ORIGINAL RESEARCH

The Effectiveness of Different E-Learning Modalities in Enhancing Neonatal Cardiopulmonary Resuscitation: Principles, Knowledge, and Communication Skills of Undergraduate Paramedic Students

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Abbreviations:
AHA: American Heart Association
ALS: Advanced Life Support
ES: effect size
MCQ: multiple-choice question
N-CPR: neonatal cardiopulmonary resuscitation
OPE: observational performance evaluation
SBE: simulation-based education
SP-G: slide presentation group
V-G: video group

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Abstract

Introduction: Paramedic students should have the crucial cognitive and psychomotor skills related to neonatal cardiopulmonary resuscitation (N-CPR).

Study Objective: The aim of this study was to evaluate the effect of blended learning on the theoretical knowledge and preliminary knowledge of the psychomotor skills, adherence to the algorithm, and teamwork in simulation-based education (SBE) of N-CPR.

Methods: This randomized, prospective study was conducted on 60 fourth-semester paramedic students. The participants were separated into two groups following a classroom lecture. Each group was assigned either a slide presentation (Group 1; SP-G) or a video clip (Group 2; V-G). All the participants answered multiple-choice questions (MCQs) and each group (Group 1 and Group 2) was divided into 10 sub-groups. These sub-groups were then tested in an observational performance evaluation (OPE) consisting of a neonatal asphyxia megacode scenario, after the classroom lecture and following the blended learning process.

Results: Group performance, teamwork, communication skills, and adherence to the algorithm were evaluated. There was a significant difference in the MCQ and OPE results between the after classroom lecture and after blended learning for both groups. The average score of Group 2 was higher than Group 1 in the MCQ results (Mann-Whitney U test; P <.001). The average score of Group 2 was higher than Group 1 in the OPE results (Mann-Whitney U test; P = .002).

Conclusion: Blended learning, especially video clips, in adjunction with the classroom lecture were effective in acquiring and developing both technical and non-technical skills among paramedic students in SBE of N-CPR training.

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Introduction

Neonatal cardiopulmonary resuscitation (N-CPR) is a low-frequency but high-acuity critical procedure, which makes it challenging for paramedics to learn. Paramedics, who could be responsible to help with giving birth in emergencies, albeit in rare situations, should have both the technical skills and the non-technical skills related to the N-CPR requirement caused by asphyxia. According to the American Heart Association (AHA; Dallas, Texas USA) Guidelines, updated in 2020, at least one person who can start the initial steps of N-CPR should be present at every birth.[1] The inadequacies in both technical and non-technical skills (eg, communication, situation awareness, decision making, and teamwork) could lead to fatal errors and poor patient outcomes.[2,3] For this reason, paramedics need to be well-trained and possess enhanced non-technical skills through clinical education such as blended learning and simulation-based education (SBE).

Clinical education is complex and requires a versatile approach to meet the needs of students. Deliberate practices such as classroom lecturing, problem-based education, discussion, and SBE could be combined with the online learning tools to create or develop effective comprehensive strategies that contain a variety of learning styles. Deliberate practice in SBE is shown to improve educational outcomes of performance and resuscitation skills compared to traditional clinical education.[4]

The blended learning was shown to facilitate the learning of the procedural, communicational, decision-making skills, and adherence to the algorithm at the cognitive level. It enables the flexible participation of the learner, meanwhile saving time and labor costs.[5–7] Blended learning, which combines the advantages of traditional face-to-face learning with asynchronous or synchronous e-learning, is widely used in today's education.[8] Blended learning provides benefits over using a single learning method.[9] Additionally, the integration of online education into the curriculum has been shown to overcome time and space constraints, support teaching outcomes that are difficult to achieve by using textbooks solely, and reach more students without increasing their need for resources.[10] However, the content of educational materials used in blended learning varies based on the original structure of the education. When the information provided is complex (ie, when a person must learn several steps), the "intrinsic load" becomes high. In these cases, a teaching design that has an impact on the "extraneous load and germane load" is important for the learning process to be effective and efficient. Therefore, when planning a blended learning program, it is important to design the training material by considering the cognitive load in order to ensure effectiveness and efficiency.[11–13]

