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ORIGINAL ARTICLE / ARAŞTIRMA YAZISI

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Effectiveness of Simulation-Based Cooperative Learning Method in Electrocardiography Education

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ABSTRACT

Objective: The study was conducted to evaluate the effectiveness of basic electrocardiography education designed in accordance with the simulation-based cooperative learning method.

Methods: This is a single group, quasi-experimental study. A two-day electrocardiography (ECG) education program was designed for the nursing internship (4th year) program (n=125). Data were gathered with pre-posttest, Students' Satisfaction and Self-Confidence Scale, Simulation Design Scale and Educational Practices Questionnaire.

Results: The knowledge pretest score and the knowledge posttest score averages of the students were 40.36±20.24 and 75.39±11.46 respectively, with a significant difference (p=.001; t=-14.78). The mean score for satisfaction with current learning was 4.77±.42 and the mean score for self-confidence was 4.51±.54. The mean total score for Simulation Design Scale was 4.44±.67 and the mean total score for Educational Practices Questionnaire was 4.66±.56.

Conclusion: After simulation-based cooperative learning method, knowledge and skills of the students improved also had high self-confidence and satisfaction with learning.

Keywords: Electrocardiography, simulation-based experience, cooperative learning, nursing education

Simülasyona Dayalı İşbirlikçi Öğrenme Modeline Göre Tasarlanan Temel EKG Kursu'nun Etkinliği

ÖZET

Amaç: Bu çalışma, Simülasyona Dayalı İşbirlikçi Öğrenme Modeli'ne göre tasarlanan Temel Elektrokardiyografi (EKG) Kursu'nun etkinliğini değerlendirmek amacıyla yapılmıştır.

Yöntem: Tek gruplu, yarı deneysel bir çalışmadır. Hemşirelik intörn öğrencilerine (4. sınıf) 2 günlük EKG eğitim programı tasarlandı (n=125). Veriler ön-son test bilgi formu, Öğrencilerin Memnuniyet ve Öz-Güven Ölçeği, Simülasyon Tasarımı Ölçeği ve Eğitim Uygulamaları Anketi ile toplanmıştır.

Bulgular: Öğrencilerin kurs öncesi bilgi puan ortalamaları 40.36±20.24, kurs sonrası puan ortalamaları 75.39±11.46 olup istatistiksel olarak anlamlı bulundu (p=.001; t=-14.78). Öğrenmede öğrenci memnuniyet puan ortalamaları 4.77±.42, özgüven puan ortalamaları ise 4.51±.54'dür. Simulasyon tasarımı toplam puan ortalamaları 4.44±.67, Eğitim Uygulamaları toplam puan ortalamaları 4.66±.56'dır.

Sonuç: Simülasyona Dayalı İşbirlikçi öğrenme modelinde kurs sonrası öğrencilerin bilgi ve beceri düzeylerini geliştirmiş ayrıca öğrenmede öğrenci memnuniyetleri ve özgüvenleri yükselmiştir.

Anahtar Kelimeler: Elektrokardiyografi, simülasyona dayalı öğrenme, işbirlikçi öğrenme, hemşirelik eğitimi

Cardiovascular diseases are the leading cause of death in Turkey and other countries; thus, treatment, care, and follow-up of patients with these conditions are important (1). Patients frequently arrive at emergency and intensive care units with cardiovascular diseases and receive critical care. In order for nurses to be able to maintain high-quality and effective care in these units, they are expected to be equipped with sufficient knowledge and skills about patients for whom they provide care (2, 3).

Emergency and intensive care nurses should be able to recognize sudden changes in patients earlier as well as implement appropriate interventions as quickly as possible. They should have adequate knowledge and skills to read monitors, perform ECG, interpret rhythms, and initiate interventions independently. As technology develops, it is also important that they use medical devices correctly (4).

Nurses having sufficient knowledge about the aforementioned skills; can carry out early and effective interventions, and save patients' lives. However, it has been reported in the literature that emergency and intensive care nurses do not have a sufficient level of knowledge about emergency ECG signs and interventions (5, 6). Several studies have shown that most nurses working in critical fields do not receive education about ECG, and that those that do receive education are not competent enough to evaluate ECG recordings and to design/start appropriate interventions (6). It is crucial to enhance nurses' knowledge so that they can offer more effective care and make fewer mistakes. It is recommended that nurses who actively perform and interpret ECG should be given experiential education about ECG at regular intervals (7-9). It has been noted in the literature that education based on a model and supported by different teaching methods like simulation helps nurses to improve their skills in recognizing the rhythms (8, 10).

