ORİJİNAL ARAŞTIRMA ORIGINAL RESEARCH

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The Effect of Computer Based Game on Improving Nursing Students' Basic Life Support Application Skills: Experimental Study

Hemşirelik Öğrencilerinin Temel Yaşam Desteği Uygulama Becerilerinin Geliştirilmesinde Bilgisayar Destekli Oyunun Etkisi: Deneysel Çalışma

Ayşe DEMİRAY[a], Selin KESKİN KIZILTEPE[a]

[a]Department of Nursing, Düzce University Faculty of Health Sciences, Düzce, Türkiye

ABSTRACT Objective: The use of computer-aided simulation in the development of nursing students' basic life support skills has become increasingly widespread. The aim of this study is to evaluate the effect of computer-aided game in the development of basic life support application skills of second-year nursing students. **Material and Methods:** The universe of this randomised controlled study included 194 second-year nursing students of Health Sciences University who were enrolled in a first-aid lesson. Experimental and control groups were randomly selected among these students according to the results of power analysis. Experimental (n=28) and control (n=28) groups of the study were determined within the scope of simple random sampling method. The data were collected by using "Introductory Information Form", "Basic Life Support Skill Evaluation Form" which were prepared by the researchers. Quantitative data were presented as median (minimum-maximum), frequency (percent). Mann-Whitney U test was used for comparison of non-normally distributed paired groups. Statistical significance level was set at $p < 0.05$. **Results:** In the study, no difference was found between the experimental and control groups regarding the basic life support application times and scores ($p > 0.05$). However, it was determined that the performance of the students who used computer based game was better than those who did not. **Conclusion:** It is recommended that computer-aided 3D serious games should be developed and used in the education of nursing students and that studies on this subject should be increased.

Keywords: Computer simulation; nursing students; basic life support

ÖZET Amaç: Hemşirelik öğrencilerinin temel yaşam desteği becerilerinin geliştirilmesinde bilgisayar destekli simülasyon kullanımı giderek yaygınlaşmaktadır. Bu araştırmanın amacı, hemşirelik 2. sınıf öğrencilerinin temel yaşam desteği uygulama becerilerinin geliştirilmesinde bilgisayar destekli oyunun etkisini değerlendirmektir. **Gereç ve Yöntemler:** Randomize kontrollü olarak planlanan çalışmanın evrenini sağlık bilimleri fakültesi hemşirelik bölümünde öğrenim gören, ilkyardım dersini alan ve 2. sınıfta okuyan 194 öğrenci oluşturmaktadır. Deney ve kontrol grubu randomize olarak bu öğrenciler içerisinden power analiz sonucuna göre seçilmiştir. Çalışmanın deney (n=28) ve kontrol (n=28) grupları basit rastgele örnekleme yöntemi kapsamında belirlenmiştir. Veriler, araştırmacılar tarafından hazırlanan "Tanıtıcı Bilgi Formu" ve "Temel Yaşam Desteği Beceri Değerlendirme Formu". kullanılarak toplanmıştır. Nicel veriler ortanca (minimum-maksimum), frekans (yüzde) şeklinde sunulmuştur. Normal dağılım göstermeyen 2'li grupların karşılaştırılmasında Mann-Whitney U testi kullanılmıştır. Anlamlılık düzeyi $p<0,05$ olarak alınmıştır. **Bulgular:** Araştırmada, deney ve kontrol grupları arasında temel yaşam desteği uygulama süreleri ve puanları açısından fark bulunmamıştır ($p>0,05$). Ancak bilgisayar destekli oyunu kullanan öğrencilerin performansının, kullanmayanlara göre daha iyi olduğu saptanmıştır. **Sonuç:** Bilgisayar destekli 3 boyutlu oyunların geliştirilerek, hemşirelik öğrencilerinin eğitiminde kullanılması ve konuyla ilişkili çalışmaların artırılması önerilmektedir.

