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Effects of Repeated Exposure in Simulation-Based Education on Hospital Emergency Care

Eun Hee Choi[1] and Eun Hwi Kim[2*]

[1]*School of Nursing, Yeungnam University College*
[2]*College of Nursing, Kyungwoon University*
[1]*eh5472@ync.ac.kr,* [2*]*pepe0508@hanmail.net*

Abstract

This study was purposed to verify the effect of repeated exposure and role to play in simulation-based education on hospital emergency care. 144 nursing students, at Y University in Daegu, Korea, had participated in this non-equivalent control group quasi-experimental study. All participants had 6 time simulation-based educations on hospital emergency care. The experimental group (n=65) had experience as a leader but the control group (n=79) didn't have. Data were collected from October 01 to December 23 in 2014 regarding problem solving, critical thinking, satisfaction of simulation, performance evaluations by evaluator and students themselves on simulation-based education. It was analyzed with two sample t-test and repeated measured ANOVA using PASW Statistics (SPSS) 21.0 program. Satisfaction (t=0.257, p=.798), self-evaluation (t=-1.650, p=.102), and performance (t=0.147, p=.883) scores between two groups were not significantly different after the educations. Performance scores were significantly increased by the number of the simulation-exposure (F=412.724, p<.001), but not significantly different by the leader experience (F=1.246, p=.266). This study would support that repeated simulation-exposures improved the performance level on hospital emergency care regardless of role of simulation settings.

Keywords*: Repeated exposure, Simulation, Emergency, Nursing*

1. Introduction

Problem solving and clinical performance with analytical critical thinking are core competencies for nursing students to achieve. Clinical practices give nursing students chance to solve a problem through critical thinking in various real situations [1, 2]. But clinical environment couldn't be controlled according to the purpose of clinical practice in nursing education and all of students couldn't get chance to enhance their nursing competencies in the same specific clinical situation [3]. In addition to that, the more complex and higher level needs in current clinical nursing practice and environmental changes of clinical practicum have being required alternative educational methods. As an alternative method to solve these problems, simulation-based education have been gradually developed [4] and many tries have been conducted to verify the effect of the simulation-based learning [5-7].

Simulation-based education can provide all students same opportunity to care a patient-simulator or standard patient with a specific health condition instead of real human patients. Therefore the clinical simulation situation can be constructed and controlled along with the purpose of education and all students can get a chance of clinical practice

[*]Corresponding Author: Eun Hwi Kim, PhD, Assistant Professor, College of Nursing, Kyungwoon University, 730, Gangdongro, Sandong-myeon, Gumi, Gyeongbuk, 730-739, South Korea, , Tel: +82-54-479-4077. Fax: +82-54-479-4013, E-mail: pepe0508@hanmail.net

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universally, consistently, and repeatedly [3]. In the simulation situation, students have an opportunity to apply and integrate their knowledge and skill to solve a problem with active participation with a reality but non-threatening and it facilitates their decision-making and critical thinking [8].

Previous studies suggest that simulation-based education improves satisfaction, knowledge, psychomotor skill, critical thinking, problem solving, and communication [9]. Most of simulation studies have been concentrated upon investigating effects depending on simulation-fidelity [10-12] and curriculum [13]. Effects of simulation-based education have been verified with numerous studies and it is already presented that simulation-based education is more effective than other educational approaches [14].

In recent years, increasing efficiency of the simulation-based education is an emerging issue. Therefore specific operation methods of simulation-based education, such as role assignment [15, 16] and numbers of the simulation-exposures [15, 17, 18], are factors to be considered. Traditionally simulation-based educations are composed of student's simulation experience and debriefing. Students can increase their knowledge, clinical performance, critical thinking, satisfaction, and self-confidence through active involvement, chance to observe, assess, and apply their decision, and reflective thinking experience in simulation-based education [19].

People can also learn with observing others' practice. They watch, understand and organize their actions through the observational learning and can increase even their psychomotor skill [20]. Also nursing students have learned practice through observation of nurses' intervention for the patients in real hospital situations. Nurses are often faced with emergency situations in hospitals and the nursing competency for hospital emergency care is essential. Although emergency nursing competency is important in hospital emergency, nursing students couldn't participate or observe in the real hospital emergency situations. Students just lean the wall and don't have to interrupt the emergency care of medical staffs.

