Effects of Simulation Education with Problem-based Learning on Information Literacy, Self-directed Learning Ability, and Academic Self-efficacy of Nursing Students

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문제중심학습기반 시뮬레이션 실습교육이 간호대학생의 정보활용능력, 자기주도적 학습능력, 학업적 효능감에 미치는 효과

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Abstract The objective of this study was to determine the effects of simulation education with problem-based learning (SIM-PBL) on information literacy, self-directed learning ability, and academic self-efficacy of nursing students. The subjects were 81 fourth-year nursing students attending a university in Chungcheongnam-do, Korea. SIM-PBL was provided once per week (150 minutes each) for four weeks, and a structured questionnaire was used to survey information literacy, self-directed learning ability, and academic self-efficacy before and after educational training. After completing the four-week program, abilities in the sub-items of information literacy, such as information integration (p=.030), information expression (p=.003), and information ethics (p=.016) were improved. However, no differences in self-directed learning ability and academic self-efficacy were noted. Findings confirmed that SIM-PBL is an effective teaching method for improving the information literacy of nursing students. Therefore, it is necessary to come up with an SIM-PBL education plan for utilizing reliable and useful information ethically.

Key Words : Education, Problem-based Learning, Information Literacy, Students, Nursing

요 약 본 연구의 목적은 SIM-PBL이 간호대학생의 정보활용능력, 자기주도적 학습능력, 학업적 효능감에 미치는 효과를 규명하기 위함이다. 대상자는 한국의 일개 대학교 간호학과 4학년 학생 81명이었다. SIM-PBL은 4주 동안, 주 1회(150분) 제공하였고, 교육 전후에 구조화된 설문지를 활용하여 정보활용능력, 자기주도적 학습능력, 학업적 효능감을 조사하였다. 교육 후에 정보활용능력의 하부영역 중 정보통합(p=.030), 정보표현(p=.003) 및 정보윤리(p=.016) 영역의 능력이 향상되었다. 그러나, 자기주도적 학습능력과 학업적 효능감은 교육 후에 변화가 없었다. SIM-PBL은 간호대학생의 정보활용능력을 향상시키는데 효과적인 교수법임을 확인하였다. 앞으로, 신뢰성 높은 유용한 정보를 윤리적으로 활용할 수 있도록 돕는 SIM-PBL 교육방안이 필요하다.

주제어 : 교육, 문제중심학습, 정보활용능력, 학생, 간호

1. Introduction

1.1. Background

In clinical practice, the necessary competencies of nursing students are autonomous education skills, leadership, knowledge, information management and literacy, interpersonal communication and teamwork, specialized values, and excellence in nursing practice [1].

Information literacy is the ability to search for necessary information and evaluate and summarize the information obtained to solve problems [2]; it also refers to the ability to integrate necessary information by recognizing, searching, and analyzing it to solve the health problems of patients [3,4].

Nurses must be able to perceive reliable and useful information among countless data and perform high-quality nursing tasks [1,5]. Information literacy is the basic ability to perform evidence-based nursing practices [6]. Previous studies have reported that problem-based learning and web-based programs are effective for improving information literacy [7,8].

In the undergraduate curriculum, nursing students' self-directed learning abilities are advanced to the level of self-regulation and control by verifying and diagnosing learning resources, setting goals, performing, and evaluating [9]. Montenery argued that problem-based learning activities improved nursing students' readiness for self-directed learning [10], and Jun, Cho, Park, and Kim stated that self-directed learning abilities improved as a result of nursing students' learning plans and practices after simulation training related to the care of patients with cerebrovascular disease [11]. Self-directed learning and nursing practice competency seems to be positive correlation [12], therefore development for self-directed learning of nursing students is important to improve nursing practice competency.

Academic self-efficacy is a learner's judgment about his or her ability to organize and practice actions necessary to perform a task [13], and it has been reported that nursing students with high levels of academic self-efficacy demonstrate considerable confidence in clinical practice [14]. The higher academic self-efficacy, the better learning motivation and communication skill [15]. It can give self-confidence and efficacy of study in school life.

The curriculum to enhance information literacy, self-directed learning ability, and academic self-efficacy of nursing students is important, equipping them to collect, select, and use the latest specialized medical and health information systematically once they become nurses. The curriculum also enhances their confidence in actively performing evidence-based nursing.

Simulation education with problem-based learning (SIM-PBL) is an education method that links problem-based learning—which enables nursing students to solve clinical problems according to their own initiative and with the use of all kinds of information— and realistic simulation training [16]. SIM-PBL is effective for practicing health assessments, clinical decision-making, nursing practicums, and communication skills, and it is a teaching-learning strategy that integrates student-led learning activities and performance-based assessment [17].