Cooperative learning is one learning method in which students play active roles and work in groups of two or more to achieve the same goal (11, 12). It improves students' thinking and communication skills, encourages them to think critically, allows them to express their opinions throughout the learning process, and helps them to take responsibility for their learning. It creates an effective learning environment where students do not consider teachers as the only source of knowledge (12). Cooperative learning facilitates students' cooperation with each other in the learning process, and is thought to be achieved through simulation-based education when enhancing clinical skills in nursing.

Simulation is increasingly used in education, being rapidly integrated into curricula (13, 14). High-fidelity simulation is a simulation method that utilizes real mannequins, which are able to react to physiological results of diseases and injuries, treatments, and interventions (15). In simulation-based education, high-fidelity mannequins are most frequently used. In a systematic review of types of education using these mannequins, simulation-based education has been reported to be effective in recognizing changes in patients and in acquiring knowledge and skills (16).

This study was conducted to evaluate the effectiveness of basic ECG education designed in accordance with the simulation-based cooperative learning method.

METHODS

This single-group, quasi-experimental study with pre- and post-tests was performed with nursing internship (4th year) program at a university in Turkey. The study population comprised of final year nursing students at a nursing school in 2017 (n=125). Sixty-six students volunteered to participate in the study and took the Emergency Care and Intensive Care Nursing courses in Specific Fields. However, data from eleven students who did not take the pre and post-knowledge tests were not included in the analysis. Of all the participants, 18.1% (n=10) were male and 81.9% (n=45) were female. All the students were informed about the study before taking basic ECG education.

Data Collection Tools: Data were gathered via pre and post-knowledge of ECG tests, Students' Satisfaction and Self-Confidence Scale (SCLS), Simulation Design Scale (SDS), and Educational Practices Questionnaire (EPQ). The pre- and post-tests were prepared by the researchers and were composed of ten questions measuring knowledge of ECG. One question of the test is presented in that SCLS, SDS, and EPQ are used to evaluate the effectiveness of simulation-based education (17, 18). They were developed by Jeffries in 2012, and their psychometric measurements were established by Franklin in 2014 (18, 19). Their validity and reliability for the Turkish population were tested by Unver et al. in 2017 (20).

Procedure: Within the framework of the Emergency Care and Intensive Care Nursing courses in Specific Fields, a two-day ECG education program was designed. It

involved an eight-hour theoretical class and an eight-hour simulation class, which together lasted two days. On the first day, the students were offered theoretical knowledge through the conventional teaching method based on the goals of the education program, and they were provided with the content material. On the second day, the simulation was conducted in three steps.

First, the students applied skill training. Second, they were divided into groups and they interpreted ECGs in the cases given to them. Last, they took a knowledge quiz (Table 1). To evaluate the effectiveness of the education, the students were administered the pre-test involving questions about knowledge of ECG rhythms before the theoretical class, as well as the post-test involving the same questions after the simulation class.

Table 1: Content of Education – Simulation Center

Step 1: I perform ECG correctly

Applied Skill Training

The students monitored the mannequins, read and interpreted ECG values and placed ECG leads under the supervision of a trainer.

Step 2: Workshop

Case Study

The students were divided into seven groups, each having three students. Target nine ECG rhythms were printed out. Images of each rhythm were given to the students in order and the students were asked to record the information about the rhythms asked in the ECG interpretation form. They were encouraged to discuss their interpretations in their groups and they were given 10 minutes to interpret each rhythm.

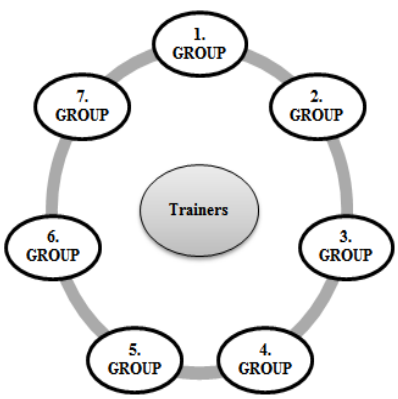
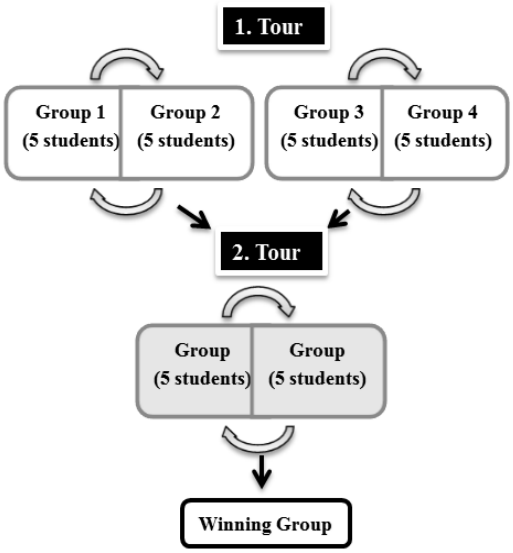
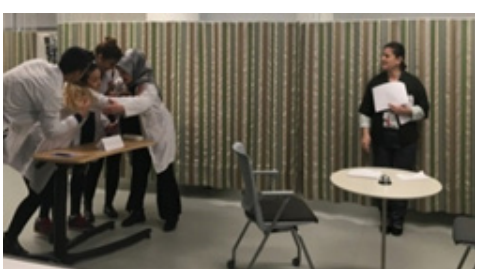


