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Simulation in Nursing Education in South Korea: An Integrative Review

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한국 간호교육에서의 시뮬레이션: 통합적 고찰

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Abstract This study aimed to determine the current state and characteristics of simulation-based operating processes in nursing education based on the Jeffries theoretical framework in South Korea by taking an integrated look at study findings in order to provide a scientific basis for future simulation-based operating processes. We searched eight databases, including the Korea Education and Research Information Service, National Library, Korean Studies Information Service System, National Digital Science Library, Korea Institute of Science and Technology Information, KOREAMED, and Korean Medical Database, using terms "simulation" and "nursing" as keywords in November 2017 in the Korean language. Sixteen studies were identified, reviewed, and appraised in this integrative review. The literature was categorized into these themes: general study characteristics, operation method, teaching and learning methods, subject characteristics, outcome variables, and theoretical framework. The simulation processes in nursing education in South Korea that were analyzed in this study did not fully reflect the main concepts suggested in the NLN Jeffries simulation framework. Thus, simulation program developers need to consider and incorporate a variety of strategies, based on the identification of essential components, to improve simulation effectiveness.

요 약 본 연구 목적은 향후 시뮬레이션 기반 운영 과정에 대한 과학적 근거를 제공하기 위해 연구 결과를 종합적으로 검토함으로써 Jeffries 이론적 프레임 워크를 기반으로 한국의 간호 교육에서 시뮬레이션 기반 운영 프로세스의 현재 상태와 특성을 확인하는 것이다. 본 연구는 2017년 11월까지 "시뮬레이션"과"간호"라는 용어를 사용하여 한국 교육연구 정보원, 국립 도서관, 한국학 정보원 서비스 시스템, 국립 디지털 과학 도서관, 한국 과학 기술 정보원, KOREAMED, 한국 의료 데이터베이스 등 8개의 데이터베이스에서 한국어로 출간된 연구들을 검색했다 연구결과 16개의 연구가 확인, 검토 및 평가되었다. 문헌은 연구의 일반적인 특성, 운영 방법, 교수학습방법, 참여자 특성, 결과변수 및 이론적 틀이라는 주제로 분류되었습니다. 본 연구에서 분석한 한국의 간호 교육 시뮬레이션 과정은 NLN Jeffries 시뮬레이션 이론적기틀에서 제안된 주요 개념을 완전히 반영하지는 않았다. 추후 시뮬레이션 프로그램 개발자는 시뮬레이션 효율성을 향상시키기 위해 필수 구성 요소를 확인하고 다양한 전략을 고려하여 통합해야 할 것이다.

Keywords : Curriculum Development, High Fidelity Patient Simulator, Integrative Review, Nursing Education, Simulation

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1. Introduction

The numbers of students admitted into nursing programs in Korea has been steadily increasing, from 8458 in 2013, to 9033 in 2017[1]. However, the criteria for clinical field training in Korea are limited to specific operating hospitals with approximately 300 beds and integrated care[2], and an alternative is needed. The goal of nursing education is to help students acquire the knowledge, skills, and attitudes necessary to become professional nurses who are able to fully exercise their competencies in clinical situations[3]. To meet this goal and rising admissions, simulation-based nursing education in South Korea has expanded in its attempts to overcome the limited avenues for clinical field training.

Simulation-based nursing education is known for improving communication skills with patients, caregivers and medical personnel in a safe environment, collaboration with medical staff, and complex situation management skills[4]. Simulation provides a rich learning opportunity for students to integrate theory with practice while making real-time clinical decisions in an environment that poses no risk to patients [4,5]. Effective simulation nursing education requires scenarios to be developed and operated based on a theoretical framework[5]. The NLN suggested the need for a more contextural, experiential type of learning through simulation and integrate simulation into the curriculum with clear connections toward achievement of student learning outcomes[4]. Effective simulation-based education practices are ones that have sound theoretical frameworks[4].

However, it was found that of 154 simulation-based nursing programs in South Korea, 128 (83.1%) programs were not based on any theoretical framework[6]. In the studies had a theoretical framework, the most widely used was found to be the Jeffries simulation framework, developed by the National League for Nursing (NLN) from the United States[7]. Based on the thorough synthesis of the literature and discussion among simulation researchers and leaders, the NLN Jefferies simulation framework is now referred to as the NLN Jeffires Simulation Theory with a few minor changes within the conceptual illustration [5]. Nursing educators need to systematically examine existing studies with theoretical structures for effective simulation operation, and explore the effectiveness and application of simulation application.