Previous studies reported that SIM-PBL for nursing students was effective in enhancing knowledge, decision-making skills, academic achievement [18-20], problem-solving skills, competency [17,21], meta-cognitive ability, and presence [22,23]. Previous study using simulation have reported improvement in clinical skill such as cardiopulmonary resuscitation and professional nursing knowledge.

Therefore, there is insufficient research to verify the effects on information literacy, self-directed learning ability, and academic self-efficacy.

1.2 Study purpose

The purpose of this study was to establish the baseline data to promote simulation training programs by determining the effects of SIM-PBL on the information literacy, self-directed learning ability, and academic self-efficacy of nursing students.

2. Study methods

2.1 Study design

This study was quasi-experimental, utilizing the pretest-posttest (one group) time series design to determine the effects of simulation training on the information literacy, self-directed learning ability, and academic self-efficacy of nursing students.

2.2 Setting and sample

To determine the effects of SIM-PBL, researchers for this study conducted a secondary analysis of variables not reported by Kim et al. [24] among the variables collected (communication anxiety, self-expression, self-efficacy in clinical practice, information literacy, self-directed learning ability, and academic self-efficacy). Subjects were selected by convenient sampling of fourth-year nursing students attending a university in Chungcheongnam-do, Korea. The minimum required number of subjects was selected to verify the mean difference before and after training using G*POWER 3.1.9.2. With levels for significance at .05, for power at .95, and for effect size at .5 (medium size) as the standards, the minimum number of subjects necessary to maintain the predicted power was 54. Power was secured in this study by analyzing the data of 81 subjects who had completed at least 1,000 hours of regular clinical training and two credits for four sessions of simulation training in the second semester of the sophomore year.

Data were collected from September to December 2016, and the pretest involving research variables was conducted a week before the educational training began. An orientation was provided for students regarding the overall details of simulation training, and teams were formed by drawing lots. After that, the SIM-PBL module was presented to the subjects once per week (150 minutes) for four weeks. The posttest was conducted a week after completion of the training sessions.

2.3 Measures

2.3.1 Information literacy

Information literacy was measured using the tool developed by Lee and Nam [2]. This tool consists of information need, information search, information evaluation, information integration, information expression, and information ethics. A total of 39 items are rated on a 5-point Likert scale from *Strongly disagree* (1) to *Strongly agree* (5), with higher scores indicating higher levels of information literacy. In the study by Lee and Nam [2], Cronbach's α was .61 - .86; in this study, it was .65 - .89 before educational training and .67 - .92 afterward.

2.3.2 Self-directed learning ability

Self-directed learning ability was measured with the Korean version [25] of the self-directed learning readiness scale developed by Guglielmino [26]. This tool includes 58 items rated on a 5-point Likert scale from *Strongly disagree* (1) to *Strongly agree* (5), with higher scores indicating greater self-directed learning ability. In the study by Jeon [25], Cronbach's α was .61 - .86; in this study, it was .90 before the training sessions and .89 after completion.

2.3.3 Academic self-efficacy

Academic self-efficacy was measured using the Academic Self-Efficacy Scale developed by Kim and Park [13], for which the validity was tested. This tool includes 28 items rated on a 6-point Likert scale from *Strongly disagree* (1) to *Strongly agree* (6), with higher scores indicating higher academic self-efficacy. In the study by Kim and Park [13], Cronbach's α was .74 - 84, whereas in this study, it was .80 - 91 before educational training and .85 - .86 afterward.

2.4 Research procedures

2.4.1 SIM-PBL module development

For SIM-PBL, a simulation training module paired with four problem-based learning scenarios was developed for the topic of "hospitalization and nursing

before/after surgery of a patient with colorectal cancer (F/55, colostomy and enterostomy)."

In week 1 of training, the scenario and tasks for "the patient visiting the emergency room because of an abdominal health problem" were presented in the problem-based learning process; in the simulation training, the scenario of "the case of the patient with abdominal pain visiting the emergency room" was implemented. In week 2, SIM-PBL was undertaken for the scenario of "nursing the inpatient." The scenario for week 3 was "nursing the patient before surgery," and for week 4, it was "nursing the patient after surgery." The validity of the developed programs was tested by experts (three nursing professors with experience in SIM-PBL)(see Table 1).