Anahtar Kelimeler: Bilgisayar destekli simülasyon; hemşirelik öğrencileri; temel yaşam desteği

In recent years, different teaching methods have been developed in nursing education due to the decrease in the number of clinical fields, the increase in the number of students and the insufficient number of teachers.[1-4] Simulation and its many forms have been part of the theoretical and practical stage of nursing education. Simulation-based training includes realistic scenarios, specialized manikin, com-

Correspondence: Selin KESKİN KIZILTEPE
Department of Nursing, Düzce University Faculty of Health Sciences, Düzce, Türkiye
E-mail: selinkeskin@duzce.edu.tr

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puter software, and humans playing the role as patient.[2,3] High fidelity patient simulation is frequently used in health care education that allows the measurement of many advanced properties such as ability to have breathing, talking, heart and lung sounds, secretion of sweat and tears. It provides feedback, giving students time to review and reflect on their performance with interactive learning in a safe, controlled environment.[1-3] According to studies on nursing students have shown that their knowledge learning, clinical practice skills, cognitive abilities, decision making and critical thinking skills have improved.[5-8] The use of these systems have become an important factor in nursing education that allows practice without risk to patients for teaching the necessary skills and knowledge to prepare competent nurses.[1,2,6,7] And educators can develop clinical scenarios that give students the opportunity to practice critical/complex situations such as cardiac arrest. Nurses are usually first responders to cardiac arrest and their cardiopulmonary resuscitation (CPR) skills must be competent in order to contribute to successful patient outcomes. For teaching CPR, there are many different learning strategies such as high fidelity mannequins, interactive videos and three dimensional (3D) simulation scenarios.[5,7,9] Another of them is also computer-aided simulation used by nursing educators and applied for the purpose of improving student basic life support (BLS) skills and has produced effective results to compare with traditional teaching.[10-15] It is preferred by institutions with a high number of students as a student can access the simulation anytime and anywhere. Furthermore, it also offers the opportunity to perform the simulation and reuse or repeat it as many times as desired.[8-9] Therefore, the use of computer-aided simulation for developing BLS skills has become increasingly widespread and effective computer based simulations have become necessary for the nursing students' preparation process to the clinic practices in nursing education recently.[16-21] Teaching the lifesaving BLS skills with attention-grabbing methods will contribute to the students' knowledge and skills.[5]

MATERIAL AND METHODS

TYPE AND PURPOSE OF RESEARCH

The study is planned as an experimental design to evaluate the impact of computer based game in improving the development of BLS application skills of second-year nursing students enrolled in a first-aid lessons.

STUDY POPULATION AND SAMPLE SIZE

The population of the study consisted of 194 second-year nursing department students enrolled in the first-aid lesson during the 2017-2018 academic year spring term. In the research, the size of the sample group was determined as 56 participants according to power analysis with 95% confidence and 80% power. To evaluate computer based game, we performed a randomized control trial that compares classical teaching, composed of self directed learning and laboratory intervention. All students were provided with theoretical knowledge in regards to BLS within the first-aid lesson, shown BLS application steps by an instructor on low fidelity manikins and made to practice themselves. The practice stage of the class was conducted by two educators as demonstration and later practice in groups. In the demonstration, students watched the educator practice usually on a still manikin, afterwards practiced themselves.

After this stage, experimental and control groups were randomly selected among these students by using the simple random method. The students in the experimental group used the computer based game for a week besides the training and practice they received in the first-aid lesson by using their user names and passwords through remote access. Experimental and control group students were taken to the application room one by one at different times. No practice was given to the control group students besides the training and practice they received in the first-aid lesson (Figure 1).

DATA COLLECTION TOOLS

The Introductory Information Form and the Basic Life Support Skill Evaluation Form prepared by the researchers and "CPR BLS traininig platform Serious Game App & Integrated Manikin" were used as data collection tools.

