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통합적 간호실무 시뮬레이션 기반 훈련이 간호대학생의 스트레스, 학습흥미, 문제해결능력에 미치는 영향*

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Effects of Integrated Nursing Practice Simulation-based Training on Stress, Interest in Learning, and Problem-Solving Ability of Nursing Students*

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Purpose: In this study the time point of effects that repeat exposure to simulation-based nursing training has on stress, interest in learning, and problem-solving abilities were identified. **Methods:** Participants for this study were 75 nursing college students in Seoul. In a preliminary survey data were collected and measured for the general characteristics, stress, interest in learning, and problem-solving abilities of the students. Then, stress was assessed before performance of each of four-rounds of simulation training scenarios. After each simulation round, interest in learning and problem-solving abilities were assessed. **Results:** With respect to stress, no significant differences were found when comparing the results of the preliminary survey to those of each of the simulation-based training exercises. For the sub-items of interest in learning, interest in nursing knowledge and interest in clinical training significantly increased between the preliminary survey and the 4th survey. Interest in lab training increased significantly at the 1st survey. Problem solving abilities showed a significant increase from the preliminary at each of the survey points. **Conclusion:** Increasing the exposure of nursing students to simulation-based training enhances their interest in learning and problem-solving abilities. Therefore it is necessary to have education strategies that includes various simulation experiences for students.

Key words : Nursing, Patient simulation, Stress, Learning, Problem solving

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The authors declare no conflict of interest.

주요어 : 간호실무, 시뮬레이션, 스트레스, 학습흥미, 문제해결능력

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Introduction

The Korean Accreditation Board of Nursing Education [1] has recently announced that nursing education must teach core competencies, including general and specialized knowledge to provide comprehensive nursing care; the ability to apply integrated nursing skills; an ability to communicate and cooperate with other professionals in order to improve patient health; critical thinking to solve nursing problems; legal and ethical responsibility as well as an awareness for the development of the nursing profession; leadership in the attainment of nursing goals; research skills to scientifically develop nursing practice; and adaptability to global public health policy changes. Not only is theory important in nursing education, but clinical training is also critical for nurses to attain these core competencies.

However, clinical training in the actual medical field is restricted in Korea. Patients are acutely aware of their rights, and therefore their safety and comfort are prioritized. As a result, nursing students mainly observe during clinical training, so simulation-based training has recently been more actively implemented [2].

Students who participate in simulation-based training have stated that they experience an increase in motivation and interest, familiarity with actual situations, a sense of security when performing the virtual scenario, nursing intervention based on nursing, experience within a role as a specialist, growth in terms of confidence in their problem-solving skills, a sense of accomplishment, development of insight for clinical situations, clinical deduction skills and a honing of their adaptability to emergencies [3]. Foronda, Liu, and Bauman performed an integrative review of evaluations for simulations in nursing education and found that simulation-based training increases cognitive skills with respect to problem solving, decision making, and clinical reasoning as well as improves hands-on skills, confidence/self-reliance, satisfaction, teamwork, collaboration and communication. On the other hand, such simulations were also found to trigger anxiety or stress [4].

A systematic review of studies on simulation-based training for nursing education reveals that the focus has been mainly on single-topic scenarios of single-course that have been held as one-time events and the educational effects of such have been checked either only once after the training or have only been compared before and after the training event [2-7]. Even though simulation-based integrative clinical practice programs based on adult, maternity, pediatric nursing care & core nursing skills were developed, the effects of these programs was only compared between before and after program [8].

Hardly any studies have investigated the time point of effects of repeat exposure to sequential simulation-based training programs designed to use integrated nursing practice scenarios.

Therefore the present study was done to improve the understanding of the effects of simulation-based training and to further the development of efficient management. The effects of the simulation-based training are examined for integrated sequential nursing scenarios in women's health, adult health I & II, and pediatric health, and the time points at which these effects become visible were identified.

Purpose

In this study, we identify the time point of effects that repeat exposure to simulation-based nursing training has on stress, interest in learning, and problem-solving abilities of nursing students. The specific objectives of this study are as follows.

- To identify the time point of effects that repeat exposure to simulation-based nursing training has on stress of nursing students.
- To identify the time point of effects that repeat exposure to simulation-based nursing training has on interest in learning of nursing students.
- To identify the time point of effects that repeat exposure to simulation-based nursing training has on problem solving abilities of nursing students.