Integrative review is a broader concept in the systematic review of literature, which can be protected from the bias of the research and provide an overview of specific phenomena and draw accurate conclusions [8]. Findings from the integrative review help illuminate what is currently known about best simulation practices, what research exists to support these practices, and priorities for future research [9].

Studies on the outcomes of education programs that have incorporated Jeffries' theory, using the measures of learning, reaction, and behavior, are relatively rare in South Korea. While some studies have assessed learning outcomes using other measures[10,11], no author has systematically analyzed the effect of simulation education using all three outcome variables (learning, reaction, and behavior).

Therefore, this study aims to present findings of an integrative literature review related to a simulation method that incorporates the Jeffries simulation framework[5], through a systematic review of studies related to simulation in Korea. The specific purposes of the study are to analysis the simulation operation, theoretical frameworks and components based on the Jeffries theoretical framework in selected studies.

2. Methods

This study is a literature review using the integrated literature review method suggested by Whittemore and Knafl [12], to present findings of an integrative literature review related to a simulation method that incorporates the Jeffries simulation framework[5]. The integrated review process presented by Whittemore and Knafl [12] consists of five stages. The first step, problem regulation, is to recognize and present research problems and objectives clearly. The research question is 'How do the literatures show the simulation operation, theoretical frameworks and components based on the Jeffries theoretical framework of simulation education in Korea?'.

The second phase is the literature search phase, which involves systematically searching for and selecting articles that are appropriate for the purpose of the study. The paper search process and the suitability of the searched papers are described in detail in the data collection section. We systematically searched for articles on simulation in nursing education. To do this, we first identified Korean-language studies in education, including experimental, quasi-experimental, and non-experimental studies, published until November 2017 in Korea. The selection criteria excluded reports on nursing students, simple skill evaluations, and basic life support; we included articles on operating simulation scenarios in adult nursing education, research on the theoretical framework of simulation-based education programs, and simulation-based education teaching and learning methods. The search keywords were "simulation" and "nursing" and "AND" when applicable. Two reviewers independently conducted the search for this study on the Korea Education and Research Information Service, National Library, Korean Studies Information Service System, National Digital Science Library, Korea Institute of Science and Technology Information, KOREAMED, and Korean Medical Databases. We then screened the full texts of eligible articles from these searches to determine their inclusion in the review.

The third step, data evaluation, is the process of evaluating selected papers through the second step. The researchers assessed the suitability of the research topic, the quality of the methodology, and the value of the research results using quality assessment tools appropriate for each study design. The two researchers examined the 16 studies in this review to determine the level of evidence following the parameters set by Fineout-Overholt et al.[13]. In their hierarchy of evidence for intervention studies, Level I refers to systematic reviews or meta-analyses, Level II refers to randomized controlled trials, Level III is reserved for controlled trials without randomization, Level IV is for case control or cohort studies, Level V contains systematic reviews of qualitative or descriptive studies, Level VI refers to qualitative or descriptive studies, and Level VII includes expert opinions or consensus. All of the 16 studies were quantitative: 1 Level II, 14 Level III, and 1 Level VI. The list of articles was finalized after consensus between authors. The levels of evidence are listed in Table 1. The quality evaluation of the literature was carried out independently by two researchers, and in the case of inconsistencies, agreement was made through the opinions of third researcher.

The fourth step is the data analysis step, which analyzes the existing data and synthesizes the meanings. The fifth step is to present the results of the integrated consideration in the form of a model as the data presentation step.

3. Results

After the initial 2,113 papers, duplicates were culled, along with an additional 138 titles deemed qualitatively irrelevant. Then, an additional 103 studies were excluded for not meeting the inclusion criteria after abstract analysis, and the remaining 35 articles underwent a more thorough examination. Following this, only a total of 16 papers met all inclusion criteria, and were used for data analysis and extraction (Figure 1). Each article was appraised for general study characteristics, operation method, teaching and learning method, subject characteristics, outcome variables, and theoretical framework (Table 1).

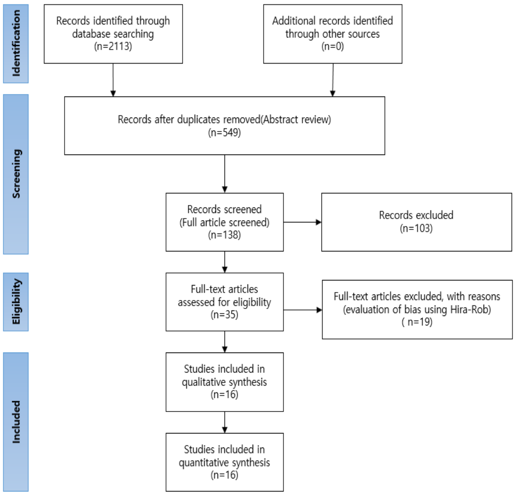

Fig. 1. Flow chart showing the study selection process during the literature review.