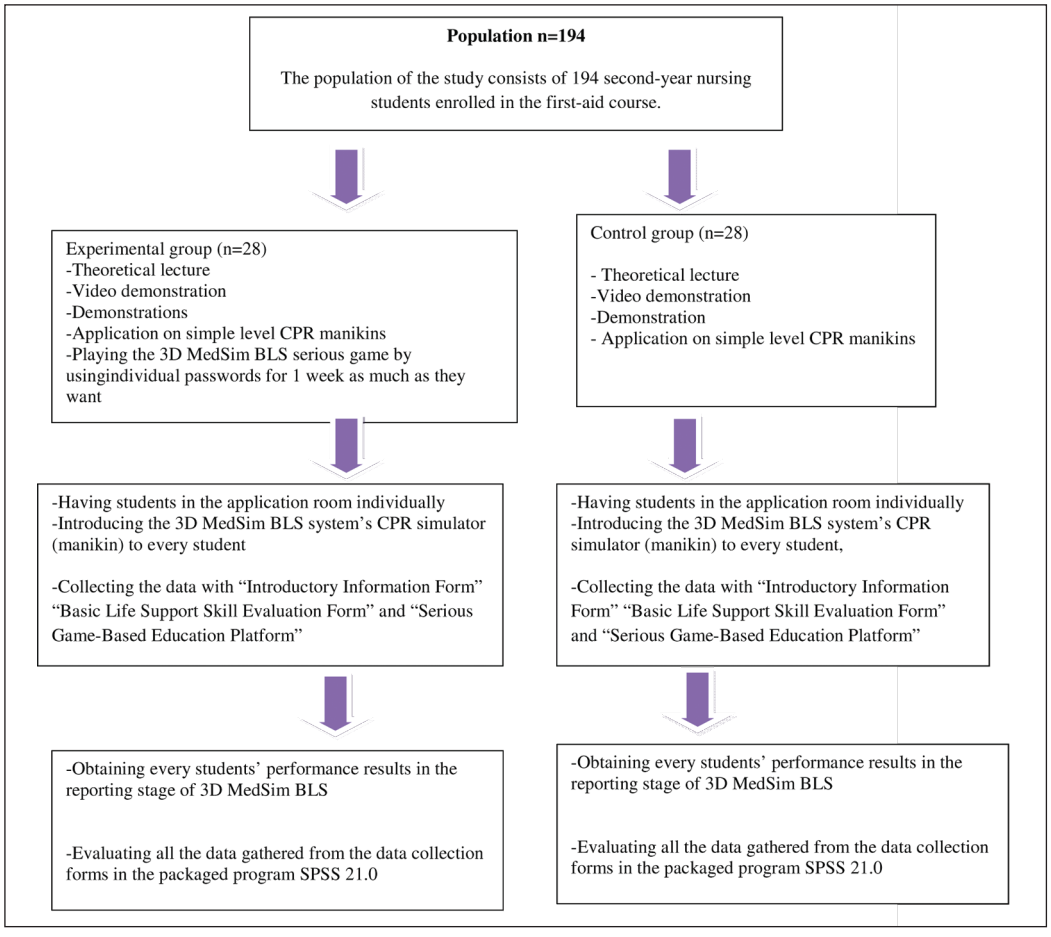

FIGURE 1: Consort flow diagram.
CPR: Cardiopulmonary resuscitation; BLS: Basic life support.

INTRODUCTORY INFORMATION FORM

The personal information form consists of seven questions about the age, gender, last graduated school, whether or not BLS training was received and if so where they had received it.

BASIC LIFE SUPPORT SKILL EVALUATION FORM

Following a literature review, the items on the evaluation form were prepared based on the latest published American Heart Association (AHA) and European Resuscitation Council (ERC) resuscitation guidelines.[22,23] The form that includes BLS application steps consists of 20 detailed items about ensuring scene safety, recognizing cardiac arrest, activating emergency response system, effective chest compressions-rescue breathes and the use of the automatic external defibrillator (AED). Steps executed correctly by the students were evaluated as "done", incorrectly as "not done."

COMPUTER BASED GAME (3DMedSim BLS) (CARDIOPULMONARY RESUSCITATION BASIC LIFE SUPPORT TRAININIG PLATFORM SERIOUS GAME APP & INTEGRATED MANIKIN)

3DMedSim BLS (Turkey/Germany) system is a computer-aided software system simulator. The software includes BLS application steps based on the 2015 AHA and ERC guides. The software has an individual module and a training module under trainer supervision, as presented in Figure 2 and Figure 3, respectively. Individual modules can be used with appropriate phone and tablet PCs by those who want to participate in the training. In the individual education module, the individual applies the BLS steps in order within a scenario and can retrospectively learn the steps they missed or did incompletely. In the reporting module, results of the same person's previous tests can be presented to the users with a graphical interface that can be understood easily. When the al-