Methods

Design

The nursing students took part in a one-group repeated quasi-experimental design experiment to investigate the effects of integrated nursing practice simulation over multiple exposures as well as to identify the time at which the effects took place. The specific design of the study is shown in Figure 1.

Sample

The study was performed with 75 third-year nursing college

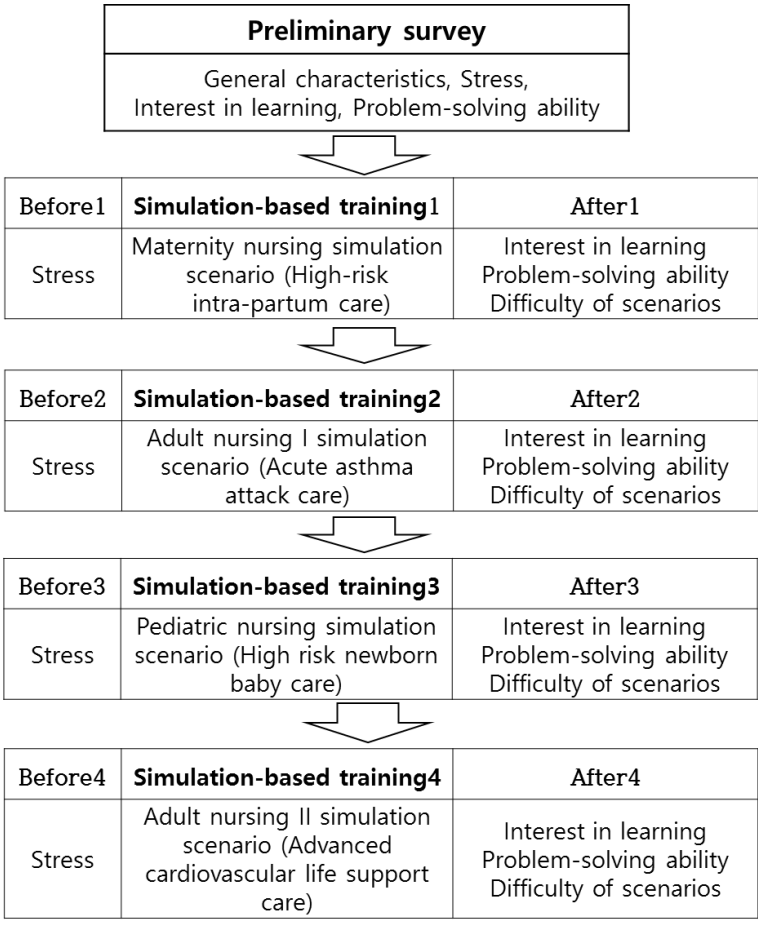

Figure 1. Research design

students enrolled in a three-year program in Seoul. As part of the study, the students experienced simulation-based training at a simulation center. The participants were all women, who had no prior training experience in Intensive Care Unit (ICU), Neonatal Intensive Care Unit (NICU), or Delivery Room (DR) scenarios, were the themes of the simulation-based training. The students had completed the nursing course of childbirth care, high-risk newborn care, adult's cardiac and respiratory care.

The number of participants was decided using the G*power (version 3.1.6) program. The effect size was 0.25, the effect power was 0.9 based on the study of Yoo [9], and the frequency of the measurements was set to 4 times. The calculation indicated that 61 participants would be the appropriate sample size, and 75 participants were selected considering the likely dropout rate.

Simulation Program

The simulation-based training program was held as a two-credit class at a frequency of five days per week over a period of two weeks for a total of 70 hours including 10 hours of open laboratory time. The program was composed of 5 sessions that consisted of integrated nursing practice. Days 1 and 2 focused on women's health (session1: SBT1); days 4 and 5 on adult health nursing, part I (session2: SBT2); days 6 and 7 on pediatric health nursing (session3: SBT3); days 9 and 10 on adult health nursing, part II (session4: SBT4); and day 3 and 8 on basic skills with respect to medication including IV medication (session5). Among 5 sessions, scenarios were used from session1 to session 4 programs. The scenarios were developed for third year nursing students in their last year of a 3-year college nursing program in order for them to develop critical thinking skills by improving both their basic knowledge and clinical experience. Content validity of the scenarios was verified by 4 nursing professors and 4 clinical experts in

accordance with sessions.

