

Room of Errors Simulation: Effects on Patient Safety Competence and Critical Thinking in Nursing Students

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Room of Errors 시뮬레이션: 간호대학생의 환자 안전 역량과 비판적 사고에 미치는 영향

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Abstract This study was conducted to analyze the educational effects of the Room of Errors simulation program in nursing education. The study participants consisted of 39 nursing students, and data were collected via self-administered questionnaires. Descriptive statistics and t-tests were performed using SPSS/WIN 28.0. The results showed significant improvements in nursing students' perceived importance of patient safety management, patient safety management activities, and critical thinking disposition after completing the Room of Errors simulation program. In conclusion, the Room of Errors simulation program is an effective educational strategy for enhancing the patient safety competencies of nursing students and can be utilized in practical training to strengthen patient safety in the field of nursing education.

Key Words : nursing students, simulation, patient safety management, critical thinking disposition

요약 본 연구는 간호교육에서 Room of Errors 시뮬레이션 프로그램의 교육적 효과를 분석하기 위해 수행되었다. 연구대상자는 간호학과 재학생 39명으로, 자기기입식 설문지를 통해 자료를 수집하였으며, SPSS/WIN 28.0 프로그램을 이용하여 기술통계와 t-검정을 실시하였다. 연구 결과, "Room of Errors" 시뮬레이션 프로그램을 이수한 후 간호대학생들의 환자안전관리 중요성 인식, 환자안전관리 활동, 그리고 비판적 사고성향이 중재 전보다 유의하게 향상된 것으로 나타났다. 결론적으로, "Room of Errors" 시뮬레이션 프로그램은 간호대학생의 환자안전 역량을 증진시키는 데 효과적인 교육전략으로, 간호교육 현장에서 환자안전 강화를 위한 실습 교육에 활용될 수 있을 것이다.

주제어 : 간호대학생, 시뮬레이션, 환자안전관리 인식, 환자안전관리 활동, 비판적 사고성향

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1. INTRODUCTION

1.1 Background and Significance

Patient safety refers to the prevention of avoidable harm that may occur to patients during the provision of healthcare services and is widely recognized as a key indicator of healthcare quality [1]. In South Korea, the enactment of the Patient Safety Act in 2016 established an institutional foundation for patient safety and increased societal awareness; however, patient safety incidents reported in clinical settings have continued to rise [2,3]. This trend suggests that institutional measures alone are insufficient to ensure patient safety and highlights the necessity of strengthening healthcare professionals' practical competencies in early risk recognition and appropriate response in clinical settings. In particular, nurses, who maintain the closest and most continuous contact with patients, play a critical role in ensuring patient safety [4]. Therefore, nursing education should not only foster knowledge and awareness of patient safety but also be designed to develop students' competencies to effectively apply these principles in real clinical situations.

The Korean Accreditation Board of Nursing Education (KABON) identifies "application of safety and quality management principles" as a core program learning outcome, emphasizing patient safety competence as a fundamental goal of nursing education [5]. Furthermore, KABON highlights the principles of continuity and sequence in curriculum design, indicating that patient safety education should be progressively deepened and reinforced across academic levels [6,7]. In particular, fourth year nursing students who are approaching graduation and clinical transition are expected to demonstrate advanced patient safety competencies beyond basic knowledge. They must be capable of identifying risks, prioritizing problems, and responding appropriately in complex, real world clinical

situations. Accordingly, educational strategies for senior students should move beyond knowledge transmission and adopt experiential approaches that integrate knowledge, judgment, and performance within authentic clinical contexts.

To address these educational needs, this study adopts Kolb's experiential learning theory and Schön's reflective practice theory as its theoretical framework. According to Kolb's experiential learning theory, learning occurs through a cyclical process consisting of concrete experience, reflective observation, abstract conceptualization, and active experimentation [8]. In this process, learners deepen their understanding by experiencing realistic situations, reflecting on those experiences, reconstructing knowledge conceptually, and applying it to new contexts. Schön further emphasized that reflection is a critical mechanism in professional practice, enabling individuals to critically evaluate their actions and improve future performance [9]. From this perspective, patient safety education should not be limited to memorizing error types but should provide structured opportunities for learners to directly experience risk situations, interpret their meaning, and adjust their judgments and actions accordingly.