Based on the real-world scenarios, SBE creates a setting where cognitive, psychomotor, and effective learning is synthesized. This way, new knowledge and skills are applied into clinical practice and have an overall impact on minimizing errors. One example of this on reducing neonatal mortality is discussed in the works of Mduma, et al.[14] In addition, the education of the paramedic students with simulation-based training to achieve proficiency in both technical and non-technical skills carries high importance to minimize these errors and to ensure patient safety.[2,3,15–17]

The main aim of this study was to evaluate the effect of blended learning on the theoretical knowledge and familiarity with psychomotor skills, adherence to the algorithm, and teamwork in SBE of N-CPR. The secondary aim was to compare the blended learning materials: the slide presentation that appeals to the visual perception and the video clip which appeals to both auditory and visual perception.

Methods

Selection and Description of Participants

This randomized, prospective study was conducted in the Acibadem Mehmet Ali Aydinlar University Vocational School of Health Services First and Emergency Aid Program (Istanbul, Turkey), which is a paramedic school. The ethical approval for the study was obtained from the same university's Medical Research Assessment Committee (ATADEK) with the decision number: 2019-14/64.

All fourth-semester paramedic students were informed about and invited to the study (n = 67). No exclusion criteria were present. Consent was obtained from those who agreed to participate (n = 60). The participating students had already received Basic Life Support training with the SBE technique for all age groups (neonate, infant, child, and adult) at the end of their second semester as a requirement of the curriculum. The participants were informed that the results would not be graded. Twenty-six (43%) of the participants were female and 34 (57%) were male. The number of participants between the age group 18-20 years was 37 (62%), 21-23 years was 21 (35%), and older than 24 years was two (3%).

Technical Information

Two hypotheses were investigated throughout the study. These hypotheses were as follows:

1. The combined use of traditional learning and e-learning is more effective than traditional learning alone in N-CPR education. Regarding this hypothesis, the study investigated the relationship between the levels of theoretical knowledge (the classroom lecturing versus the blended learning) measured by the multiple-choice questions (MCQs) and the levels of psychomotor skills, adherence to the algorithm, and communication skills through observational performance evaluation (OPE) between Group 1 and Group 2.
2. Video clip modality that appeals to the visual and auditory perception in blended learning is superior to the slide presentation modality which appeals only to the visual perception. Regarding this hypothesis, the study explored the relationship between the levels of theoretical knowledge of both learning methods through MCQs and the levels of psychomotor skills, adherence to the algorithm, and communication skills through OPE between Group 1 and Group 2.

Study Design

A 45-minute classroom lecture about the N-CPR algorithm, prepared according to the updated 2018 AHA Guideline, was given to the participants by an instructor. The participants were randomly separated using a uniform pseudorandom number generator available in MATLAB software (MathWorks; Natick, Massachusetts USA) into two groups 10 days after the classroom lecture (Group 1 and Group 2). A test comprising of MCQs was assigned to the participants after the classroom lecture. Ten sub-groups, consisting of three people each, were randomly divided with the previous randomization method into two groups (Table 1). Each sub-group participated in an eight-minute neonatal asphyxia megacode scenario on the same day. High fidelity and high emotion Preterm Simulator Paul (SIMCharacters GmbH; Vienna, Austria), which indicates the compression and ventilation efficiency, was used in the scenarios. The simulated neonatal megacode scenario performance of each sub-group was recorded. Feedback was given to students after this. A performance checklist was created by the neonatal resuscitation program instructor. Thirty-four items of the 35-step N-CPR performance evaluation checklist were developed based on the updated AHA 2018 Guideline for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Steps. The evaluation of the communication skills with a closed-loop system was added to the checklist as the 35th step. The sub-group performances were monitored by two independent instructors and evaluated based on the performance checklist. The correlation coefficient

Groups	Participants	Sub-Groups
SP-G (Group 1)	30	10
V-G (Group 2)	30	10
Total	60	20

Table 1. Study Groups and Sub-Groups of the Participants
Abbreviations: SP-G, Slide Presentation Group; V-G, Video Clip Group.

among the instructors was 0.85. The evaluation of the ventilation and compressions was done on a three-point scale based on the feedback of the simulator during the application (Successful [100 points] – 76%-100% errorless and effective application; Partially successful [50 points] – 51%-75% errorless application; Unsuccessful [0 points] – 0%-50% erroneous application and step-missing]. The e-learning materials of the groups (Group 1: slide presentation group [SP-G] and Group 2: video clip group [V-G]) were determined randomly using the previous method (Table 1).