The training is based on the core competencies stated in the Korean Accreditation Board of Nursing Education [1] which include comprehensive adaptability of knowledge and skills, communication and cooperation skills, and critical thinking to solve nursing problems. A high-fidelity simulator with virtual scenarios related to adult health, women's health, and pediatric health were developed to allow the students to solve nursing problems in a step-by-step manner.

During the 2 weeks' simulation program, 24–26 students were randomly placed into teams of 3–4 individuals who experienced simulation scenarios together. The participants were given a workbook that consisted of preview material, a checklist of nursing skills, a training report paper, and a reflection diary. In order for each student to solve the simulation scenarios presented, a task trainer gave a preview of the learning and nursing skills necessary. Afterwards, the simulation scenarios were conducted for each student, followed by a debriefing.

The level of difficulty for each simulation scenario increased on subsequent instances. For women's health, day 1 consisted of a normal pregnancy, and day 2 of a high-risk pregnancy. For pediatric health, day 1 required students to take vital signs and to nurse a healthy neonate while they had to attend to respiratory distress of high-risk infants on day 2. The data in the present study was collected before and after the most difficult scenario which required more extensive problem-solving skills and critical thinking than the other scenarios of each session, except for basic skills.

Tools

● General characteristics

The general characteristics, including age, motives for choosing a nursing major, satisfaction with campus life, and aptitude for nursing science, were collected through a preliminary survey. The perceived level of difficulty of the scenarios of the training sessions, which could affect the results of the study, was collected after every session of the training. The level of difficulty was asked as 'high', 'intermediate', and 'low'.

● Stress

The stress levels of the students were measured through preliminary survey and before each selected simulation-based training. The question was "How much stress do you feel before simulation-based training?"

It was measured using a Visual Analogue Scale (VAS) which ranged from "Not at all" (0) to "Extremely severe" (10), meaning that a higher score indicated stronger stress.

● Interest in learning

The interest in learning was measured after the simulation-based training by the tool of Chu, Hwang, and Park [10]. It has three questions related to interest in nursing knowledge, lab training, and clinical training. Content validity was verified by 3 nursing professors. Each question was measured using a 5-point Likert scale which ranged from "Strongly interested" (5) to "Strongly uninterested" (1), meaning that a higher score indicated stronger interest.

● Problem solving ability

Problem-solving ability was measured using a tool developed by Lee, Park, and Choi to measure the problem-solving process of adults [11]. The tool consists of 5 subcategories that include clarifying the problem (6 items), seeking a solution (6 items), making a decision (6 items), applying the solution (6 items), and evaluation & reflection (6 items). The responses for each of the 30 items were recorded using a 5-point scale, meaning that higher points indicate a higher ability for problem-solving. Content validity of this tool was verified by 3 nursing professors.

The study results provided by Lee, Park, and Choi showed that their tool had satisfactory reliability (Cronbach's α =.93) [7]. In the present study, the tool was found to have Cronbach's α ranging from .91 to .97 throughout the preliminary, 1st, 2nd, 3rd, and 4th surveys.

Data Collection

The study was done after receiving approval from the Institutional Review Board (P01-201304-SB-14-02), and the participants were recruited from August to November of 2013 by the researcher in charge, and all joined the study voluntarily.

The preliminary survey gathered information on their general characteristics, stress, interest in learning, and problem-solving abilities. Stress was then measured again right before each of the four rounds of scenario-based simulations. After each of the four rounds, the interest in learning and the problem-solving ability were measured. Each survey took 15 minutes to

administer, and the study design and dependent variables were measured at the time points listed in Figure 1.

Statistical Analysis

Data were collected and analyzed at a 0.05 level of significance utilizing SPSS/WIN (ver. 20.0). General characteristics were expressed in terms of frequency and percentage while the interest in learning and the problem-solving abilities were presented according to the level of difficulty of the scenarios and were analyzed using unpaired-test. The differences in stress levels, interest in learning, and problem-solving abilities were analyzed using repeated measures ANOVA according to the instance of the simulation-based training sessions, then a post-hoc analysis was performed using the Bonferroni method.

Results

General characteristics

Sixty-six point seven percent (n=50) of the students were aged 22 or younger while 33.3% (n=25) were 23 or older. Among the motives for choosing a nursing major, the largest percentage (57.3%, n=43) of the students replied that they chose due to "personal intention." 25.3% (n=19) reported that they chose as a result of a "recommendation from others." On campus life, 81.3% (n=61) reported that their campus life satisfaction was above-average, while 92.0% (n=69) answered that they thought of themselves that they had above-normal levels of correspondence of their personality with an aptitude for nursing (Table 1). The students that were selected had not experienced simulation scenarios with the same type of hospital scenarios at any point in their clinical training before taking the training sessions in this study.