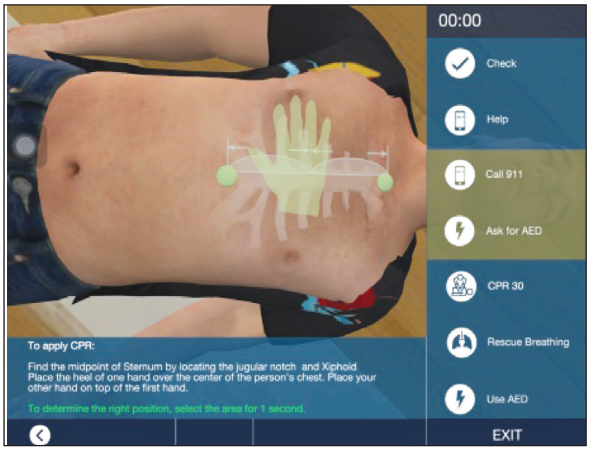

FIGURE 2: Individual module basic life support steps-applying cardiac resuscitation.

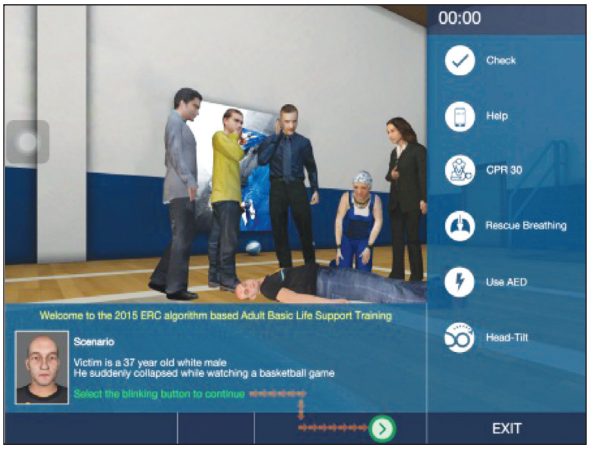

FIGURE 3: Individual module basic life support steps- (ensuring scene safety).

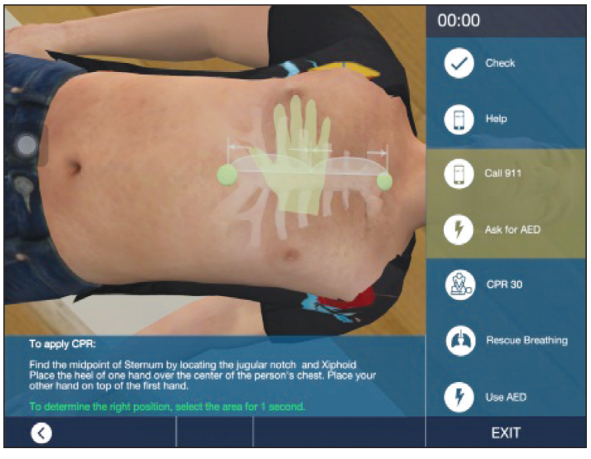

FIGURE 4: Individual module basic life support steps-applying cardiac resuscitation-1.

FIGURE 5: Individual module reporting screenshots.

gorithm's steps that appear as unsuccessful in the report are clicked, incomplete steps can be viewed by the user. The original language of the game is English and language options are available. The most updated version of the 3D Medsim BLS has an integrated virtual reality use module and it was not incorporated in our study.[24]

The system-operated mannequin, as seen in Figure 2, is designed for performing adult CPR practices according to the AHA and ERC CPR protocol algorithm.[22,23] The carotid pulse is provided by an electrical motor and the mannequin has a neck position sensor. The physical data of Chest Compression Depth, Chest Compression Number and Frequency, Ventilation Volume and Ventilation Number obtained from the manikin can be viewed through the software and in the result report (Figure 4). 3D MedSim BLS system automatically calculated a total score according to each students' level of performing and correcting the application steps respectively (Figure 5). All the applications can be preserved in an international "Teaching Management System" as "per person", the data can be checked per person when desired and the applications performed by the same person in different times can be checked.