3.1 General characteristics of selected studies

The general characteristics of the 16 studies finally selected for analysis were as follows (Table 1) : A total of four studies were published in 2012-2014[14-17], and four were published in 2015[18-21], 2016[22-25], and 2017[26-29]. 12 of those papers were published in an academic journal, and four were released as dissertations [14,23,24,27]. Regarding the study designs, the control group design was the most prevalent, and the research participants were either juniors and seniors. Lastly, 7 of the 16 papers had no more than 60 participants[17,19,22-24,27,29].

3.2 Analysis of the simulation processes in the selected studies

All 16 studies conducted different forms of precedent learning, either individual and team, or lecture and nursing skill practicum(Table 1). Twelve studies has simulation times less than 20 minutes, 1 study ran within 20-30 minutes[15]; 4 studies described no simulation[19,21,23,29]. Concurrently, 6 studies had a debriefing time of 30-40 mins [14,15,17,18,24,25]. Other researchers debriefed solely by team[14,16,18,19,26,27]; while others debriefed by team and class[15,21,23-25] .

3.3 Analysis of theoretical frameworks used in selected studies

Ten of the 16 studies made no mention their theoretical framework, while 3 referred to the NLN Jeffries theory[17,24,27]; the remaining highlighted a systems thinking approach[17], goal-based learning[26], present state outcomes[23], practice-based simulation[27], and the jigsaw model[15] as their theoretical frameworks(Table 1).

3.4 Analysis of components based on the Jeffries theoretical framework

The studies were then evaluated using Jeffries simulation theory as the standard, and each was examined for their inclusion of any major concepts mentioned therein(Table 2). When considering simulation experiences, nine studied programs [14,16,18,19,22-27] that incorporated simulation in orientation and self-training in environments of trust, and eight [14,15,18,20, 22,24,26,27] were experiential, making use of role play.

On the other hand, in terms of interactivity, eight programs included interactions with patients [14,15,17,18,22-24,27], but in terms of collaboration, ten were team-based[14,16,18,19-22,25,27,29]. Notably, however, all programs studied were learner centered. Next, six of the studies made mention of the facilitator's simulation-related records[14,20,22-25]. Then, in terms of dynamic interactions between teaching and learning personnel, two studies notably did not include any discussion[17,29]; whereas three studies mentioned a dynamic interaction framework[14,22,24].