One week following the determination of the e-learning materials of the sub-groups, e-learning access comprising of a presentation consisting of 25 slides with pictures about the conceptual/procedural information, and team dynamics based on the updated AHA Neonatal Advanced Life Support (ALS) Guidelines 2018, was made available to Group 1 (SP-G) for three days. A six-minute video clip containing practical demonstrations about the conceptual/procedural information, and team dynamics based on the updated AHA Neonatal ALS Guidelines 2018, was made available via e-learning to Group 2 (V-G) simultaneously at the same timeframe. The contents of the training materials were identical.

Following three days of access, on the fourth day, students were invited to the simulation laboratory. The number of the students who studied the material was retrieved from the e-learning system. A test containing MCQs was applied to all students after blended learning. The scenario sub-groups formed in the beginning were preserved. Each sub-group participated again in the simulated neonatal asphyxia megacode scenario and the performances were recorded. The simulator was used again in the scenarios. The students were then given feedback on their errors to enhance the complete learning process. The video recordings of the sub-groups were viewed by two independent instructors, and the students' procedural skills, performance levels, adherence to the algorithm, task distribution, communication, and decision-making skills were scored using the same 35-step checklist. The correlation coefficient among the instructors was 0.83. The scorings outside of the correlation coefficient were singularized by calculating the mean score. Individual scores were based on the answers to the MCQs and the sub-group performance OPE score was based on the scenarios.

Statistics

Descriptive statistics were presented using the mean and the standard deviation scale variables. T-test was used for the comparison of two normally distributed independent groups. Non-parametric statistical methods were used for the values with skewed distribution. Mann-Whitney U test was used to compare two non-normally distributed independent groups.

Non-parametric statistical methods were used for values with skewed distribution. Wilcoxon signed-rank test was used to compare two non-normally distributed dependent groups. Statistical significance was determined when the two-sided P value was lower than .05.

The statistical analysis was performed using the MedCalc Statistical Software version 12.7.7 (MedCalc Software bvba; Ostend, Belgium). The post-hoc power analysis was performed with the ClinCalc online post-hoc power calculator (ClinCalc LLC; North Chicago, Illinois USA).

Results

The post-hoc power analysis for the collected data was performed with 5% Type 1 error. The calculated power for the after blended learning MCQs and OPE was found as 100.0% and 82.7% between the SP-G and V-G, respectively. This analysis showed that the sample size was reliable for this study and there was a significant difference between the after classroom lecture and after blended learning for both groups in terms of MCQ results (Table 2). The average of the results on the MCQs after blended learning was higher than the results on the MCQs after classroom lecture for both groups (Wilcoxon signed-rank test; $P < .05$). There was a significant difference between the results of the groups after blended learning ($P < .001$). The average of the V-G was higher (Mann-Whitney U test; $P < .05$). The effect size (ES) was calculated as very large (Cohen's $d > 1$).

There was a significant difference between the after classroom lecture and the after blended learning OPE performances for both groups (Table 3). The average of the after blended learning OPE performances was higher than the after classroom lecture OPE performances (Wilcoxon signed-rank test; $P < .05$). There was a significant difference between the groups in terms of after blended learning OPE performance ($P = .002$). The average of the V-G was higher (Mann-Whitney U test; $P < .05$). The ES was calculated as large (Cohen's $d > 0.50$).

In general, the average scores increased in both groups after blended learning (Table 4). There was a significant improvement in steps 34 and 35 in favor of the V-G group (Group 2) when the checklist steps were analyzed (Student's t-test; $P < .05$). The improvement in steps 5, 7, 12, 14, 16, 17, 18, 19, 23, 26, 27, 30, 32, 33, 34, and 35 in the V-G group (Group 2) was more significant compared to the SP-G (Group 1) when the checklist steps were analyzed in terms of ES. The ESs calculated were between 0.30-1.191 (Cohen's d).