Table 1: Content of Education – Simulation Center

Step 3: ECG Quiz





The students were randomly assigned into groups and each group included five students. In the first round, the groups were matched in pairs and they competed against each other. The winners got the right to join the quiz in the second round. The group winning the competition in the second round was rewarded.

Rules of the Quiz:

- The group members are seated and one member gets ready to ring the bell every time a question is asked.
- The member wanting to answer a question rings the bell and gives his/her answer.
- If he/she gives the correct answer, he/she gets points. After that, another member gets ready to answer the next question.
- If he/she gives a wrong answer, the rival team gets the right to answer the question. If a member of the rival group gives the correct answer, that groups gets points.
- If both groups give a wrong answer, they discuss the question. Whichever group rings the bell first gets the right to answer the question.
- In each round, the group providing the highest number of correct answers passes that round. If there is a draw, one more question is asked and the group answering that question first wins.

Statistical Analysis

Data were analyzed with the Statistical Package for Social Sciences (SPSS, Inc., Chicago, IL, USA) for Windows version 21.0. The normality of data was tested with the Kolmogorov–Smirnov test. The descriptive statistics; mean and standard deviation, minimum-maximum values, frequency, and percentage were used. The results obtained were compared by using Wilcoxon Signed-Ranks Test. A p-value of <0.05 was considered statistically significant.

RESULTS

The pre- and post-tests results, satisfaction with learning, self-confidence, simulation design, and educational practices were evaluated. Table 2 presents the mean scores for the pre- and post-tests. The mean pre-test knowledge score was 40.36±20.24, and the mean post-test knowledge score was 75.39±11.46; there was a significant difference (p=.001, t=-14.78). Table 3 outlines the mean scores for satisfaction with learning and self-confidence, simulation design, and educational practices. The mean score for satisfaction with current learning was 4.77±42, and the mean score for self-confidence was 4.51±54. The mean score for simulation design was 4.44±67, and the mean score for educational practices was 4.66±56.

Table 2. Pre- and Post-Tests Knowledge Scores (N=55)

Score	Min-Max	$\bar{X}$ ±SD	Statistical test*
Pre-test	0-75	40.36±20.24	t=-14.78
Post-test	43-95	75.39±11.46	P=0.01
*Wilcoxon Signed Ranks Test			

Table 3. Students' Satisfaction and Self-Confidence Scale, Simulation Design Scale and Educational Practices Scores (N=55)

	Min-Max	$\bar{X}$ ±SD
Satisfaction with Current Learning	3-5	4.77±.42
Self-confidence in Learning	2.71-5	4.51±.54
Simulation Design Scale		
Objectives and Information	3-5	4.56±.57
Support	2-5	4.32±.82
Problem-Solving	1.6-5	4.39±.81
Feedback/Guided reflection	1.25-5	4.59±.69
Fidelity(Realism)	1-5	4.33±.95
Total	1.77-5	4.44±.67
Educational Practices Questionnaire		
Active learning	2.3-5	4.54±.59
Collaboration	2.5-5	4.69±.57
Diverse Ways of Learning	1-5	4.71±.68
High Expectations	1.5-5	4.7±.61
Total	1.83-5	4.66±.56

DISCUSSION

At present, cardiovascular diseases are the leading cause of death (21). Course content about the prevention and treatment of these diseases along with care for patients with these diseases were described in the National Nursing Core Curriculum in 2014 (22).

Many studies have shown that nurses do not have sufficient basic knowledge and skills of ECG. This evidence led nursing educators to utilize different models and methods to teach ECG (2-4, 23). Prior studies have used online web-based programs (e-learning) (24) algorithms (25), dance and movement (26), and the six-stage method (27) to help nurses recognize ECG rhythms and plan appropriate interventions. Unlike the reported studies, in the present study, the teaching method that was employed was designed in accordance with the simulation-based cooperative learning.