Within this theoretical framework, simulation based education can serve as an effective strategy for enhancing patient safety competencies. Previous studies have suggested that Room of Errors or Room of Horrors simulation can enhance learners' ability to identify patient safety hazards in clinical environments [10]. However, conventional simulation approaches often focus on performing assigned roles or applying procedural skills within predefined clinical scenarios. In contrast, the Room of Errors simulation is distinct in that it emphasizes learners' active identification, interpretation, and correction of intentionally embedded errors and hazards within a simulated environment [11]. Whereas traditional simulation focuses on performance based application, Room of Errors simulation operates as an exploratory

and reflective learning strategy centered on risk recognition, situational judgment, error analysis, and corrective decision making. These characteristics align closely with Kolb's experiential learning cycle and Schön's concept of reflective practice, thereby providing a strong theoretical foundation for its educational effectiveness.

Previous research indicates that perceived importance of patient safety management and actual safety related behaviors are closely associated, and that enhancing students' understanding and awareness of safety increases the likelihood of safe performance [12,13]. In addition, critical thinking disposition is a fundamental cognitive component required for prioritization and sound decision making in complex clinical situations and is considered essential for patient safety related problem solving [14]. Therefore, evaluating the effectiveness of Room of Errors simulation requires not only assessing changes in perceived importance of patient safety management but also examining patient safety management activities and critical thinking disposition. This approach enables a comprehensive understanding of how Room of Errors simulation, grounded in experiential learning and reflective practice, facilitates the integrated development of cognitive, behavioral, and judgmental competencies.

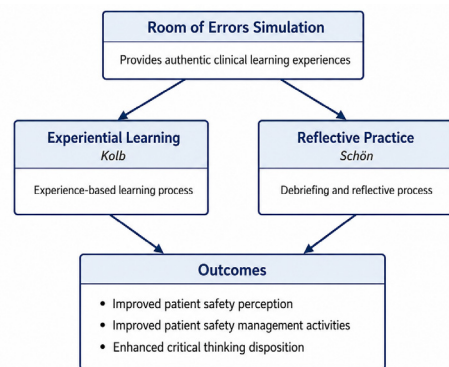
Meanwhile, previous studies on Room of Errors simulation have primarily focused on the development and validation of Room of Errors items [11] or the evaluation of educational effects using a single simulation scenario [15]. However, studies that apply multiple Room of Errors simulation scenarios to examine perceived importance of patient safety management, patient safety management activities, and critical thinking disposition in an integrated manner remain limited. In particular, there is a lack of research investigating the effects of multi scenario based Room of Errors simulation on the comprehensive patient safety competencies of fourth year nursing students who are preparing

for clinical transition.

Therefore, this study was guided by experiential learning theory and reflective practice theory to explain how the Room of Errors simulation may improve patient safety-related learning outcomes. Through this investigation, the study seeks to identify the distinctive educational mechanisms of Room of Errors simulation compared to conventional simulation approaches and to provide theoretical and practical evidence for developing evidence based nursing education strategies to enhance patient safety competencies.

1.2 Theoretical Framework

This study was grounded in Kolb's experiential learning theory and Schön's reflective practice theory. The Room of Errors simulation was conceptualized as an instructional strategy that provides nursing students with authentic clinical learning experiences by requiring them to identify and analyze embedded patient safety hazards. Based on Kolb's theory, the simulation offers concrete experiences that help students connect patient safety knowledge with clinical practice. Schön's reflective practice theory supports the role of debriefing, through which students review their observations, reflect on their judgments, and internalize patient safety principles. Accordingly, the simulation was expected to promote learning through experiential



[Fig. 1] Theoretical Framework

engagement and structured reflection, thereby improving perceived importance of patient safety management, patient safety management activities, and critical thinking disposition (figure 1).

2. Materials and Methods

2.1 Study design

This study employed a one-group pretest-posttest design to examine the effects of the Room of Errors simulation on nursing students' perceived importance of patient safety management, patient safety management activities, and critical thinking disposition.

2.2 Subject of study

Participants were fourth-year nursing students enrolled in a simulation course at a university in Gyeonggi-do, South Korea, who gave their voluntary consent after being fully informed of the purpose of the study. The required sample size was calculated using G*Power version 3.1.9.7. Based on an effect size of 0.55 reported in a previous study [10], with a significance level of $\alpha = .05$ and statistical power of .95, the minimum required sample size was determined to be 38 participants. Considering potential attrition, a total of 42 participants were recruited. After excluding incomplete responses, data from 39 participants were included in the final analysis.