There was no significant difference between these groups in terms of the number of times the learning materials were studied (Table 5; Mann-Whitney U test; $P > .05$).

Discussion

A statistically significant improvement was detected in the theoretical knowledge and performance levels of both groups when the average scores based on MCQs and OPEs, that were performed after the classroom lecture and e-learning, were compared ($P < .05$). The results support that blended learning was more effective. It was suggested that the use of the blended approach helps students to overcome the gap between theoretical knowledge and practice in clinical scenarios.[18,19] It was found in a study on medical students that blended learning (both electronic and face-to-face) provided statistically significant and better results on different types of examinations (written, OPE, and case scenarios) than traditional learning.[20] Rowe, et al concluded that blended learning has the potential to increase the development of a series of clinical competencies among health care students.[21]

Group	After Classroom Lecture		After Blended Learning			
	Mean	95% CI	Mean	95% CI	P[c]	Cohen's *d*
SP-G	63.2	59.7-66.7	69.5	66.3-72.7	.004	0.750
V-G	58.7	55.2-62.2	80	77.8-82.2	<.001	2.756
P	.056[b]		<.001[a]			
ES	0.503		1.482			

Table 2. The Multiple-Choice Question Results of the Groups and their Comparison According to the Measurements
Abbreviations: SP-G, Slide Presentation Group; V-G, Video Clip Group; ES, Effect Size.
[a] Mann-Whitney U test.
[b] Student's t-test.
[c] Wilcoxon signed-rank test.

Group	After Classroom Lecture		After Blended Learning			
	Mean	95% CI	Mean	95% CI	P[b]	Cohen's *d*
SP-G	79.3	74.9-83.6	86.7	83.1-90.3	<.001	0.748
V-G	83.3	79.8-86.4	92.3	90.1-94.5	<.001	1.234
P[a]	.104		.002			
ES	0.052		0.749			

Table 3. The Observational Performance Evaluation Results of the Groups and Comparisons According to the Measurements
Abbreviations: SP-G, Slide Presentation Group; V-G, Video Clip Group; ES, Effect Size.
[a] Mann-Whitney U test.
[b] Wilcoxon signed-rank test.

Sub-Group	SP-G		V-G		
	Mean	95% CI	Mean	95% CI	P
1	1.33	(1.12-1.54)	0.67	(0.46-0.88)	.400
2	1.33	(1.12-1.54)	1.67	(1.46-1.88)	.700
3	0	– constant	2	(1.64-2.36)	.100
4	0.67	(0.46-0.88)	1.67	(1.46-1.88)	.200
5	1	(0.5-1.5)	3.33	(2.78-3.88)	.200
6	0	– constant	2.33	(2.12-2.54)	.100
7	2	– constant	2	(1.64-2.36)	1.00
8	1	- constant	1.5	(1.25-1.75)	.667
9	1.33	(1.12-1.54)	2.33	(1.92-2.74)	.400
10	0.64	(0.44-0.84)	2.33	(2.12-2.54)	.100

Table 5. The Number of Times the Video Clip and the Slide Presentation were Studied According to the Sub-Groups (Mann-Whitney U test)
Abbreviations: SP-G, Slide Presentation Group; V-G, Video Clip Group.

The comparison between the two learning modalities after classroom lecture learning, SP-G and V-G, showed that the success of the V-G was higher in the OPE, whereas SP-G results were higher in MCQs. These results were not statistically significant (P = .104 and P = .056 in OPE and MCQ, respectively). The comparison between the two learning modalities after blended learning, V-G and SP-G, showed that the success of the V-G was statistically higher in the MCQs and OPEs (P <.05; CI 77.8-82.2; Cohen's *d* >1; and P < .05; CI 90.1-94.5; Cohen's *d* = 0.749, respectively). In other words, the V-G was more skillful and had obtained more information. This result was in line with the literature on the acquisition of clinical skills by video clip training materials. Cardoso, et al observed that the cognitive and technical competence required to achieve quality nursing care was developed more after the video clip was watched.[22] Forbes, et al found that the video clip was equal to or more effective than the traditional clinical face-to-face learning for advanced clinical skills when used as teaching material.[23] They also stated that the use of video clips is effective in terms of skill acquisition and student satisfaction.