Because of gap between needs for competency and learning chance about emergency care, educators have to develop the alternative and effective methodology. As simulation is not real emergency situation and can be repeated, nursing students can take part in and observe the emergency situation. Because of safety and repetition, nursing educators prefer simulation practice than clinical practice in the emergency hospital care. Usually nursing students learn how to act as an emergency team in the simulation-based education for hospital emergency care. Because of trait operated by team care, only one nursing student has experience as a leader in the one group. If simulation practice didn't repeated as students' number, many nursing students are hard to get an opportunity as a leader. They frequently get experiences as an observer or any other roles.

If experience of leader in the emergency simulation would be important, repetition as number of students in a group is essential. The more time is needed to operate simulation practice. Recent studies also suggest that repeated exposure in the simulation-based education on hospital emergency care is effective to enhance the performance level [15, 18]. At this point, it is needed to compare between the effects of repeated exposure and role experience as a leader of in the simulation-based education on hospital emergency care.

Therefore this study was planned to verify effects of the simulation-based education on hospital emergency care with considering the number of the simulation-exposures and the role, especially as a leader, to play in the simulation team.

1.1. Purposes

The purpose of this study was to investigate effects of repeated exposure and differences of the effects by role as a leader to play in the team-based simulation education on hospital emergency care. A first specific purpose is that evaluate effect of repeated exposure of emergency hospital care simulation. Second specific purpose is that

find out effect of experience as a leader on emergency hospital care simulation. Third specific purpose is that compare effect between repetition of simulation practice and experience of leader.

2. Materials and Methods

This is a quasi-experimental study with a non-equivalent control group design. This comparative study intended to find out the effects of repeated simulation-exposure depending on having leader experience on hospital emergency care. All subjects who took part in this study were nursing students who had previously submitted written consent.

2.1. Sample and Instrument of Data Collection

The convenience sample for this study consisted of 144 nursing students attending a baccalaureate undergraduate program at a college in the Republic of Korean.

Problem solving instrument was developed by Lee (2003) was consisted with subscales including recognize the problem, data gathering, analysis, divergent thinking, decision making, ability to make plan, practice and adventure, evaluation and feedback and Cronbach's alpha of developing was .94. The number of total item is 45 and Cronbach's alpha was .91 in this study [21].

Critical thinking tool was developed by Kwon et al. (2006) was consisted with subscales intellectual integrity, creativity, challenge, open-mind, prudence, objectivity, truth seeking and inquisitiveness and Cronbach's alpha of developing was .89. The number of total item was 35 items and Cronbach's alpha was .88 in this study [22].

Clinical competency was developed by Son et al. (2007) consisted 7 subscales including data collection, basic nursing care, communication, critical thinking, teaching and leadership, nursing management developing nursing professionalism and legal implementation and Cronbach's alpha of developing was .82. The number of total item is 64 and Cronbach's alpha was .95 in this study [23].

Simulation satisfaction was used debriefing experience scale developed by Reed (2012) consisted with subscales analyzing thought and feeling, learning and making connection, facilitator skill in conducting the debriefing and appropriate facilitator guidance. The number of total item is 20 and Cronbach's alpha was .97 in this study [24].

Situational performance evaluation scale by educator and themselves was items consisted with more than content validity index 0.8 [33]. It was developed according to scenario by researcher and 3 members of coworkers had more than 5yrs career as an educator and nurses. Emergency scenario was about care of cardiac arrest. The instrument for situational performance consist activities such as emergency notice, EKG reading (e.g. ventricular fibrillation, pulseless ventricular tachycardia, asystole and pulseless electronic activity), cardio-pulmonary resuscitation, defibrillation, intravenous medication and fluid infusion and treatment of return of spontaneous circulation. Total score of items is 23. Score allocation is depending on importance of intervention and is decided to researcher and coworkers.

Data collection is divided two sections. Baseline data gathering for evaluating homogeneity including general characteristics, problem solving and critical thinking was done from October 01 to October 07, 2014. Data gathering for effects of emergency simulation practice including simulation satisfaction, performance evaluation by evaluators and students themselves was done from December 01 to December 23, 2014.