Table. 1. Simulation education integrated with problem-based learning module

Sub-ject	Admission, pre-and post-operation care of female colon cancer patient (55/F)	
Wk (min)	Problem-Based Learning session (90min)	Simulation-based learning session practice (15min), debriefing (30min), rest (15min)
1wk (150)	PBL session on patient care in emergency room with abdominal health problem	Sim session on patient care in emergency room with abdominal health problem
2wk (150)	PBL session on admission care	Sim session on admission care
3wk (150)	PBL session on pre-operation care	Sim session on pre-operation care
4wk (150)	PBL session on post-operation care	Sim-session on post-operation care
Contents	-Scenario, task presentation -Group task problem discussion -Find scenario -focused subjects -Establishing nursing goal, a hypothesis	-Organizing priority-focused nursing processes -Establishing nursing planning for nursing problem-solving -Performing nursing inter-ventions -Summarize the whole process and the contents of the lesson -Present nursing student's feelings

2.4.2 SIM-PBL operation

As mentioned previously, this training program was conducted once a week for four weeks, with each session lasting about 150 minutes. There were four classes, with each one divided into four teams. Each team consisted of five or six members.

The SIM-PBL was carried out with problem-based learning (90 minutes), simulation training (15 minutes), debriefing (30 minutes), and a break (15 minutes). The subjects were provided with "information use guidelines" that were to be studied thoroughly before training began. The guidelines included the use of reliable online data, citation of research articles, presentation of references, and contents about learning ethics. In problem-based learning activities, students were the main agents of each team, designated to deal with the task presented to solve the patient's health problem according to the nursing process (assessment, diagnosis, planning/performance, evaluation). To perform the task, they could use textbooks, previous studies, and online data. Teams that completed problem-based learning were to proceed with simulation training. To minimize the effect of the experimenters, one instructor with experience in simulation training led the program.

2.5 Data analysis

The data collected were analyzed using SPSS/WIN 23.0. The general characteristics, information literacy, self-directed learning ability, and academic self-efficacy of the subjects were verified with real numbers, percentages, means, and standard deviations. The differences between these variables before and after education were analyzed with a paired t-test.

3. Results

3.1 General Characteristics of Subjects

The subjects of this study were 81 nursing students in their fourth year, and their average age was 22.4 (range: 21 - 28). There were 71 females (87.7%) and 10 male students (12.3%). For subjective academic achievement, 15 (18.5%) students were evaluated as

high; 46 (56.8%) students, medium; and 20 (24.7%) students, low. Academic stress received 6.32 (±2.14) points and satisfaction with nursing received 6.85 (±2.03) points (see Table 2).

Table 2. General Characteristics of Participants

(N=81)

Variables	n (%)	M±SD (range)
Age (years)		22.4±1.5 (21-28)
Gender		
Male	10 (12.3)	
Female	71 (87.7)	
Subjective academic achievement		
High	15 (18.5)	
Medium	46 (56.8)	
Low	20 (24.7)	
Academic stress*		6.32±2.14
Satisfaction of nursing		6.85±2.03

* Numeric Rating Scale (0-10)

3.2 Effects of Simulation Training

The overall average of information literacy increased from 3.87 points before educational training to 4.02 points afterward (t = 2.57, p = .012). Among the sub-items, information literacy increased after completion

Table 3. Differences after SIM-PBL education on Information Literacy, Self-directed Learning Ability, Academic Self-efficacy

(N=81)

Variables	Pre-education M±SD	Post-education M±SD	t	p
Information literacy	3.87±0.47	4.02±0.29	2.57	.012
Information need	3.91±0.64	4.01±0.56	1.42	.158
Information search	3.74±0.57	3.87±0.70	1.77	.081
Information evaluation	3.83±0.59	3.94±0.71	1.54	.127
Information integration	3.82±0.58	3.99±0.50	2.21	.030
Information expression	3.90±0.72	4.17±0.77	3.06	.003
Information ethics	4.07±0.61	4.27±0.69	2.46	.016
Self-directed learning ability	3.37±0.34	3.42±0.28	1.65	.103
Academic self-efficacy	3.64±0.49	3.69±0.54	0.78	.436
Task difficulty preference	3.29±0.79	3.38±0.67	1.40	.165
Self-regulatory efficacy	3.85±0.62	3.95±0.62	1.63	.108
Self-confidence	3.83±0.74	3.73±0.83	-1.02	.311

of the training program, as follows: information integration (t = 2.21, p = .030), information expression (t = 3.06, p = .003), and information ethics (t = 2.46, p = .016). However, there was no significant change in self-directed learning ability and academic self-efficacy after completion of the program (see Table 3).

