of the post-training questionnaire showed, for both the TTG and the BTG, an increase in the frequency of correct answers in both the questions corresponding to the SA and TC dimensions (Table 4).

Items evaluated	BTG (n=44)				TTG (n=41)			
	Pre-T	Post-T			Pre-T	Post-T		
	Success (%)	Success (%)	*Sig (p)	OR	Success (%)	Success (%)	*Sig (p)	OR
SA1: Assessing consciousness as the first action to be taken	61.36% (n=27)	84.09% (n=37)	.052	1.312	48.8% (n=20)	92.7% (n=38)	.578	1.050
C1: Recognize actions to assess awareness	59.09% (n=26)	63.63% (n=28)	.028*	1.905	61.0% (n=25)	82.9% (n=34)	.054	1.338
SA2: Identify that the next step for an unconscious victim is to check for breathing	52.27% (n=23)	81.81% (n=36)	.355	1.141	58.5% (n=24)	95.1% (n=39)	.085	1.133
SA3: Place an unconscious person who is still breathing normally in LSP	59.09% (n=26)	97.72% (n=43)	.224	1.059	41.5% (n=17)	95.1% (n=39)	.222	1.091
SA4: Initiating CC to an unconscious person without breathing	59.09% (n=26)	81.81% (n=36)	.003*	1.573	43.9% (n=18)	80.5% (n=33)	.005*	1.533
SA5: Sequence of actions to be performed in a choking situation	52.3% (n=23)	90.9% (n=40)	.028*	.810	61.0% (n=25)	87.8%(n=36)	.003*	1.455
C2: Recognize the clinical situation in which the use of an AED is indicated (in CRA).	65.9% (n=29)	86.4% (n=38)	.070	1.270	51.2%(n=21)	90.2 (n=37)	.031*	1.250
C3: Identify the correct placement of electrodes on the chest of a victim.	25.0% (n=11)	63.6% (n=28)	.148	1.421	12.2% (n=5)	80.5% (n=33)	.240	1.286
SA6: AED handling sequence	18.2% (n=8)	72.7% (n=32)	.873	1.038	9.8% (n=4)	61.0% (n=25)	.092	1.762
C4: Action to be taken if the AED authorizes discharge	20.5% (n=9)	45.5% (n=20)	.152	1.667	17.1% (n=7)	48.8% (n=20)	.188	1.619
C5: Action to be taken if the AED does not authorize discharge	18.2% (n=8)	79.5% (n=35)	.186	.750	24.4% (n=10)	63.4% (n=26)	.045*	1.641

SA: sequence of action; C: conceptual knowledge; LSP: lateral safety position; CC: chest compressions; AED: automated external defibrillator; FBAO: foreign body airway obstruction; BTG: breakout training group; TTG: traditional training group. Pre-T: pre-training; Post-T: post-training. *Statistical significance p<0.05; OR: odds ratio.

Table 4. Frequency of correct answers and the pre- and post-training significance for both groups. Source: Self-made.

Although this increase was statistically significant in different questions between the two training groups, both groups coincided with a significant increase in two questions corresponding to the fundamental SA dimension in BLS "Initiate CC to an unconscious person without breathing" and "Sequence of actions to perform in a choking situation."

3.5. Abilities

After the training, each participant was presented with the following clinical situation in a room and individually: "You are a teacher in a school, you receive a warning that an adult has collapsed on the floor".

Of the total sample of the TTG and BTG, more than 50% of the participants correctly performed all the actions on the checklist, except for the action "opening the airway" for the BTG, where 46.51% (n=20) performed this action using the forehead-to-chin maneuver.

In general, the participants who underwent the digital breakout training obtained a lower percentage of correctly performed actions compared with the group that underwent traditional training (Table 5).

	BTG (n=43)	TTG (n=41)		
	Frequency	Frequency	Sig (p)	OR
Assess consciousness	69.76% (n=30)	78.05% (n=32)	.388	.894
Airway opening	46.51% (n=20)	63.41% (n=26)	.120	.733
Breath detection	65.17% (n=28)	78.05% (n=32)	.190	.834
Notice to EMS	69.77% (n=30)	92.68% (n=38)	.008*	.753
Recognize EMS number	88.37% (n=38)	92.68% (n=38)	.501	.953
CC hand position	86.05% (n=37)	56.09% (n=23)	.002*	1.534
Turn on AED	81.39% (n=35)	53.66% (n=22)	.007*	1.517
Place electrodes on the chest	81.39% (n=35)	53.66% (n=22)	.007*	1.517

EMS: emergency medical service; CC: chest compressions; AED: automated external defibrillator; BTG: breakout training group; TTG: traditional training group. *Statistical significance p<0.05; OR: odds ratio.

Table 5. Frequency of actions correctly performed by both groups. Source: Self-made.

4. Discussion

Given that the latest update of the ERC (Greif et al., 2021) recommends both encouraging self-instruction and including new teaching tools in all levels of CPR courses, in this study, we decided to opt for an experience based on a digital breakout, in which the user, through self-learning, acquires the knowledge, skills, and sufficient self-confidence to act in a real CRA or FBAO context.