Table 1. Simulation-based nursing education in South Korea

Author Level of Evidence	Study Purpose Scenario Topic	Study Design Sampling	Dependent Variable Theoretical Framework	Simulation Operation Process	Study Results and Conclusions
Kim, J.A. (2012) Level III	To evaluate the effects of cooperative learning applying the jigsaw model in simulation-based nursing education by comparing knowledge, intrinsic motives, and course satisfaction Congestive heart failure with dyspnea; chest pain	Nonequivalent control group Pretest-posttest design Convenience sample of third-year undergraduate nursing students (n=83) **Control group** (CON) Lecture, skills training, simulation, debriefing (n=41) **Experimental group** (EXP) Cooperative learning, simulation practice, debriefing(n=42)	Knowledge, education satisfaction, and intrinsic motivation Jigsaw model	**Pre-Simulation** Orientation (present scenario topics), lecture, self-precedent learning, skills practicum, develop scenario and distribute roles **Simulation** Present scenario (40 min) Conduct simulation (20-30 min) **Post-Simulation** Debriefing, team and class (40 min)	EXP showed significantly higher knowledge scores (*p*=.034) and education satisfaction (*p*=.034) than did CON, but there was no significant difference in intrinsic motivation. Cooperative learning applying the jigsaw model can improve the scholastic achievement and class satisfaction of students in simulation-based education.
Kim, H. R. (2012) Level III	To develop a team-based simulation learning program and to evaluate this program's effects on undergraduate nursing students Pneumonia, chronic obstructive respiratory disease Hydration, pneumothorax	Nonequivalent control group Pretest-posttest design Convenience sample of third-year undergraduate nursing students (n=63) **Control group** Case study (n=31) **Experimental group** Team-based simulation learning program (n=32)	Interpersonal understanding, problem-solving ability, academic achievement No mention	**Pre-Simulation** Orientation (present scenario topics and nursing skills), lecture (only Con), precedent learning (Con: self; Exp: self and team), skills practicum, develop scenario and distributing roles **Simulation** Orientation (equipment description, training), conduct simulation (15 min) **Post-Simulation** Debriefing, team (30 min)	EXP showed significantly higher scores in interpersonal understanding, problem-solving ability, and academic achievement (all: *p*<.001) than did CON. A team-based simulation learning program for undergraduate nursing students was very effective in promoting interpersonal understanding, problem-solving ability, and academic achievement.
Kang et al. (2013) Level VI	To understand how team performance related to team efficacy, interpersonal understanding, positiveness in problem solving, and class satisfaction, after team-based simulation learning Myocardial infarction	Descriptive study Convenience sample of third-year undergraduate nursing students (n=228)	Interpersonal understanding, Team efficacy, problem-solving ability, class satisfaction No mention	**Pre-Simulation** Orientation (present scenario topics), precedent learning (self and team), skills practicum **Simulation** Conduct simulation (15 min) **Post-Simulation** Debriefing, team (30 min)	Team performance score was related to interpersonal understanding (p<.001), team efficacy (p<.001), positiveness in problem solving (p=.001), and class satisfaction (p=.002). There is a need to increase team efficacy, interpersonal understanding, positiveness in problem solving, and class satisfaction to improve team performance of nursing students.
Kim & Yun (2014) Level III	To develop and apply a simulation skills package designed to improve nursing students' knowledge integration and their systems thinking (ST) skills regarding congestive heart failure and to identify the changes in students' ST skills using a ST-based learning approach Congestive heart failure	One group pre-posttest design Convenience sample of third-year undergraduate nursing students (n=35)	Direction of causality, polarity of causal relationships NLN Jeffries simulation theory and systems thinking	**Pre-Simulation** Orientation (present scenario topics), cause and effect map (team) **Simulation** Orientation (10 min), conduct simulation(20 min) **Post-Simulation** Debriefing (60 min)	Mean test scores for students who completed the program were significantly higher than their pre-intervention scores including on direction of causality, polarity of causal relationships, feedback loop, polarity of feedback loop (reinforcing, balancing), and time delay (p=.030~p<.001) More education programs are needed on various topics in order for nursing students to improve their ST skills as well as knowledge integration in clinical nursing practicum packages.
Kim & Kim (2015) Level III	To evaluate the effects of a colonoscopy simulation program on knowledge and clinical performance among nursing students Health assessment module on nursing before and after colonoscopy including emergency care for post-colonoscopy bleeding	Nonequivalent control group Pretest-posttest design Convenience sample of third-year undergraduate nursing students (n=149) **Control group** Usual lecture program (n=78) **Experimental group** Simulation (n=71)	Knowledge, clinical performance No mention	**Pre-Simulation** No mention **Simulation** Conduct simulation (20 min) **Post-Simulation** Debriefing (30 min)	EXP showed significantly higher scores on knowledge and clinical performance (both: p<.001) than did CON. The simulation program was useful for improving knowledge and clinical performance among nursing students.