DATA COLLECTION

The data were collected by the researchers between March-June 2018, using the above mentioned forms. Experimental and control group students were taken to the application room one by one, the simulator was introduced Serious Game App & Integrated Manikin and were began to perform BLS

application steps with a scenario. Students were observed by 2 researchers with a "Basic Life Support Skill Evaluation Form" which was prepared on the literature. Students' skills of BLS were evaluated according to this form. And a screen connected to the simulator, students practices were followed by this screen and duration of BLS steps was measured with reports. The time required for each students to practice the BLS steps was between 15 and 20 minutes.

ETHICAL ASPECTS OF RESEARCH

For this study to be conducted, written permission was received from the Düzce University Clinical Research Ethics Committee (Ethics approval no:2018/38) and Head of the Department of Nursing, Faculty of Health Sciences. This research was made in accordance with principles of Helsinki Declaration. The study was conducted on a voluntary basis, all the students were informed regarding the purpose of the study and verbal consent was obtained from the students. Participation in the study was on a volunteer basis and all students were informed about the purpose of the study and their verbal consent was obtained.

EVALUATION OF DATA

Data were analysed by using the SPSS (Statistical Package for the Social Sciences) 21.0 package program. Quantitative data are presented as frequency, percentage, arithmetic mean, standard deviation, median (minimum-maximum).The Mann-Whitney U test was used to compare the groups not showing normal distribution at a significance level of $p<0.05$.

LIMITATIONS OF THE STUDY

The results of the study are limited to the second-year students enrolled in the first aid lessons in the Nursing Department of the Faculty of Health Sciences of a public university in the 2017-2018 academic year.

RESULTS

Of the 56 participants, 40 students were women and 16 were men. With ages ranging from 19 years to 27 years (mean 20.52, standard deviation 1.31). Ten of the students are health vocational high school graduates, 41 of them had a high school degree, 5 of them had a graduate degree. Fifteen students previously received BLS course, 10 of them received form health vocational high school, 5 of them received from driving course (Table 1).

TABLE 1: Distribution of students by socio-demographic characteristics.

	Experimental group (n=28)		Control group (n=28)	
Descriptive characteristics of students	**n**	**%**	**n**	**%**
Age groups (20.52±1.31)				
19-20	20	71.4	14	50.0
21-27	8	28.6	14	50.0
Gender				
Female	24	85.7	16	57.1
Male	4	14.3	12	42.9
Most recently graduated school				
Health vocational high school	7	25.0	3	10.7
High school	20	71.4	21	75.0
University	1	3.6	4	14.3
Basic life support training status				
Yes	8	28.6	7	25.0
No	20	71.4	21	75.0
Place of training				
Health vocational high school	7	25	3	10.7
Driving course	1	3.6	4	14.3

It was found that all students in both groups performed the steps of "Continuing the chest compression rate at 100-120 per minute (appropriate rate)" and "Continue breathing once every 5-6 seconds or at 10-12 breaths/min" (steps 10 and 13) (Table 2).

All the students of the experimental group performed the steps of "Ensuring safety of the emergency scene", "Shaking the patient's shoulders, checking for consciousness" and "Checking for breathing or only gasping (simultaneously checking for

TABLE 2: Student frequency distribution of basic life support application steps.