The results of our study show that the participants trained through the proposed digital breakout have managed to increase their skills in the management of CRA and FBAO. Although the results of the use of gamification and, more specifically, of educational games such as breakouts as a teaching methodology for BLS are still poorly addressed, the results obtained would be in line with other studies in which the acquisition of knowledge and skills was demonstrated for the management of emergency situations using educational tools far from traditional expository-demonstrative methodologies (Marchiori et al., 2012; Álvarez-Cebreiro et al., 2020; Pérez-López et al., 2023).

In our study, the participants assigned to the self-training arm via digital breakout increased their knowledge in CPR, FBAO, and handling of semi-automatic external defibrillation in a way similar to those undergoing instructor-led face-to-face classroom training using the expository-demonstrative method, which differs from the results of other studies (Rubio et al., 2023; Navarro-Patón et al., 2018; Navarro-Patón et al., 2021; Álvarez-Cebreiro et al., 2020; Blanco-Ávila et al., 2020; Espinosa et al., 2019), in which, although the innovative method under study increased the knowledge and skills of the participants, this increase was reportedly lower than that obtained by face-to-face training. Even in our work, better results were obtained in the GFB for key questions such as recognizing that "When faced with an unconscious person with breathing, the victim should be placed in LSP" (97.72% of the BTG vs. 95.1% of the TTG), in the situation in which "The unconscious person is not breathing, so CPR should be initiated" (81.81% of the GFB vs. 80.5% of the GFT), "in the sequence of actions in the event of choking" (90.9% of the GFB vs. 87.8% of the GFT) and "in the handling of AEDs" (72.7% of the GFB vs. 61.0% of the GFT). It is striking, however, a higher frequency related to the hand position to perform CC, the action of turning on the AED and placing the electrodes. These results are very useful to determine the points of improvement of the digital breakout.

These results also differ from those published from a pilot study with characteristics and presentation similar to our work and developed by the Aragonese Center for Educational Technologies (CATEDU), in collaboration with the e-learning group of the Complutense University and SEMES, in which, through the creation of the game "First Aid Game," the effectiveness in terms of knowledge of the group subjected to the game (experimental group) was compared with a traditional teaching method, based on the practical demonstration of the procedures by personnel health, demonstrating a significant increase in the experimental group's theoretical knowledge, although this is less than that achieved by the control group. The game consisted of three scenarios: (1) chest pain, (2) unconsciousness, and (3) choking. This study involved students between 12 and 16 years of age in the 1st, 2nd, 3rd, and 4th years of ESO and 1st year of Bachillerato.

No significant post-training differences were observed depending on whether or not the participants had received pre-study training in this subject (TTG: chi-square: 2.152; p=.541; BTG: chi-square: 0.574; p=.750).

The results of this study revealed a significant increase ($p < .005$) in self-confidence in all actions evaluated after training with digital breakout. In our study, although it is not common, the self-confidence of the participants was evaluated, since this variable is essential to ensure that the participant, in addition to acquiring knowledge of the subject, also feels capable of acting in a real context of CRA, the purpose of this training and, consequently, a greater number of OHCA attended in the first minutes by the bystanders.

Among the limitations of this work, it is worth noting that the sampling is not random, so the representativeness of the sample cannot be assured. The digital breakout was not carried out in the manner

for which it was designed (an autonomous and flexible training, in which the participant could take the training at any time and place), but rather it was carried out, albeit individually, in person and simultaneously in a classroom. This may have affected the results related to the time pressure among the participants to finish the breakout. The participants constituted a young sample, so the handling of this virtual tool in other age groups is unknown. Future studies should be conducted to analyze the learning curves and forgetting curves of self-training through a breakout.

The duration effect of traditional training may affect its results. In our study, we chose to set the time of traditional training to 60 minutes, a time similar to that used in other studies (Marchiori et al., 2012; Navarro-Patón et al., 2018).

Finally, the results found are positive and confirm the need to continue to delve deeper into digital tools for BLS training, moving away from the more face-to-face methods, availability of instructors, and, consequently, a significant economic cost. The digital breakout could increase motivation to learn BLS. Inclusion of this knowledge in the school curriculum is essential to achieve a general population trained in this subject, so training based on tools such as the digital breakout could be considered as self-learning for students or as a support tool for the teacher who teaches this subject to school children (Abelairas−Gómez et al., 2021; Bañeras et al., 2022). It should be noted that an educational resource such as the proposed digital breakout allows for frequent repetition, which helps the user to periodically reinforce his or her knowledge.

5. Conclusion

Through this research we have been able to confirm the usefulness and effectiveness of digital breakout for acquiring content, skills, and competencies related to CPR. The results of digital breakout-based training were comparable to those of traditional instructor-led classroom training.

With this type of innovation, not only do we achieve an increase in CPR competencies, but we can also obtain higher levels of commitment and motivation in the students, which is fundamental if we want to achieve a critical mass of the population with this knowledge to guarantee care in the first minutes of OHCA.

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