2.2. Process

Experimental group experienced roles as a leader and control group didn't know which group was experimental or control group. They just knew to take part in simulation practice about emergency care in the hospital and listen to the process of simulation

practice. The evaluation of simulation was done in the control room where nursing students didn't know what was evaluated. Simulation practice was done six-times by group. Debriefing was operated 6 times by students and facilitator after each simulation practice. Evaluators who didn't know which group is experimental and control group and have a career as a nurse over than 5yrs were same between experimental and control group. In order to prevent experimental effects, researcher and coworkers that developed the performance tool were excluded as an evaluator and collector of data. Evaluators had checked the performances on 1st, 3rd, 6th simulation practice. Nursing students evaluated their performances and simulation debriefing satisfaction by themselves after debriefing of 6thsimulation practice.

2.3. Data Analysis

Data were analyzed using PASW Statistics (SPSS) 21.0 program as follow. General characteristics, satisfaction, self-evaluation, and performance were analyzed with mean and standard deviation. Homogeneity of general characteristics between the experimental and control group at baseline was verified with two sample t-test. Differences of satisfaction, self-evaluation, and the 1st, 3rd, and 6th performance between groups after the simulation based education were testified with two sample t-test. Difference of performance change between groups was analyzed with repeated measured ANOVA.

3. Results

3.1. Homogeneity Test for Characteristics between Groups

All participants in this study were 144 nursing students. The experimental group, who had experience as a leader in simulation-based education on hospital emergency care, included 65 subjects and the control group, who didn't have experience as a leader, included 79 subjects. Before the simulation-based education, all subjects were investigated general characteristics including age, academic achievement, problem solving, critical thinking and clinical competency. There were no significant differences in age, academic achievement, problem solving, critical thinking, and clinical competency between the experimental and control group. Therefore two groups were homogeneous at baseline. Homogeneity test for characteristics between groups is presented in Table 1.

Table 1. Homogeneity Test for Characteristics between Groups

(N=144)

Characteristic	Exp. (n=65) Mean±SD	Con. (n=79) Mean±SD	t	p
Age (year)	22.63 ± 1.88	22.60 ± 2.18	0.067	.946
Academic Achievement	2.50 ± 0.75	2.64 ± 0.66	-1.170	.244
Problem Solving	3.65 ± 0.42	3.59 ± 0.34	0.866	.388
Critical Thinking	2.84 ± 0.31	2.81 ± 0.24	0.602	.548
Clinical Competency	3.02 ± 0.27	3.04 ± 0.24	-0.601	.549

Exp, Experimental group; Con, control group; SD, standard deviation; p, p-value

3.2. Comparison for Satisfaction, Self-Evaluation, and Performance Scores after the Repeated Simulation-Exposures

After the 6 times simulation-based education, simulation satisfaction and self-performance evaluation and the 1st, 3rd, and 6th performance evaluation by evaluators between the experimental and control group were compared. There were no significant differences in simulation satisfaction (t=0.257, p=.798) and self-performance evaluation (t=-1.650, p=.102) between the experimental and control group. Performance scores of

the experimental group after the 1st, 3rd and 6th simulation-exposure were respectively 8.63 ± 5.44, 13.03 ± 4.79, 19.40 ± 3.08. Performance scores of the control group after the 1st, 3rd and 6th simulation-exposure were respectively 7.89 ± 3.81, 15.51 ± 3.91, 19.32 ± 2.70. Performance scores after the 1st, 3rd and 6th simulation-exposure were increased continuously in both groups. There were no significant differences in performance scores after the 1st and 6th simulation-exposure between groups (respectively t=0.915, p=.362; t=0.147, p=.883). Only those after the 3rd simulation-exposure were significantly different between experimental and control group is higher than experimental group (t=-3.363, p<.001).