High school students were presented with visual/visual and audio/visual content, and it was shown that the audio/visual content was more effective than the visual/visual content.[24] The visual

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and verbal components of video-based learning facilitate the learning process and lead to better comprehension according to the dual-channel theory.[25]

In the OPEs which were done after the blended learning, the scores of both groups increased, and this increase was higher in the V-G. The increase could be observed in Table 4; although the evaluation time (Step 32) and evaluation criteria (Step 33) were not statistically significant in the critical decision-making skills, they were significant in terms of ESs (Steps 12, 16, 17, and 19). There was a statistically significant difference between the two groups in the application of the correct concentration of oxygen support (Step 34: P <.05) and communication skills (Step 35: P <.001) in favor of the V-G. The reason for the lack of statistical difference between the groups in the preparation for resuscitation steps (Steps 1, 2, and 3: P >.05) might be that the paramedic students obtain theoretical and practical knowledge, teamwork skills, case preparation, case-related skills training, and practice these skills in six-hour-long simulation case scenarios each week. It could be stated that the increase in the number of practices increases the probability of developing an attitude about the topic at hand.

The fact that students who participated in the study had already completed the neonatal psychomotor skills training, as required by the curriculum, might explain the absence of a statistically significant difference in the ventilation and effective compression skills. However, when considered in terms of ES, there was a significant difference in favor of the V-G in the location of cardiac compression, depth, and ventilation technique (Cohen's d >0.70). These results could be explained by the fact that the dynamic video training materials create a better internal representation than the static images in the acquisition of procedural skills and cause the development of certain parts of the working memory during the learning process by imitation of the video clips.[23,26]

Both groups were provided access to educational materials equally in the study. There was no statistically significant difference between the groups in terms of how many times the learning material was studied. Therefore, it could be stated that this variable does not affect scores.

Limitations

Both MCQs and OPEs were not performed before the classroom lecture, which if performed, the extent of pre-existing knowledge and skills would be affected. The academic success levels of both groups at the end of the lecture and the accuracy level of the pre-existing knowledge gained could have been determined. The number of sub-groups was low. The ES of each parameter was calculated to prevent the number of sub-groups from compromising the strength of the research. The number of times the learning materials were studied was low in the study. In order to determine the threshold of the number of times the materials were studied, to achieve the optimal level of competency, more studies are needed. Lastly, the feedback was not received from the students and the learning strategy could not be evaluated from the students' perspective.

Conclusions

The use of the blended learning method with video clips appears to be an expedient, widely used, and promising educational strategy that could increase the quality of clinical skills under the circumstances of this era. The results demonstrated that blended learning, especially video clips, was effective in acquiring and developing both technical and non-technical skills at a cognitive level among paramedic students in the N-CPR training. The results of the study could be used as a foundation for the SBE-using academic community to determine the blended learning strategy for the preliminary material in the simulation-based N-CPR training programs.

Author Contributions

Serpil Yaylaci: Conceptualization, Data curation, Project administration, Investigation, Resources, Visualization, Writing – original draft preparation, Writing – review and editing. Feray Guven: Conceptualization, Methodology, Data curation, Project administration, Investigation, Supervision, Writing – original draft preparation, Writing – review and editing.