Kim & Park (2015) Level III	To identify the effects of problem-based learning integrated with simulation on nursing students' critical thinking, problem-solving processes, and nursing self-confidence Acute asthma	One group pre-posttest design Convenience sample of undergraduate senior nursing students (n=47)	Critical thinking, problem-solving processes, nursing self-confidence No mention	**Pre-Simulation** Orientation (present scenario topics), precedent learning(self, team) **Simulation** No mention **Post-Simulation** Debriefing (create a concept map after debriefing)	There were significant differences in the nursing students' critical thinking, problem-solving processes, and nursing self-confidence following problem-based teaching with simulation practice. There were also correlations between variables.
Lee et al. (2015) Level III	To identify the differences in nursing students' problem-solving ability and learning flow in team-based simulation learning depending on their metacognition levels No mention	One group pre-posttest design Convenience sample of undergraduate senior nursing students (n=81)	Metacognition and problem-solving ability, metacognition and Learning flow No mention	**Pre-Simulation** Orientation (present scenario topics), precedent learning (team) **Simulation** Orientation (equipment description), conduct simulation(15 min) **Post-Simulation** Debriefing, class(60 min)	This study showed significant differences in problem-solving ability (p>.000) and learning flow (p=.007) by students' metacognition levels. These results suggest that metacognition has a positive effect on nursing students' learning outcomes.
Park et al. (2015) Level III	To examine the effects of action learning techniques in simulation class Diabetes mellitus; asthma; myocardial infarction	Nonequivalent control group Pretest-posttest design Convenience sample of undergraduate senior nursing students (n=184) **Control group** Only simulation (n=92) **Experimental group** Simulation and action learning (n=92)	Professional self-concept, communication skills, self-directed learning No mention	**Pre-Simulation** Orientation (present scenario topics), precedent learning (team), skills practicum (CON only: 120 min) **Simulation** Conduct simulation **Post-Simulation** Reflection sheet, team and class	Professional self-concept (p=>.001), communication competence, and self-directed learning capability were all higher in EXP than in CON. Creative education techniques such as future action learning and hands-on training are helpful.
Chae (2016) Level III	To develop a scenario and determine the effects of nursing students' learning attitudes, problem-solving processes, and clinical performance in simulation learning on care for acute patients with asthma in emergency units Abdominal pain, cerebrovascular accident, hypoglycemia, voiding difficulty, arrhythmia, mild asthma	Nonequivalent control group Pretest-posttest design Convenience sample of third-year undergraduate nursing students (n=60) **Control group** Traditional lecture and practice education (n=30) **Experimental group** Team study (problem-based learning), team simulation and debriefing (n=30)	Learning attitudes, problem-solving processes, clinical performance No mention	**Pre-Simulation** Orientation (present scenario topics), lecture (CON only, 60 min), precedent learning (CON: self, EXP: team; 60 min), skills practicum (CON only: 120 min) **Simulation** Orientation (equipment description, training, feedback), conduct simulation(10 min) **Post-Simulation** Debriefing, team(10 min)	EXP showed significant differences in learning attitudes, problem-solving processes, and clinical performance (all: p<.001) than did CON. Problem-based simulation is an effective teaching method to improve learning attitudes and problem-solving processes in nursing students who are learning to care for patients with asthma.
Seo (2016) Level III	To develop and assess a simulation-based nursing education program using the OPT model Gastrointestinal bleeding, acute myocardial infarction	Nonequivalent control group Pretest-posttest design Convenience sample of undergraduate senior nursing students (n=45) **Control group** Clinical practicum (n=20) **Experimental group** OPT-based simulation program (n=25)	Clinical reasoning, problem-solving ability, self -efficacy, clinical competence Outcome-Present State Test	**Pre-Simulation** Orientation (present scenario topics and nursing skills), lecture (EXP: 2 hr), precedent learning (exp: self and team), skills practicum (EXP: OSCE video) **Simulation** Conduct simulation **Post-Simulation** Discussion about nursing process (class)	EXP group showed significantly higher scores in clinical reasoning (p=.002), problem-solving ability (p<.001), self-confidence (p<.001), and clinical competence (p=.002) than did CON. Simulation using the OPT model is needed in nursing education to enhance students' competencies.
Cho & Hwang (2016) Level III	To develop a problem-based nursing education program based on simulation and examine its effects on nursing students' learning motivation, learning strategies, and academic achievement No mention	One group pre-posttest design Convenience sample of undergraduate senior nursing students (n=69)	Learning motivation, learning strategy, academic achievement No mention	**Pre-Simulation** Orientation (present scenario topics), lecture (40 min), problem-based precedent learning (90 min) **Simulation** Conduct simulation (15 min) **Post-Simulation** Debriefing(30 min)	Problem-based nursing education based on simulation reduced the nursing students' other-directed (external) motivation, increased their self-regulation motivation (identified, intrinsic), and improved their use of resource management strategies. In addition, academic achievement and education satisfaction correlated positively with identified motivation and learning strategies (cognitive, metacognitive, and resource management).