		Experimental group (n=28)		Control group (n=28)	
Steps related to application of BLS		**n**	**%**	**n**	**%**
1. Ensuring the safety of the emergency scene	Done	28	100.0	27	96.4
	Not done	0	0.0	1	3.6
2. Shaking the patient's shoulders, checking for consciousness	Done	28	100.0	22	78.6
	Not done	0	0.0	6	21.4
3. Opening the airway with head back - jaw up and/or jaw thrust maneuver to ensure airway clearance	Done	26	92.9	26	92.9
	Not done	2	7.1	2	7.1
4. Checking for breathing or only gasping (simultaneously checking for pulse)	Done	28	100.0	26	92.9
	Not done	0	0.0	2	7.1
5. Is the carotid pulse felt within 10 seconds?	Done	27	96.4	25	89.3
	Not done	1	3.6	3	10.7
6. Calling for help	Done	21	75.0	18	64.3
	Not done	7	25.0	10	35.7
7. Requesting AED	Done	23	82.1	17	60.7
	Not done	5	17.9	11	39.3
8. If there is no breathing or there is only gasping, if there is no pulse, place the hands correctly for chest compression on the lower half of the sternum to start 30:2 CPR	Done	27	96.4	28	100.0
	Not done	1	3.6	0	0
9. Performing 5 cycles of 30 heart massage/2 artificial respiration operations	Done	27	96.4	28	100.0
	Not done	1	3.6	0	0
10. Continuing the chest compression rate at 100-120 per minute (appropriate rate)	Done	28	100.0	28	100.0
11. Shoulders over the patient, arms held straight and vertically positioned to precipitate appropriate, strong pressure of at least 2 inches (5 cm) in depth on the chest and avoiding excessively deep pressure	Done	26	92.9	25	89.3
	Not done	2	7.1	3	10.7
12. Compression, decompression times equal	Done	27	96.4	27	96.4
	Not done	1	3.6	1	3.6
13. Continue breathing once every 5-6 seconds or at 10-12 breaths/min	Done	28	100.0	28	100.0
14. Pinching the nose, extending the head and giving 2 breaths	Done	22	78.6	18	64.3
	Not done	6	21.4	10	35.7
15. Checking the pulse every 2 minutes. If there is no pulse, starting CPR	Done	15	53.6	18	64.3
	Not done	13	46.4	10	35.7
16. Switching on the AED if the AED has arrived at the scene,	Done	26	92.9	25	89.3
	Not done	2	7.1	3	10.7
17. Placing the right paddle under the right clavicle; placing the left paddle 10 cm below the left front axillary line	Done	27	96.4	23	82.1
	Not done	1	3.6	5	17.9
18. Loudly announcing you will be delivering a shock; clearing the surroundings	Done	22	78.6	13	46.4
	Not done	6	21.4	15	53.6
19. Continuing CPR immediately after shock, performing 5 cycles of 30:2 CPR	Done	24	85.7	19	67.9
	Not done	4	14.3	9	32.1
20. If the patient does not have a pulse, continuing with CPR; if there is a pulse, maintaining an appropriate position until the emergency team arrives	Done	24	85.7	26	92.9
	Not done	4	14.3	2	7.1

BLS: Basic life support; CPR: Cardiopulmonary resuscitation; AED: Automatic external defibrillator.

pulse)"(steps 1, 2 & 4) (Table 2). In contrast to the experimental group, all of the control group students had placed the hands correctly for chest compression on the lower half of the sternum to start 30:2 CPR when there was no pulse and respiration, and performed 5 cycles of 30 cardiac massage/2 artificial respiration operations (steps 8 & 9) (Table 2). Experimental group students' achievement percentage was found higher compared to the control group in "Carotid pulse felt within 10 seconds", "Pinching the nose, extending the head and giving 2 breaths", "Requesting AED", "Shoulders over the patient, arms held straight and vertically positioned to precipitate appropriate, strong pressure of at least 2 inches (5 cm) in depth on the chest and avoiding excessively deep pressure" and the use of AED steps. (steps 5, 6, 7, 11, 14, 16-19) (Table 2). It was determined that experimental group students' percentage was higher regarding the steps of "Switching the AEDs on and placing the paddles correctly and loudly announcing they will be delivering the shock; clearing the surroundings" (Table 2). Of the experimental group students, 85.7% continued the CPR immediately after the shock, whilst 67.9% of the control group managed to execute this step correctly.

The scores of BLS application were examined that the mean scores of experimental and control groups are very close to each other. And there is no statistical difference between the total scores of both groups in practice. It was found that students who used computer based game executed the BLS steps quicker than the students who did not use it. But the total application time for these steps was evaluated according to the groups, no statistically significant difference was found between them (Table 3, $p>0.05$).