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Steps		After Classroom Lecture						After Blended Learning					
		Group 1		Group 2			Cohen's *d*	SP-G (Group 1)		V-G (Group 2)			Cohen's *d*
		Mean	95% CI	Mean	95% CI	P	ES	Mean	95% CI	Mean	95% CI	P	ES
1	Asked questions to dispatch to assess the perinatal risks	55	(44.98-65.02)	55	(37.11-72.89)	1.000	0.0	85	(71.76-98.24)	90	(82.46-97.54)	.522	0.166
2	Prepared and checked the equipment and supplies to ensure immediate access to the pulse oximeter, 3-lead ECG, cardiac monitor, self-inflating bag, appropriate masks, suction catheter, dry warmth towels, epinephrine, and normal saline	100	– (constant)	100	– (constant)	–	0.0	100	– (constant)	100	(100-100)	–	0.0
3	Determined the leader, clarified the roles and responsibilities, delegated tasks, identified team members	100	– (constant)	100	– (constant)	–	0.0	100	– (constant)	100	(100-100)	–	0.0
4	Asked the three questions to rapidly assess the need for resuscitation: Gestation age, good tone, breathing or crying?	65	(56.41-73.59)	25	(9.97-40.03)	.017	1.169	100	– (constant)	100	(100-100)	–	0.0
5	Provided warmth	60	(41.39-78.61)	80	(64.97-95.03)	.357	0.423	96	(90.99-101.01)	100	– (constant)	.378	0.404
6	Positioned the head and neck	45	(27.11-62.89)	100	– (constant)	<.001	1.555	96	(90.99-101.01)	90	(82.46-97.54)	.463	0.039
7	Checked the mouth then the nose, and if necessary, suctioned the mouth then the nose	45	(27.11-62.89)	80	(64.97-95.03)	.107	0.758	85	(73.55-96.45)	100	– (constant)	.156	0.663
8	Dried the baby to protect against hypothermia and to give tactile stimulation for respiration	55	(44.98-65.02)	55	(37.11-72.89)	1.000	0.0	85	(71.4-98.6)	90	(82.49-97.51)	.720	0.163
9	Dried the baby and removed the wet towels from the environment	90	(78.55-101.45)	30	(12.82-47.18)	.004	1.471	100	– (constant)	95	(89.34-100.66)	.330	0.004
10	Assessed the baby's breathing	75	(65.7-84.3)	95	(89.27-100.73)	.053	0.926	96	(90.99-101.01)	95	(89.34-100.66)	.882	0.001

Table 4. Distributions of the Performance Checklist Steps and their Comparison Between the Groups (Student's t-test) *(continued)*

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11	Applied tactile stimulus with the right technique to the baby without spontaneous respiration	55	(37.11-72.89)	65	(49.97-80.03)	.634	0.217	77	(63.04-90.96)	95	(89.34-100.66)	.193	0.016
12	Assessed the respiratory effort (apneic) started PPV	100	– (constant)	90	(82.49-97.51)	.149	0.673	96	(90.99-101.01)	100	– (constant)	.378	0.404
13	Applied PPV with room air for 15 seconds	60	(41.39-78.61)	100	– (constant)	.025	1.088	77	(61.25-92.75)	95	(89.34-100.66)	.239	0.016
14	Applied the pulse oximeter to monitor the HR and SpO_2, and the 3-lead ECG correctly (oximeter probe: right hand/wrist)	100	- (constant)	100	- (constant)	–	0.0	96	(90.99-101.01)	100	- (constant)	.378	0.404
15	Assessed the vitals (HR: 70/min, SpO_2: 65%), checked the chest movements, and provided continuous PPV with room air, if necessary, applied ventilation corrective steps	80	(70.7-89.3)	80	(70.7-89.3)	–	0.0	92	(85.2-98.8)	75	(62.35-87.65)	.197	0.007
16	Assessed the vitals (HR: 65/min, SpO_2: 65%), checked the chest movements, and provided continuous PPV	100	– (constant)	90	(82.49-97.51)	.149	0.673	85	(73.55-96.45)	100	- (constant)	.156	0.663
17	Assessed the vitals (HR: 50/min, SpO_2: 65%), started chest compressions in coordination with 100% O_2-assisted ventilation	100	– (constant)	95	(89.27-100.73)	.336	0.442	81	(69.19-92.81)	90	(82.46-97.54)	.477	0.325
18	Assessed the vitals (HR: 40/min, SpO_2: 65%) and checked the chest movements	65	(56.41-73.59)	70	(54.97-85.03)	.747	0.146	46	(27.03-64.97)	70	(54.97-85.03)	.276	0.502
19	Applied epinephrine	100	– (constant)	85	(72.83-97.17)	.019	0.624	85	(76.41-93.59)	95	(89.34-100.66)	.062	0.490
20	Gave the correct dose and concentration of the epinephrine solution	85	(76.41-93.59)	75	(59.97-90.03)	.522	0.292	85	(73.55-96.45)	85	(76.41-93.59)	1.000	0.0
21	Completed the initial steps at the right time	75	(65.7-84.3)	70	(60.7-79.3)	.672	0.192	92	(85.2-98.8)	95	(89.34-100.66)	.706	0.172