2.3 Measures

2.3.1 Perceived importance of patient safety management

The perceived importance of patient safety management was assessed using an instrument originally developed by Park, Kim, and Ham [16] for hospital healthcare workers and later modified for nursing students by Choi and Lee [13]. Responses were rated on a 5 point Likert

scale, with higher scores indicating greater perceived importance of patient safety management. The original reliability of the instrument was Cronbach's $\alpha = .67$, and the reliability in this study was Cronbach's $\alpha = .79$.

2.3.2 Patient safety management activities

Patient safety management activities were assessed using the Patient Safety Management Activity Scale (PSM A) developed by Yoo and Lee [17] for nursing students. The instrument consists of 15 items rated on a 5 point Likert scale, with higher scores indicating higher levels of patient safety management practice. The original reliability of the instrument was Cronbach's $\alpha = .89$, and the reliability in this study was Cronbach's $\alpha = .88$.

2.3.3 Critical thinking disposition

Critical thinking disposition was assessed using Yoon's 27 item instrument [18]. Responses were rated on a 5 point Likert scale, with higher scores indicating greater critical thinking disposition. The original reliability of the instrument was Cronbach's $\alpha = .84$, and the reliability in this study was Cronbach's $\alpha = .87$.

2.4 Study process

2.4.1 Development of the Room of Errors Simulation

To determine the educational content and instructional strategy, an extensive literature review was conducted, leading to the selection of patient safety management as the core topic and the Room of Errors simulation as the educational method.

The Room of Errors simulation scenarios were developed based on the study by Kim [11]. Two nursing professors collaboratively designed two postoperative nursing scenarios—colorectal cancer surgery and liver cancer surgery—taking into account the learning level of students

enrolled in the simulation practicum course.

The foundational data for each scenario were derived from de-identified electronic medical records (EMRs) of hospitalized patients in general hospitals, including diagnoses, medical histories, and physician orders. All cases were reconstructed into hypothetical scenarios in compliance with institutional privacy protection standards.

Initial drafts were developed by a researcher with more than 15 years of clinical experience in a tertiary hospital. Content validity was subsequently evaluated by a panel of experts, including one clinical nurse specialist (CNS) with over 25 years of surgical ward experience and two nursing professors specializing in patient safety and simulation-based education. Evaluation criteria included clinical realism, validity and difficulty of medical errors, educational appropriateness, and alignment with learning objectives. Based on expert feedback, physician orders, error types, and terminology were refined to enhance both educational accuracy and practical relevance.

The colorectal cancer surgery scenario involved a 75-year-old male patient on the first postoperative day following bowel resection and included 25 embedded medical errors related to core nursing skills such as patient identification, pressure injury and fall prevention, drainage management, oxygen therapy, SpO₂ monitoring and ECG monitoring, intravenous fluid administration, enteral feeding, and indwelling urinary catheter care. The liver cancer surgery scenario involved a 70-year-old male patient on the second postoperative day after hepatic resection and included 35 medical errors addressing similar nursing competencies.

Following development, a pilot test was conducted to evaluate feasibility and realism. Four nursing graduates participated under simulated clinical conditions and provided feedback on realism, error validity, and educational appropriateness. Based on their feedback, minor revisions were made to enhance authenticity.

This process established the content validity and feasibility of the Room of Errors simulation scenarios.

2.4.2 Implementation of the Intervention

The intervention was conducted in three sequential phases: pre-test, intervention, and post-test.

(1) Pre-test phase

Prior to the intervention, participants completed a pre-test to assess baseline levels of perceived importance of patient safety management, patient safety management activities, and critical thinking disposition. Before completing the questionnaire, the researcher explained the study objectives and procedures and obtained written informed consent from all participants.

(2) Intervention phase

(Room of Errors simulation)

The intervention consisted of a structured sequence of prebriefing, simulation, and debriefing. Participants first attended a 30-minute prebriefing session to learn about the objectives and structure of the Room of Errors simulation.

The simulation lab was designed to replicate an actual hospital environment, including a full-body manikin, physician and medication orders, intake/output records, diet sheets, fall-prevention signs, patient identification bands, and bedside cards. A medication cart containing prescribed drugs was also prepared, and the manikin was equipped with postoperative devices such as a nasogastric tube, urinary catheter, and drainage system.