Oh (2016) Level III	To test the effects of transformative learning theory-based debriefing on knowledge, problem-solving processes, clinical thinking disposition, and clinical judgment of nursing students Hypoglycemia, hyperglycemia	Nonequivalent control group Pretest-posttest design Convenience sample of third-year undergraduate nursing students (n=56) **Control group** Usual debriefing (n=26) **Experimental group** Transformative learning theory-based debriefing (n=30)	Knowledge, problem solving, critical thinking NLN Jeffries simulation theory, transformative learning theory	**Pre-Simulation** Orientation (present scenario topics and nursing skills), lecture (40 min), precedent learning (self and team), skills practicum(30 min) **Simulation** Orientation (equipment description, training; 20 min) Conduct simulation (10 min) **Post-Simulation** Debriefing, team and class (oral, 20 min; paper, 10 min)	EXP showed significantly higher scores for problem-solving processes (p<.001), clinical thinking disposition (p=.009), and clinical judgment (p<.001) than did CON, but there was no significant difference in knowledge. Transformative learning theory-based debriefing is effective during simulation-based learning.
Park (2017) Level III	To investigate the effectiveness of simulation training designed according to goal-based scenario constituent elements such as educational goals, mission cover story, role, scenario operation, resources, and feedback Hepatic coma, diabetic ketogenic coma, chest pain	Nonequivalent control group Pretest-posttest design Convenience sample of undergraduate senior nursing students (n=130) **Control group** Traditional simulation practicum (n=60) **Experimental group** Simulation practicum based on goal-based scenario (n=70)	Clinical thinking, problem solving, clinical judgment, clinical performance, course satisfaction, academic achievement Goal-based-learning	**Pre-Simulation** Orientation (present scenario topics and nursing skills), lecture (30 min), precedent learning (self, team) **Simulation** Orientation (equipment description, training; 30 min) Conduct simulation (15 min) **Post-Simulation** Debriefing (120 min)	EXP showed significantly higher scores in critical thinking (t=1.81,p=.073), problem solving ability (t=1.79,p=.076), course satisfaction (t=8.61, p<.001), and academic performance (t=5.48, p=.001) than did CON. The goal-based scenario simulation program presented clear objectives for simulating training and learning methods that were appropriate to the education environment.
Yun (2017) Level II	To compare the effects of problem-based learning with simulation according to the integration sequence of problem-based learning and high-fidelity patient simulation on nursing students' knowledge, clinical performance, clinical judgment, self-confidence, and satisfaction Postoperative pneumonia, chronic obstructive respiratory disease, congestive heart failure, stroke	Randomized crossover design Convenience sample of undergraduate senior nursing students (n=25) **Experimental group 1** Problem-based learning -> high-fidelity patient simulation (n=13) **Experimental group 2** High-fidelity patient simulation -> problem-based learning (n=12) Applied to cross four times for eight weeks	Knowledge, clinical performance, clinical judgment, self-confidence, satisfaction NLN Jeffries simulation theory, practice-based simulation model	**Pre-Simulation** No mention **Simulation** Conduct simulation (15 min) **Post-Simulation** Debriefing, team and class(20 min)	EXP 1 showed statistically significantly higher knowledge scores (p=.023), and EXP 2 showed significantly higher clinical performance and clinical judgment scores (both: p <.001), but there were no differences in self-confidence and satisfaction.
Chu & Hwang (2017) Level III	To assess the efficacy of web-based simulation and high-fidelity simulation on acute heart disease patient care No mention	Nonequivalent control group Pretest-posttest design Convenience sample of third-year undergraduate nursing students (n=144) **Control group** High-fidelity simulation (n=68) **Experimental group** Web-based simulation (n=76)	Self-efficacy, problem solving, interest in learning, stress level, satisfaction with simulation experience, difficulty of simulation No mention	**Pre-Simulation** Orientation (present scenario topics), precedent learning (self, workbook) **Simulation** Orientation (Equipment description, training; 30 min) Conduct simulation (15 min) **Post-Simulation** Debriefing, team and class(60 min)	The scores for self-efficacy, problem-solving ability, and interest in learning including interest in clinical training in the high-fidelity simulation group were higher than those in the web-based simulation group. However, there were no significant differences in interest in learning, including interest in nursing knowledge, or in lab training, stress level, satisfaction with the simulation experience, and difficulty of the simulation.
Ma et al. (2017) Level III	To examine the effects of a self-directed learning program on nursing students' learning attitudes, self-directed learning, and problem-solving ability Congestive heart failure with dyspnea, chest pain	Nonequivalent control group Pretest-posttest design Convenience sample of undergraduate senior nursing students (n=40) **Control group** Lecture-centered simulation class (n=20) **Experimental group** Self-directed learning-based simulation class (n=20)	Learning attitudes, self-directed learning, problem-solving ability No mention	**Pre-Simulation** Orientation (present scenario topics), lecture (Only con: 60 min), precedent learning (Con: self; Exp: web-based team learning), skills practicum (6 hr) **Simulation** No mention **Post-Simulation** No mention	Exp showed significant effects on learning attitudes, self-directed learning, and problem-solving ability compared with con.