Table 2. Satisfaction and Performance after Repeated Simulation-Exposure

(N=144)

Variable	Exp. (n=65) Mean±SD	Con. (n=79) Mean±SD	t	p
Simulation satisfaction	1.69 ± 0.49	1.67 ± 0.49	0.257	.798
Self-performance evaluation	21.56 ± 2.56	22.18 ± 1.79	-1.650	.102
Performance after 1stexposure	8.63 ± 5.44	7.89 ± 3.81	0.915	.362
Performance after 3rdexposure	13.03 ± 4.79	15.51 ± 3.91	-3.363	.001
Performance after 6thexposure	19.40 ± 3.08	19.32 ± 2.70	0.147	.883

Exp, Experimental group; Con, control group; SD, standard deviation; p, p-value

3.3. Difference of Performance Changes between Groups

Difference of performance changes between the experimental and control group after the 1st, 3rd and 6th simulation-exposure was verified. Difference of changes in performance scores was not significantly different between the experimental and control group (F=1.246, p=.266). It means that having a role as a leader in simulation-based education on hospital emergency care doesn't make a difference in performance level. But the changes of performance scores within the group were significantly different by time (F=412.724, p<.001) and the interaction between time and group (F=9.668, p<.001). It means that repeated exposure simulation-based education on hospital emergency care make a difference in performance level.

Table 3. Difference of Performance Change between Groups

(N=144)

Variable	Source of Variance	d.f.	F	p
Performance	Groups(Exp.-Con.)	1	1.246	.266
	Time	2	412.724	<.001
	Group × Time	2	9.668	<.001

Exp, Experimental group; Con, control group; Time, Performance Score after 1st, 3rd, and 6th Simulation-Exposure; p, p-value

4. Discussion

Nursing competency is basic requirement performances including knowledge, skill and attitude [29]. Emergency nursing competency is very essential because nurses often contact with emergency situations. Although the importance of competency is high for the nurses, nursing students can't have a chance to improve emergency nursing competency through the clinical practice. Simulation-based education is an alternative educational methodology.

Efficiency of simulation-based education is an emerging issue in recent years. In this context, various approaches and application methods to increase this have been carefully deliberated. Especially there were not articles comparing between repetition effects of simulation and experience as a leader on hospital emergency care. This study investigated the effect of repeated simulation-exposure and the difference of effect by participants' role in the simulation-based education on hospital emergency care.

As a result of this study, performance scores in the experimental and control group had been continuously increased by the repeated number of the simulation-based education on hospital emergency care. Many previous studies also present that simulation-based education increases performance skill on emergency care [15, 18, 27]. But most of simulation studies examine only effect right after simulation-based education [5, 25-27] and don't ascertain change of performance by repeated exposure in simulation-based education. Consistently with the present study, it is verified that repeated exposure of simulation-based education on hospital emergency care increases performance skill [15, 18]. Furthermore, repeated exposure of simulation-based education also increases nontechnical skill, teamwork including attitudes on the superior, job satisfaction, and confidence as a team member [15].

On the contrary to that, Yee and Naik [28], who investigate the effect of repeated exposure in simulation-based education to enhance nontechnical skill like team working, task management and decision making on anesthesia crisis management, verify that repeated exposure more than one time isn't helpful to increase nontechnical skill and additional simulation sessions may not take additional advantage [28]. In addition to that, it couldn't decide whether repeated exposure on the simulation-based education on hospital emergency care could improve performance in other scenario simulations or not. Although a systematic review of simulation-based nursing educations presents that simulation-based education increases critical thinking, problem solving and decision-making in nursing practical education [9], it seems difficult to apply and extend their knowledge and competency in other various situations.

It is possible that competency differences among the subjects who take part in the studies made different results. It means that understanding meaning and level of nursing competency is very important to enhance performances [29]. Before operating simulation based education, it is needed to assess the nursing competency of nursing students and develop the tailored scenario for them.

A study indicates that repeated exposure can improve performance in similar situations but can't improve performance in other situations [18]. Therefore the repeated-simulation educations seems to be an effective method to increase performance skill, but effects of other core nursing competencies and the extension possibility in other clinical situations have to be examined furthermore.

Secondly, the present study investigated whether having leader experience influenced on the effect of simulation-base education. In this study, there were no significant differences on simulation satisfaction and performances scores by evaluator and nursing students themselves depending on having leader experience after debriefing of the 6 times simulation-based practice. Both groups, which having leader experience as well as not having, increased performance score gradually by the number of simulation exposure. It is difficult to compare to other result because it is hard to find similar studies. But a study of repeated exposure in simulation-based education on hospital emergency care shows that subjects, who have a chance to observe another's performance before they do it, have better performance scores than those who don't have the chance [15]. It is similar to our result. It indicates that people can successfully conduct their performance with a series of observing, understanding, and reconstructing process inside of themselves. People can enhance their performance with cognitive process. They can judge their act and others' act, analyze complex decision-making situations, generate hypotheses from their pre-existing knowledge, and integrate their experience to decide their performance [30].