During the simulation, students were required to identify embedded patient safety errors within a limited time. Based on the systematic review by Lee et al. [19], which demonstrated that team-based participation enhances educational effectiveness, the simulation was conducted in teams. A total of 10 teams, each consisting of

three to four students, participated in the simulation sessions twice.

Each team was given 10 minutes to identify errors, followed by a 20-minute team debriefing session to discuss identified hazards and appropriate corrective actions. Subsequently, a 20-minute plenary debriefing session was conducted with all participants to consolidate learning outcomes related to patient safety.

(3) Post-test phase

Immediately after completion of the intervention, participants completed a post-test using the same instruments as the pre-test to evaluate the effects of the Room of Errors simulation program.

2.5 Data analysis

Data were analyzed using SPSS/WIN 28.0. Descriptive statistics were used to summarize participants' general characteristics and study variables. Paired t-tests were conducted to examine differences in perceived importance of patient safety management, patient safety management activities, and critical thinking disposition before and after the intervention.

2.6 Ethical concerns

The study adhered to ethical research principles. Before data collection, the purpose, procedures, and rights of participants were thoroughly explained. Participation was entirely voluntary, and informed consent was obtained. The survey form specified that collected data would be used exclusively for research, and that participants were free to decline or withdraw from the study at any time without penalty.

3. Results

3.1 General characteristics of the subjects

The average age of the subjects was 22.70 ± 1.42 years, with 7 men (17.9%) and 32 women (82.1%). Major learning satisfaction and campus life satisfaction are shown in Table 1.

<Table 1> General characteristics of the subjects
N=39

Characteristics	Category	n(%)/. Mean(SD)
Age(years)		22.70±1.42
Gender	Male	7(17.9)
	Female	32(82.1)
Major learning satisfaction	Very satisfied	9(23.1)
	Satisfied	13(33.3)
	Average	13(33.3)
	Dissatisfied	4(10.3)
	Very dissatisfied	-
Campus life satisfaction	Very satisfied	13(33.3)
	Satisfied	12(20.8)
	Average	10(25.6)
	Dissatisfied	4(10.3)
	Very dissatisfied	-

3.2 Perceived importance of patient safety management

The mean scores of nursing students' perceived importance of patient safety management before and after applying the Room of Errors simulation were 3.18 before and 4.47 after, which was a statistically significant difference ($t=-17.671$, $p<.001$) (Table 2).

3.3 Patient safety management activities

The mean scores of nursing students' patient safety management activities before and after applying the Room of Errors simulation were increased from 3.46 before application to 4.74 after application of Room of Errors simulation, and this difference was statistically significant ($t=-12.972$, $p<.001$). (Table 2).

3.4 Critical thinking disposition

The mean score of critical thinking disposition before and after the Room of Errors simulation

was applied to nursing students was 3.67 before and 4.12 after, which was a statistically significant difference ($t=-5.019$, $p<.001$). (Table 2).

<Table 2> Difference of dependent variables between before and after Room of errors simulation
N=39

Variables	Pretest	Posttest	t	p
	M±SD	M±SD		
Perceived importance of patient safety management	3.18±0.32	4.47±0.30	-17.67	<.001***
Patient safety management activities	3.46±0.46	4.74±0.31	-12.97	<.001***
Critical thinking disposition	3.67±0.35	4.12±0.37	-5.02	<.001***

* P<.05, ** P<.01, ***P<.001

4. Discussion

This study demonstrated that the Room of Errors simulation significantly improved nursing students' perceived importance of patient safety management, patient safety management activities, and critical thinking disposition. These findings are consistent with previous studies reporting that simulation-based education enhances knowledge, clinical skills, and patient safety competencies among nursing students [20].

Importantly, the present study extends prior research by applying multiple Room of Errors simulation scenarios rather than focusing on single-scenario applications or tool development [11,15]. By incorporating diverse clinical contexts, this study provides a more comprehensive understanding of how Room of Errors simulation contributes to the integrated development of patient safety competencies. In particular, the inclusion of critical thinking disposition as an outcome variable offers novel evidence, as empirical studies directly examining the relationship between Room of Errors simulation and critical thinking remain limited [14].

From a theoretical perspective, these findings

can be explained through Kolb's experiential learning theory [8] and Schön's reflective practice theory [9]. Kolb proposed that learning occurs through a cyclical process involving concrete experience, reflective observation, abstract conceptualization, and active experimentation [8]. In the present study, Room of Errors simulation provided learners with realistic clinical experiences in which they actively identified and interpreted embedded errors. This experiential process was followed by structured reflection during debriefing, enabling students to reconstruct their understanding and apply it to future clinical situations. Schön further emphasized that reflection is a critical component of professional practice, allowing individuals to critically evaluate their actions and improve subsequent performance [9].