The level of difficulty of the scenarios was only answered 'high' or 'intermediate' during the four rounds of simulation-based training session.

The interest in learning and problem-solving ability according to the level of difficulty of simulation scenarios was investigated and the results were as follows. No significant differences were found among the results with respect to interest in learning – including items measuring interest in nursing knowledge, interest in lab training, and interest in clinical training – when compared across different levels of difficulty of the scenarios applied to the students throughout the 1st, 2nd, 3rd, and 4th simulation sessions, indicating that the level of difficulty did not have any influence on the students' interest in learning. Also, there were no significant differences found in the students' problem-solving abilities when compared against the level of difficulty of the simulation scenarios, indicating that the level of difficulty of the scenarios did not have any influence on problem-solving abilities (Table 2).

Table 1. General Characteristics of Participants (N=75)

Characteristics	Categories	Frequency (n)	Percentage (%)
Age (years)	21	6	8.0
	22	44	58.7
	23	10	13.3
	24	9	12.0
	Older than 25	6	8.0
Motives in choosing nursing major	Personal intention	43	57.3
	Recommendation of others	19	25.3
	High-school GPA in college admission requirements	13	17.4
Satisfaction with campus life	Very satisfied	3	4.0
	A little satisfied	16	21.3
	Mediocre	42	56.0
	A little unsatisfied	9	12.0
	Very unsatisfied	5	6.7
Level of correspondence of personality with aptitude for nursing	Highly matched	3	4.0
	A little matched	35	46.7
	Mediocre	31	41.3
	A little unmatched	4	5.3
	Highly unmatched	2	2.7

Stress

There were significant differences in the stress levels measured, depending on the number of the training session (F=2.918, p=.045), but no significant differences were found in the post-hoc test. Therefore, the stress levels did not differ depending on the number of the training session (Table 3).

Interest in learning

There were significant differences in the results of the interest in learning, including interest in nursing knowledge, interest in lab training, and interest in clinical training, at each survey point. There was a significant difference in the score for the interest in nursing knowledge at each point (F=6.311, p<.001), and the post-hoc test revealed an especially significant increase between the preliminary survey results and the survey results after the 4th simulation session (p<.001). There was also a significant difference in the interest in lab training at each survey point (F=24.028, p<.001). Interest in lab training significantly increased after the 1st simulation session (p<.001) relative to the results of the preliminary survey, and then it significantly increased once again at the 4th survey (p<.001). The interest in clinical training significantly differed between the preliminary survey results and each of the results of the four rounds of the simulation sessions (F=4.223, p=.005). In particular, a significant increase was observed between the preliminary survey and the 4th survey (p=.034) (Table 3).

Problem solving ability

The problem-solving abilities were found to be significantly

Table 2. Interest in Learning and Problem-solving Ability According to the Level of Difficulty of Simulation Scenarios (N=75)

The number of simulation-based training sessions	Level of difficulty of scenarios	Interest in nursing knowledge		Interest in lab training		Interest in clinical training		Problem-solving ability	
	(n)	M (SD)	t (*P*)	M (SD)	t (*P*)	M (SD)	t (*P*)	M (SD)	t (*P*)
1st	High (24)	3.92 (0.58)	.331 (.741)	4.04 (0.75)	1.802 (.076)	3.88 (0.61)	1.335 (.186)	17.79 (2.97)	.080 (.779)
	Middle (48)	3.85 (0.82)		3.69 (0.80)		3.60 (0.89)		17.78 (2.87)	
2nd	High (17)	4.12 (0.60)	1.844 (.069)	4.00 (0.79)	1.596 (.115)	3.88 (0.86)	1.542 (.127)	19.17 (2.25)	1.080 (.302)
	Middle (58)	3.76 (0.73)		3.64 (0.83)		3.55 (0.75)		18.50 (2.36)	
3rd	High (17)	3.59 (0.87)	-1.142 (.257)	3.65 (0.93)	-1.020 (.311)	3.47 (0.94)	-.798 (.428)	18.65 (2.62)	2.477 (.120)
	Middle (57)	3.82 (0.71)		3.88 (0.78)		3.65 (0.77)		19.80 (2.64)	
4th	High (36)	4.03 (0.84)	.162 (.872)	4.14 (0.93)	.426 (.671)	3.89 (1.04)	.132 (.895)	19.90 (2.51)	2.345 (.130)
	Middle (36)	4.00 (0.59)		4.06 (0.71)		3.86 (0.72)		20.88 (2.92)	