According to that, not only direct experiences but also indirect, observational experiences are effective to enhance their performance. Actually, observational learning is effective to enhance even complex medical procedure such as anesthesia training [20] and invasive surgical training [31]. In the simulation-based education on hospital emergency care, having a chance as an assistant or observer is more frequent than having a chance as a leader. In this study, 3rd results present that performance of subjects who experience indirect leader as an observer in hospital emergency simulation was higher than direct experience. From our result, we propose that observational learning is also effective method to increase performance in the simulation-based education on hospital emergency nursing. This result can be applied to plan simulation-based education with restricted time, places, and sources and increase the effectiveness of the simulation-based education with repetition. But more relevant studies in various simulation-situations or participants are needed to conclude it.

Finally, this study verified that the performance scores were significantly improved by the number of the simulation-exposure rather than having leader experiences. Our results showed that difference of performance changes after the 1st and 6th simulation-exposure was not significantly different between the experimental and control group. Therefore, having a role as a leader isn't essential to improve performance in simulation-based education on hospital emergency care. Instead of that, repeated exposure of the simulation-based education was more important factor to improve performance on hospital emergency care. Previous studies are consistent with this result. Repeated exposure of the simulation-based education improves performance skill on cardiovascular critical nursing care [15], general anesthesia for emergency cesarean delivery [32], and pediatric emergency care with various scenarios [18].

Observational learning is also effective to train psychomotor skill [20, 31]. Especially the study of Abe and Kawahara [15] is most similar to this study. The performance is increased along with the number of repeated exposure and observation of performance of other people before the same simulation makes better performance in the simulation-based education on critical care [15]. Actually nursing students have more experiences as an observer in the clinical setting as the patients' right is increasing. Although direct patient care was more lessen in the clinical setting, there was no one that it is not needed to indirect practice in clinical practice. It is recognized effects of observation or indirect learning.

But there are several studies which are not consistent with our results. A study to assess the nontechnical skill effect of repeated exposure in the simulation-based education on anesthesia crises for 20 anesthesia residents shows that a single exposure is enough to increase nontechnical skills [28]. A study to investigate the effect of repeated exposure in performance on pediatric emergency scenarios shows that repeated exposure only enhance the performance in similar simulations but doesn't improve in other scenarios [18]. Therefore the effect of repeated exposure in simulation-based education has to be examined further relevant studies with diverse participants and simulation contents.

5. Conclusions

This is a non-equivalent control group quasi-experimental study to examine effects of repeated simulation-exposure depending on having leader experience on hospital emergency care.

144 nursing students had participated in this study and all of them had the 6 times simulation-based education on hospital emergency care. The experimental group had experience as a leader but the control group didn't have. After the 1^{st}, 3^{rd}, 6^{th} simulation-based education, performance scores gradually increased in both group. There was no significant difference in simulation satisfaction and performance by student themselves after 6^{th} simulation based education and performance by evaluator after the 1^{st} and 6^{th} simulation-base education between the experimental and control group. Even though performance after the 3^{rd} simulation-based education was significantly different between the groups, difference of performance change by group during the 6 times simulation-based education wasn't significantly different. On the contrary to that, difference of performance change by time within group was significantly different.

Based on these results, we could conclude that repeated exposure was more important than role allocation to play in simulation-based education on hospital emergency care. It indicates that the key element to enhance performance level in simulation-based education on hospital emergency care is not playing which role but the number of simulation-exposure.

In conclusion, the number of simulation-exposure has to be considered first of all and role to play in simulation-setting can be supplemented with observational learning. This result could be applied to plan simulation-based education on hospital emergency care with considering efficiency of the simulation-based education.

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Authors

Eun Hee Choi
Yeungnam University College, Associate Professor (2008.03~)
Korean Society for Simulation in Nursing, Director (2013.03~)

Eun Hwi Kim
Kyungwoon University, Assistant Professor (2015.03~)