Based on Kolb's experiential learning theory, the observed improvement in the perceived importance of patient safety management suggests that the Room of Errors simulation provided concrete experiences through which students transformed abstract safety knowledge into meaningful, practice-oriented, and context-based understanding [8]. Students were required to reinterpret familiar clinical environments from a risk-oriented perspective, thereby promoting deeper awareness of patient safety issues. This finding aligns with previous research indicating that experiential learning environments enhance learners' ability to recognize potential hazards and respond appropriately [21].

Furthermore, the significant increase in patient safety management activities indicates that Room of Errors simulation effectively promotes behavioral change by engaging students in active problem-solving and error correction. Unlike traditional lecture-based approaches, Room of Errors simulation requires learners to make decisions within realistic clinical contexts, thereby strengthening their practical competencies. This finding is consistent with prior studies demonstrating that

simulation-based training enhances patient safety behaviors and clinical performance [22].

The improvement in critical thinking disposition represents a particularly meaningful contribution of this study. Engaging in processes such as error identification, prioritization, and consequence analysis requires higher-order cognitive abilities, which are essential for safe clinical decision-making. These findings suggest that Room of Errors simulation functions not only as a skills-based training method but also as a cognitive learning strategy that enhances analytical and reflective thinking.

Another important finding is the role of repeated exposure and structured debriefing in maximizing the educational effectiveness of Room of Errors simulation. Consistent with the NLN Jeffries Simulation Theory, effective simulation learning requires well-structured design, active learner engagement, and systematic debriefing processes [23]. The findings of this study indicate that incorporating multiple scenarios, structured prebriefing, and guided debriefing enhances the depth and sustainability of learning, supporting the theoretical proposition that simulation effectiveness is closely linked to instructional design and reflective learning processes.

Despite these contributions, several limitations should be considered. First, the use of a one-group pretest-posttest design without a control group limits the ability to establish causal relationships; therefore, the observed improvements should not be interpreted as definitive evidence of the causal effect of the Room of Errors simulation. Second, the study was conducted in a single institution with a relatively small sample size, which restricts the generalizability of the findings. Third, the posttest was conducted immediately after the intervention, and no follow-up assessment was performed; therefore, the long-term sustainability of the observed effects remains unclear.

Future research should adopt more rigorous

designs, such as randomized controlled trials or quasi-experimental studies, to strengthen internal validity. In addition, studies involving larger and more diverse samples across multiple institutions are needed to enhance external validity. Furthermore, longitudinal follow-up studies are recommended to examine the persistence of learning effects over time.

5. Conclusion

This study provides empirical evidence supporting the educational effectiveness of the Room of Errors simulation in undergraduate nursing education. By applying multiple scenario-based Room of Errors simulations, this study extends prior research that has primarily focused on single-scenario applications or tool development and demonstrates that the Room of Errors simulation can enhance nursing students' perceived importance of patient safety management, patient safety management activities, and critical thinking disposition.

In particular, this study contributes novel evidence by examining critical thinking disposition as an outcome of the Room of Errors simulation, an area that has been insufficiently explored in previous research. The findings suggest that the Room of Errors simulation functions as an integrative experiential learning strategy that promotes the development of cognitive, behavioral, and reflective competencies required for safe clinical practice.

From a practical perspective, the Room of Errors simulation provides a structured and safe learning environment in which nursing students can actively identify, interpret, and manage patient safety risks prior to entering clinical practice. Therefore, incorporating multiple scenario-based Room of Errors simulations into undergraduate nursing curricula may strengthen students' readiness for clinical transition and

contribute to patient safety education.

Nevertheless, the findings should be interpreted with caution due to the one-group pretest-posttest design and the absence of follow-up assessment. Future studies should adopt controlled or randomized designs and include longitudinal follow-up to verify the causal and sustained effects of the Room of Errors simulation.

In conclusion, the Room of Errors simulation represents a promising educational approach for enhancing patient safety competencies among nursing students. When implemented through multiple scenarios and supported by systematic prebriefing and debriefing, it has the potential to serve as an effective instructional strategy for preparing future nurses for safe and competent clinical practice.

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