Table 3. Level of Stress and Interest in Learning According to the Number of Simulation-based Training Sessions (N=75)

Variable		Preliminary a M (SD)	1st b M (SD)	2nd c M (SD)	3rd d M (SD)	4th e M (SD)	F(*p*)	Post-hoc
Level of stress		6.63 (1.77)	7.15 (1.30)	7.05 (1.39)	7.08 (1.33)	6.88 (1.20)	2.918 (.045)	
Interest in learning	Interest in nursing knowledge	3.69 (0.73)	3.87 (0.76)	3.86 (0.73)	3.79 (0.76)	4.00 (0.72)	6.311 (<.001)	a<e
	Interest in lab training	3.31 (0.81)	3.79 (0.80)	3.73 (0.85)	3.84 (0.83)	4.09 (0.83)	24.028(<.001)	a<b, d<e
	Interest in clinical training	3.54 (0.86)	3.70 (0.82)	3.67 (0.78)	3.64 (0.80)	3.89 (0.89)	4.223(.005)	a<e

different depending on the number of the training session (F=46.036, p<.001), with significant increases observed at the 2nd, 3rd, and 4th surveys (Table 4). Of the subcategories for problem-solving abilities, problem clarification was found to be significantly different at each survey point (F=19.895, p<.001), and it especially increased at the point between the preliminary survey and 3rd (p<.001), and between the 3rd and 4th surveys (p=.003). Searching for a solution, decision making, and performing solution were significantly different at each point (F=31.943, p<.001; F=30.305, p<.001; F=24.145, p<.001), with significant increases in the post-hoc test between the preliminary survey and the 2nd (p<.001; p=.003; p<.001), between the 2nd and 3rd (p=.001; p<.001; p=.004), and between the 3rd and 4th sessions (p=.011; p=.005; p=.022). Evaluation and reflection, the other subcategories for problem-solving abilities, were significantly different at each point (F=50.617, p<.001), with significant increases observed at each point.

Discussion

The purpose of this study was to verify level of stress, interest in learning, and problem-solving ability with respect to the number of the session of the simulation-based training protocol.

No significant differences were observed in the stress score between the preliminary survey and each of the stress scores measured before the 1st, 2nd, 3rd, and 4th simulation-based training sessions. The students experienced an above-average level of stress every time before the simulation session began, even when they had taken several simulation sessions beforehand. This result is somewhat similar to what was found in previous studies where simulation-based training caused students anxiety or stress [4], too much stress from the simulation training even though the actual danger level was low [12],or a high level of state anxiety compared to the control group [13]. With respect to such observations, Foronda asserted that the effect on learning of the simulation-based training was suspect because it caused students much anxiety [4].

Also, previous studies reported that the students felt anxiety about making mistakes [14], and this kind of anxiety disturbed students' learning process [15]. Meanwhile, Shors pointed out that anxiety and stress can lead to a confident job performance [16]. The effectiveness of simulation-based training is still debatable because students experienced above-average levels of stress at the very moment of the simulation session. This proposes a study to determine the effects of stress level on a simulation-based training.

As stress or anxiety during training can cause difficulty in concentrating or can have negative effects on the learning process, a solution such as orientation regarding simulation could be investigated to decrease the stress induced in students during simulation-based training. Physiologic indicators of stress need to be included in the further study for more reliable result.

As shown above, the result for interest in nursing knowledge significantly increased after the simulation-based training session, and this can be understood within the same context as the results of a previous study that found simulation-based training to be an effective method that can enhance nursing knowledge [17]. Interest in nursing knowledge appeared to increase as a result of the process where students actively utilized their nursing knowledge and performed nursing activities in order to solve the scenario of the simulation. However, the score measuring the interest in nursing knowledge did not significantly increase for each of the 1st, 2nd, and 3rd surveys, but only at the 4th survey. This indicates that it took several repetitions for the students to understand the clinical situation and to provide adequate nursing care. Meanwhile, the score for the interest in the lab training increased according to the number of the training sessions. Nursing students want to have a familiar and safe training environment without any fear of making mistakes