Knowledge of ECG

The students scored very high on the post-test. The mean test score increased from 40.36±20.24 to 75.39±11.46 (Table 2). It is known that cooperative learning, an active learning strategy, helps in acquiring desirable educational skills and attitudes like academic success, social skills, ability to express opinions, and critical thinking skills (12). Therefore, the learning outcomes of skill training in the cooperative learning method can be equal to and even better than those achieved through individual learning (28). It has also been reported that pedagogically-shared efforts in cooperative learning positively affect learning (29). In fact, student contributions to their peers' learning through the intragroup exchange of knowledge and discussions might have increased the post-test scores in the present study.

The simulation-based education utilized to teach ECG skills in the present study increases the fidelity of nursing education programs and is effective in improving critical thinking skills, ability to recognize changes in ECG monitors, and psychomotor skills in nursing students (16). The simulation-based method in nursing education—in which two-thirds of the curriculum involves practice—is important to improve psychomotor skills (30-32); furthermore, there is evidence that this method contributes to patient care. Performing practices in a high-fidelity environment provide students with an opportunity to enhance their decision-making and problem-solving skills and experience cases they may rarely encounter in their real life (30, 33).

In the present study, thanks to the simulation-based method, the students had a chance to recognize basic ECG rhythms and in particular manage lethal arrhythmia. The literature reports that offering theoretical knowledge combined with using simulation to teach ECG increases nurses' success. It has been emphasized that both paper-based and electronically-monitored ECG rhythms should be utilized since their interpretations can be different (34). In the present study, the students worked in groups to analyze ECG cases. They experienced rhythm interpretation techniques by using electronically-recorded rhythms from the mannequins.

The students placed ECG leads on the mannequins and interpreted the rhythms they obtained, which strengthened their psychomotor skills (Table 3). It has been noted in the literature that offering theoretical knowledge along with using simulation for skill training increases students' success (35). In a study by Alinier et al. (2004), a significant increase was detected in psychomotor and cognitive skills following simulation-based education (36). In a systematic review, simulation-based education was recommended as preferable, since it enhances the psychomotor skills of nurses (31).

In the current study, the students were given various ECG cases to improve their critical thinking skills. The students worked in groups to analyze and discuss these cases. Many studies have shown that discussions in groups revolving around case analyses can ameliorate critical thinking skills (37, 38). Consistent with the literature, in the present study, knowledge quizzes conducted for a general revision of what was learned showed an improvement in the students' ability to make quick decisions about ECG.

Students' Satisfaction and Self-Confidence

As a result of the simulation-based education, the mean scores for current student satisfaction with learning (4.77±.42) and current student self-confidence (4.51±.54) increased (Table 3). The students noted that the teaching methods used in education were effective, motivating, and helpful for learning. In a study of the effects of simulation-based ECG education on critical thinking and self-confidence, the students in the simulation group had higher self-confidence (42). Comparable with the literature (37, 39, 40), the students in the present study were found to be satisfied with the simulation-based education and were self-confident in terms of their skills.

Educational Practices

The mean total score for educational practices was 4.66±.56, which was very high. Sumner et al. found that simulation in which nurses actively participated was effective in learning ECG (8). In a study by Brannan et al., the effectiveness of a classroom lecture was compared to the use of simulation in terms of knowledge gain. They showed that education given through simulation-based learning about patients with acute myocardial infarction led to a significant increase in the post-test scores of the students, compared to the education given through the conventional method (41). The results of the present study also suggest that the active learning underlying simulation-based education has positive effects on students.

Simulation Design

The mean total score for simulation design was 4.44±.67, which indicated that the simulation-based ECG education was very effective (Table 3). National Council of State Boards of Nursing reported that it is difficult to create evidence-based practices due to lack of standardization, although it supports using simulation in education. Therefore, it is recommended that educational content should be created using the best-practice standards provided by the International Nursing Association for Clinical Simulation and Learning, and that the education should be evaluated with valid and reliable tools (42). The mean high score for simulation design in the present study can be attributed to the simulation education planned in accordance with the best-practice standards.

CONCLUSION

Basic ECG education that is developed in accordance with the simulation-based cooperative learning model created positive learning outcomes. The use of different teaching techniques and the active involvement of the students were found to positively influence learning. It was also observed that the students contributed to their peers' learning. In addition, the students' self-confidence and satisfaction with learning increased. However, further studies are needed to evaluate the effectiveness of the model in terms of learning outcomes, satisfaction, and self-confidence in different subjects.

Limitations

The fact that this study was performed in only one nursing school restricts the generalizability of its results.

Compliance of Ethical Statement

Ethical approval was obtained before starting the study from the ethical committee of the university where the study was conducted (approval number: 2017-13/7). We are allowed to use pictures of the students.

Conflict of Interest

All authors declare no conflict of interest.

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Financial Disclosure/Statement

None declared.

Author Contribution

All authors contributed equally to the preparation of this article.

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