Table 4. Distributions of the Performance Checklist Steps and their Comparison Between the Groups (Student's t-test) *(continued)*

Steps		After Classroom Lecture						After Blended Learning					
		Group 1		Group 2			Cohen's *d*	SP-G (Group 1)		V-G (Group 2)			Cohen's *d*
		Mean	95% CI	Mean	95% CI	P	ES	Mean	95% CI	Mean	95% CI	P	ES
	Ventilation												
22	Used the self-inflating bag with the correct size mask	100	– (constant)	100	– (constant)	–	0.0	96	(90.99-101.01)	95	(89.34-100.66)	.883	0.066
23	Provided effective ventilation with the right technique	90	(82.49-97.51)	80	(70.7-89.3)	.356	0.423	73	(63.7-82.3)	90	(82.46-97.54)	.126	0.718
24	Applied the ventilation in the correct frequency	55	(47.13-62.87)	75	(65.7-84.3)	.079	0.830	88	(80.13-95.87)	80	(70.76-89.24)	.465	0.333
	Cardiac Compression												
25	Used the two-thumb technique correctly	100	– (constant)	100	– (constant)	–	0.0	100	– (constant)	100	– (constant)	–	0.0
26	Applied compressions on the correct area	100	– (constant)	95	(89.27-100.73)	.336	0.442	81	(69.19-92.81)	100	– (constant)	.085	0.814
27	Applied effective pressure in chest compressions	95	(89.27-100.73)	90	(82.49-97.51)	.557	0.268	73	(57.25-88.75)	100	– (constant)	.068	0.868
28	Applied the correct ratio of compression to ventilation	100	– (constant)	95	(89.27-100.73)	.336	0.442	100	– (constant)	95	(89.63-100.37)	.330	0.447
29	Applied continuous chest compressions for 60 seconds at the beginning of the resuscitation	80	(70.7-89.3)	90	(82.49-97.51)	.357	0.423	92	(85.2-98.8)	90	(82.46-97.54)	.826	0.001
30	Successfully increased the oxygen concentration to 100%	85	(76.41-93.59)	85	(72.83-97.17)	1.000	0.0	96	(90.99-101.01)	100	– (constant)	.378	0.404
31	Completed the initial steps at the right time	75	(65.7-84.3)	70	(60.7-79.3)	.672	0.192	92	(85.2-98.8)	95	(89.34-100.66)	.706	0.172
32	Reassessed the baby in correct frequencies during the resuscitation process (every 30 seconds)	80	(70.7-89.3)	80	(70.7-89.3)	–	0.0	73	(61.19-84.81)	95	(89.27-100.73)	.074	0.848
33	Applied the correct order of the evaluation criteria (HR, SpO_2, Breathing)	80	(70.7-89.3)	85	(76.41-93.59)	.660	0.200	85	(76.41-93.59)	95	(89.34-100.66)	.286	0.492

Table 4. Distributions of the Performance Checklist Steps and their Comparison Between the Groups (Student's t-test) *(continued)*

34	Administered PPV and successfully raised the oxygen concentration according to the target oxygen saturation	25	(9.61-40.39)	75	(59.97-90.03)	.017	1.176	58	(43.33-72.67)	95	(89.34-100.66)	.016	1.191
35	Communication skills	70	(54.97-85.03)	75	(62.48-87.52)	.776	0.129	69	(53.25-84.75)	95	(89.27-100.73)	<.001	0.785

Table 4. *(continued).* Distributions of the Performance Checklist Steps and their Comparison Between the Groups (Student's t-test)
Abbreviations: ES, Effect Size; SP-G, Slide Presentation Group; V-G, Video Clip Group; ECG, Electrocardiogram; PPV, Positive Pressure Ventilation; HR, Heart Rate; SpO_2, Peripheral Capillary Oxygen Saturation.