Table 2. Components based on the Jeffries theoretical framework

(N=16 studies)

Characteristic		Categories	N (%)
Simulation Experiences	Environment of trust	Orientation	7 (43.75)
		Orientation and self-training	9 (56.25)
	Experiential	Role play	8 (50.0)
		No mention or not applicable	8 (50.0)
	Interactive	With patient	8 (50.0)
		With patient and medical staff	1 (6.25)
		With patient, medical staff, guardian	1 (6.25)
		No mention	6 (37.5)
	Collaborative	Team	10 (62.5)
		No mention or not applicable	6 (37.5)
	Learner-centered		16 (100.0)
Facilitator		Various simulation-related records	6 (37.5)
		No mention	10 (62.5)
Participant		General characteristics and other variables	16 (100.0)
		No mention	0 (0.0)
Dynamic interaction		Debriefing and feedback (with framework)	3 (18.8)
		Debriefing and feedback (without framework)	11 (68.8)
		No mention	2 (12.5)
Independent variables in Jeffries framework		Collaborative	3 (18.75)
		Learner-centered	11 (68.75)
		Dynamic interaction	1 (6.25)
		Participant	1 (6.25)

Regarding analysis of manipulated variables among concepts of the Jeffries theory, 11 studies manipulated the learner-centered concept[17-19, 21-23,25-29], while three others manipulated collaboration[14-16]. However, there was one study on dynamic interaction[24] and one on simulation education participants[20].

3.5 Analysis of general characteristics of participants

The general characteristics of participants are listed in Table 3. Notable is that among the general characteristics, 13 studies considered sex, and 9 considered age. While eight other studies covered satisfaction with nursing, five tackled religion, five covered previous semester grade, and five looked at satisfaction with college life.

Table 3. General characteristics of participants in the selected studies

(N=16 studies)

Categories	N (%)
Age	9 (56.25)
Sex	13 (81.25)
Religion	5 (31.25)
Previous semester grade	5 (31.25)
Interpersonal relationships in school	3 (18.75)
Nursing choice motive	3 (18.75)
Satisfaction with nursing	8 (50.0)
Satisfaction with college life	5 (31.25)
Satisfaction with clinical practice	2 (12.5)
Experience of simulation	2 (12.5)

3.6 Analysis of outcome variables used in selected studies

This review also analyzed the different studies' results based on the Jeffries simulation theory : learning, reaction, and behavior. Among the reviewed works, five studies measured all three[14,19,26,27,29], whereas four measured only reaction and behavior[16,22,23,28], and three studies only measured learning [18,21,25]. No study measured patient or system outcomes.

4. Discussion

This integrative review attempted to identify a scientific basis for simulation-based nursing education operation methods. The simulation-based learning processes we analyzed in this study incorporated pre-simulation, simulation, and post-simulation debriefing stages (Table 1); all of which has been previously identified as common in simulation-based education[30]. When looking at operating methods at the pre-simulation stage, there were five studies on self-precedent learning and four on self-precedent learning and self-training; these concepts were most frequently used to improve the effectiveness of simulation learning. Another study proposed rehearsal techniques, such as self-training, as the best way to reduce trial-and-error before running a scenario[8], supporting the findings from this review. Authors of 12 studies reported on operation times within 20 mins, which was identical to the suggested time[30] indicating that simulation in Korea may be effectively operated within theoretical parameters.

Regarding debriefing size in this study, six studies debriefed by team group, and five did so in mixed-size groups. In the team group studies, debriefing was used in their simulation in order to encourage students to participate in learning and to promote their critical thinking, interpersonal, and communication skills[31]. In a few cases, debriefing took place in large groups because of time constraints. However, the effects of debriefing in different group sizes are still being discussed[32], and more studies are needed to verify its importance.

Although the effectiveness of simulation-based education can be maximized when it is based on a sound theoretical framework[5], in this study, only six studies discussed the use of any theoretical framework[15,17,23,24,27]. This implies that simulation in Korea is conducted without a reviewed theoretical basis, and any improvements in the quality of simulation-based education will need the inclusion of that theoretical background.

Using the Jeffries simulation theory and framework[4,5], we ruled out the background and design because these overlap with operating processes. Instead, we discuss simulation in education as based on facilitators, participants, dynamic interactions, and outcomes frameworks. The Jeffries simulation theory emphasizes the importance of simulation experiences in education, and this learner-centered experience must be gained in environments of trust, interaction, and collaboration[4].

While all the reviewed articles referred to learner-centered simulation education in some form, none provided details on participant experiences. To meet this learner-centered framework, future simulation experiences require orientation and operation strategies that consider students' psychological stability and autonomy, as well as ethical aspects. There is also a need to explore strategies that allow as many students as possible to experience the simulation in a limited time and space. Given the complexities of clinical practice, strategies should be considered that allow students to experience not only patient interactions, but also interactions with next of kin and other professionals.