DISCUSSION

In this study conducted with second-year nursing students taking the first-aid lesson, computer based game training increased their BLS application skills. In the literature, video, sound and high-level simulators were found to be highly effective in developing basic and advanced life support application skills.[11-12,25-30] When the BLS application steps of the students were examined, it was found that the students in the experimental group performed better than the control group. But, it was found that there was no difference statistically between the experimental and control groups' scores and duration regarding BLS. The reason for this situation may be that both groups received BLS training both theoretically and practically before. In a randomised controlled study using experimental and control groups, Attin, Winslow and Smith, investigated nursing students' responses to cardiac arrest and the time they took to initiate chest compressions.[31] Compared to the control group students, participants in the group who had received training in the high-fidelity laboratory had faster response time upon recognition of the deteriorating condition of the individual and began timely application of CPR. Aqel and Ahmad, found in their study that the participants who received high-fidelity simulation training were better overtime in their acquisition and retention of the knowledge and skills of CPR.[25] An experimental randomised controlled study by Tawelbeh and Tubaishat (2014), found that simu-

TABLE 3: Comparison of experimental and control group duration and total score of basic life support steps.

	Experimental group (n=28)		Control group (n=28)	
Difference of groups	**AM+SD**	**Median ± (Minimum-Maximum)**	**AM±SD**	**Median (Minimum-Maximum)**
Total score	52.11±3.87	52.50±(44-60)	51.18±5.30	52.00 (37-58)
Test value	U=375.500			
	p=0.784			
Application time	83.29±19.37	78±(61-137)	115.86±79.60	79.00 (55-292)
Test value	U=372.000			
	p=0.743			

AM: Arithmetic mean; SD: Standard deviation; U: Mann-Whitney U test.

lation was significantly more effective than traditional education for developing the students' knowledge about cardiac life support and boosting their self-confidence.[14] Previous studies have shown that the use of computer aided simulation programs can be an effective method for improving BLS skills among nursing and medical students.[19-21] In our study, in some of the BLS application steps (steps 1, 2, 4-7, 11, 14, 16-19), it was observed that the students in the experimental group performed better than the control group. Compared to the students who were trained using traditional methods, it can be said that the students who received computer based game training are better in the BLS application steps. In the study of Bonnetain et al. using 28 medical students, students given traditional BLS training were compared with those trained with computer-aided simulation. The students who received computer-aided simulation training scored higher than others and stated that the scenarios used in the simulation better prepared them for real situations.[17] Although in our study there were no differences in BLS application scores and duration among students, it was found that students who used 3D MedSim BLS serious game executed the BLS steps quicker than the students who did not use it. Similar results have been obtained in other studies in the literature. In the study of Curtin et al., there were no differences in computer-based simulation scores between teams, but computer based simulation effect to improve pharmacy students' achievement of learning goals and course outcomes.[32] According to the study of Boada et al., nursing students improved their knowledge by using a serious game.[16] On the other hand, there was no difference in CPR skills between both groups. At the same time, the majority of research results determined that computer-aided simulation effected positively on nursing student' knowledge and clinical intervention.[5,18,33]

CONCLUSION

In nursing education, high-fidelity simulation systems aim to allow the students to unify the knowledge with skill, learn by doing, repeat until achieving the correct application and most importantly, minimize incorrect interventions in clinical applications. Students will provide a more efficient health service with the experiences they gained from the realistically conducted applications in their professional life. For developing the skills of the nurse who would be the first to give the patient medical attention particularly in vital interventions such as CPR, computer-aided simulation methods in training are quite important. Thus, the results of the study support the continued use of simulation in nursing education for risky applications such as BLS. At the same time, it is suggested that computer based games are convenient for nursing education and should be applied in other nursing skills as well and more studies should be conducted on this topic.

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Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: *Ayşe Demiray, Selin Keskin Kızıltepe;* ***Design:*** *Ayşe Demiray, Selin Keskin Kızıltepe;* ***Control/Supervision:*** *Ayşe Demiray;* ***Data Collection and/or Processing:*** *Ayşe Demiray, Selin Keskin Kızıltepe;* ***Analysis and/or Interpretation:*** *Selin Keskin Kızıltepe, Ayşe Demiray;* ***Literature Review:*** *Selin Keskin Kızıltepe, Ayşe Demiray;* ***Writing the Article:*** *Selin Keskin Kızıltepe, Ayşe Demiray;* ***Critical Review:*** *Ayşe Demiray, Selin Keskin Kızıltepe;* ***References and Fundings:*** *Ayşe Demiray, Selin Keskin Kızıltepe;* ***Materials:*** *Ayşe Demiray, Selin Keskin Kızıltepe.*

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