Table 4. Problem-solving Ability According to the Number of Simulation-based Training Sessions (N=75)

Variable		Preliminary [a] M (SD)	1st [b] M (SD)	2nd [c] M (SD)	3rd [d] M (SD)	4th [e] M (SD)	F (p)	Post-hoc
Problem-solving Ability	Overall	16.92 (2.01)	17.82 (2.84)	18.65 (2.34)	19.50 (2.66)	20.28 (2.76)	46.036 (<.001)	a<c, c<d, d<e
	Problem clarification	3.62 (0.48)	3.66 (0.59)	3.80 (0.49)	3.95 (0.52)	4.09 (0.5)	19.895 (<.001)	a<d, d<e
	Search for solution	3.42 (0.49)	3.51 (0.64)	3.72 (0.54)	3.92 (0.61)	4.07 (0.61)	31.943 (<.001)	a<c, c<d, d<e
	Decision making	3.26 (0.57)	3.44 (0.67)	3.57 (0.64)	3.82 (0.61)	3.97 (0.66)	30.305 (<.001)	a<c, c<d, d<e
	Performing solution	3.43 (0.44)	3.60 (0.67)	3.76 (0.43)	3.90 (0.58)	4.05 (0.60)	24.145 (<.001)	a<c, c<d, d<e
	Evaluation and reflection	3.19 (0.57)	3.60 (0.66)	3.80 (0.55)	3.92 (0.63)	4.10 (0.62)	50.617 (<.001)	a<b, b<c, c<d, d<e

[18], and they can more easily concentrate on caring for the patient when they know they will not harm the patient [15]. The simulation-based training provides students with opportunities to practice nursing skills with confidence in a safe environment [19].

Furthermore, interest in clinical training increased only at the 4th simulation session when the students might have gained some confidence in their nursing knowledge and skills after the full series of training sessions. Not only did students feel potential risk for failure to provide nursing intervention for patients during clinical training, but they could also experience unexpected situations related to a variety of human factors, unlike in lab training. According to this study, at least 4 sessions in simulation training education can increase the interest in clinical training.

An increase in interest in learning motivates students, and highly-motivated students participate more actively in the learning process [20]. An increased interest in learning is essential for students to be encouraged to learn, and as shown above, in our study the level of interest in nursing knowledge, lab training, and clinical training increased significantly after the 4th simulation session. Therefore, in order to boost student interest in learning, simulation-based training should be repeated a several times rather than finishing within a single session.

The problem-solving ability of the students was enhanced according to an increase in participation in simulation-based training sessions. In modern medical situations that require health care providers to have high-level knowledge-based problem-solving skills and decision making abilities [21], simulation-based training seems to be an appropriate educational method. However, the problem clarification stage of students' problem-solving abilities increased only at the 3rd simulation session. This result could indicate that students felt difficulties in figuring out and clarifying the patient's problems during the simulation, but they were able to clarify the problem after experiencing simulation sessions several times. Therefore, an increase in the repetition of simulation sessions and appropriate instructional strategies are needed in order to enhance the problem-solving abilities of nursing students.

There were some limitations in this study. One group pretest-posttest design with no control group has weak internal validity and should be compared with the effects of a traditional clinical practicum group or a single session of simulation training group in further study. Long-term effects of simulation training program should be included as outcome variables. Even though the difficulty of the scenario was controlled in this study, contents of the scenario could affect the variables. Consideration of changing the order of the scenarios is needed in further study.

According to this study, the minimum number of session of simulation-based training was four for the effects on interest in learning, and two for the effect on problem-solving ability. The maximum number of session for the effects should be investigated in the future.

Conclusions

This study was performed in order to verify the stress levels, interest in learning, and problem-solving abilities according to the number of the simulation-based training sessions.

The students showed above-average levels of stress before each round of the simulation despite participating in an increasing number of sessions. The interest of the students with respect to nursing knowledge, lab training, and clinical training significantly increased along with an enhanced problem-solving ability during the four rounds of simulation-based training session.

A solution should be investigated to decrease the stress felt by students during the simulations. The effects of simulation-based training can be maximized when they are repeated rather than when they are administered as a single session. This study, therefore, has value because it reveals the effects of four rounds of simulation-based training sessions, but further studies are needed in order to verify diverse educational effects according to an increase in experience through simulation-based training.

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