Only six of the studies (37.5%) discussed the features of simulation facilitators, indicating a lack of recognition regarding facilitator expertise in simulation education in Korea. Facilitators should have clinical expertise they can transfer to the simulations, provide practical learning environments, feedback, and evaluations, and guide learners towards an active reflection of their experiences[33]. As such, specialized facilitator training is required to successfully lead learners' simulation experiences[34]. Efforts should be made to review a standardized set of qualifications expected of facilitators, and cultivate the skills required for this role, allowing for the development of facilitator role models. Evaluation tools may also be needed to monitor facilitator quality.

The Jeffries simulation theory also contends that simulation training experiences vary according to the participants' sex, age, anxiety levels, confidence, and resolution[4,5]. However, we found that no study considered anxiety levels among their general student characteristics. This may be due to the fact that the studies reviewed only focused on the effectiveness of their simulation training programs as an instructional and learning method in adult nursing education. However, the Jeffries simulation theory proposes that in order to maximize the simulation experience and improve the effectiveness of education, learning-related participant characteristics should be considered in a simulation and curriculum's design and operation. This means that is may also be necessary to examine learning theories as a development strategy, and adapt to participants' circumstances to increase a simulation program's effectivity.

In the studies reviewed, the Jeffries theory's concept of dynamic interaction between facilitator and participant was mostly incorporated in the debriefing stage. Dynamic interaction between a facilitator and a participant seen in NLN Jeffries simulation theory was mostly found in debriefing. In previous studies, debriefing is described as a process of active interaction between learners and teachers[5,35]. It is a key element in simulation education. All simulations have suggested that a well-planned debriefing plan should be included to facilitate reflective thinking [5,36]. While studies related to debriefing in nursing simulation training in South Korea have been conducted since 2012, only about half of these studies implemented a debriefing stage based on any structured framework[35]. It may be necessary to develop a debriefing guide model that is suitable for the circumstances in South Korea, and its interaction-enhancing effects should be verified. In addition to debriefing, learning tools may promote dynamic interactions between the facilitators and the participants throughout the simulation process, supplemented by project reports and further research to validate their effects.

Also, according to the Jeffries simulation theory[5], to evaluate the effectiveness of simulation training, it is necessary to include not only participants, such as nurses and nursing students, but also patients. In terms of study participants, any curricula being assessed may benefit from incorporating the Jeffries theory components of learning, response, and behavior[32]. However, the present review found that all 16 studies analyzed evaluated the effects of simulation-based education on active participants only. Education programs may benefit from strategies that incorporate patients' assessments of their experiences in simulation activities, as well as that of the involved hospital systems to allow for better integration of these experiences in future curricula.

In the present study, we only found five studies that included measurements of outcome variables (i.e., participants' learning, reactions, and behaviors) suggested by Jeffries, Rodgers, and Adamson[5]. Most of the studies reviewed only evaluated simulation-based education programs in the learning domain, including affect. Simulation-based education strategies may improve if they also incorporate participants' reactions and behaviors, as well as their learning; valid and reliable tools may be needed to evaluate these various factors.

This study provides a basis for developing simulation-based education methods from an integral review of simulation processes in nursing education in Korea using the Jeffries simulation theory. However, because we only analyzed studies on simulation in nursing education, the scope was narrow, limiting the generalizability of the results. In addition, we only reviewed studies on simulation-based education operating processes, providing no discussion of the feasibility of the simulation scenarios that were used or discussed in the research. Finally, because we only analyzed and integrated results from studies based on the Jeffries simulation theory and framework, we did not compare or analyze any other learning theories or study methods. This study conducted systematic data retrieval but could not perform meta-analysis because of heterogeneity of study design.

5. Conclusion

This study was conducted to check the current state and characteristics of simulation-based operating processes in nursing education based on the Jeffries theoretical framework in South Korea by taking an integrated look at study findings to provide a scientific basis for future simulation-based operating processes. We found the following: First, there are ongoing efforts to improve the effectiveness of simulation-based nursing education, as reflected in the variety of operating processes studied. Second, we confirmed the need for standardized simulation operation guidelines that are suitable for the South Korean context. Third, the five Jeffries conditions for simulation experiences were not evenly reflected in the studies reviewed. Fourth, we evaluated the effectiveness of the simulation-based operating processes of nursing education in only one category rather than the three suggested by the Jeffries simulation theory. Thus, program developers need to consider and incorporate a variety of strategies, as well as the identified essential components, to improve a simulation's effectiveness. Nursing educators need to consider scenarios so that learning can take place around active interactions between instructors and learners, taking into account the complex and rapidly changing clinical situation. Tools are also needed for evaluating outcome variables(e.g., outcome variables related to system, patient, dynamic interation) and validating the effects of simulation-based nursing education.

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