4. Discussion

Regarding the aim of this study to determine the effects of SIM-PBL on information literacy, self-directed learning ability and academic self-efficacy of nursing students, information literacy of nursing students increased after SIM-PBL, especially in terms of information integration, information expression, and information ethics among the sub-items. This finding is similar to the result of a previous study in which information literacy of Turkish nursing students increased after problem-based learning (relative to classroom learning)[27]. Furthermore, Williamson et al. stated that simulation training can help improve technical competencies for evidence-based nursing [28].

Arthur et al. also supported this result by verifying that nursing students who participated in simulation training showed improvement in their ability to read the general flow of the situation and integrate information, their ability to apply required expertise immediately, and their ability to read and use information and medical device results [29]. If university students acquire information literacy, their ability to understand the ethical, legal, and socioeconomic issues of information may also improve [5].

In this study, it seemed that the preparatory learning activities such as searching for and using health information obtained through a website search and reviewing knowledge from the curriculum (major) obtained before SIM-PBL may have helped improve information literacy in terms of information integration. Cho and Gu stated that nursing information literacy competency showed direct effects on problem solving ability [30]

Based on the information collected during problem-based learning activities, the training process in which team members shared and applied information to solve the problem of the patient (simulator) in the simulation might have promoted literacy in information expression. Moreover, it seems that providing guidelines regarding the use of information and citations in the problem-based learning process through the "information use guidelines" in the first session of SIM-PBL also contributed to promoting students' literacy in information ethics.

Recently, ethical issues pertaining to information use or learning, such as plagiarism or copying and pasting material [19], have been gaining attention. For nursing students to establish nursing strategies for patients, the ability to comply with ethical standards concerning knowledge, information use, and learning and the capability to manage and apply appropriate techniques are important for cost-effective and safe evidence-based practices [1,31].

Findings of this study indicated that there was no significant change in self-directed learning ability before and after education. This result was different from that of previous studies, possibly because the application time for SIM-PBL and the number of modules in this study were smaller than those in previous studies. Kohan et al. stated that the barriers for self-directed learning in a virtual environment are cognitive barriers (information overload and lack of focus on learning, or mind wandering), communication barriers (inadequate coping skills), and environmental barriers to education (e.g., heavy workload and role ambiguity)[32]. It is necessary to consider these barriers to organize simulation modules and team activities and verify the changes in self-directed learning ability by engaging in at least four weeks of specialized training.

In this study, there was no significant change in academic self-efficacy before and after educational training. This finding was similar to the report by Jung and Ko that there was a significant change in critical thinking after simulation training but no change in academic self-efficacy [33]. However, Kim and Heo stated that there was no effect on task difficulty and self-regulatory efficacy in academic self-efficacy after simulation training, but there was a significant increase in self-confidence after intervention [14]. Kim and Heo applied the simulation program immediately after clinical training; it consisted of orientation (20 minutes), simulation training (15 minutes), and debriefing (90 minutes)[14]. In this study, the program was organized as follows: problem-based learning (90 minutes), simulation training (15 minutes), and debriefing (30 minutes). Findings of the study indicated that the former had an adequate orientation but relatively little time for debriefing after simulation training, thereby resulting in insufficient introspection regarding training and the perception of academic self-efficacy. Debriefing has the learning effect of understanding the basis of actions through introspection and feedback about the student's training experience, leading to improvement in the ability to apply it to caring for patients and thinking critically [34]. Thus, it is necessary to sufficiently allow an appropriate amount of time for debriefing in order to improve academic self-efficacy through SIM-PBL.

This study was conducted with nursing students at a university according to the convenience sampling method. The target of this study was a single experimental group; participants were given equal educational opportunities, and a comparison with a control group was not possible. This study did not confirm the difference of information literacy according to the computer operating skill of nursing students. In this study, SIM-PBL was applied based on the previous studies, but the effect of this study was not obtained.

Future research could assess the results of expanding the implementation time of the training program and verify the effects of variables at each point. Future research to verify the effect longitudinally by various clinical scenarios and providing SIM-PBL program is necessary.

5. Conclusions

A quasi-experimental research approach characterizes this study; the pretest-posttest (one group) time series design was used to determine the effects of simulation training on the information literacy, self-directed learning ability, and academic self-efficacy of nursing students. The results showed that SIM-PBL for nursing students was effective for improving information literacy in terms of information integration, information expression, and information ethics, but no effect was found on self-directed learning ability and academic self-efficacy.

Based on the results described herein, it is necessary to develop SIM-PBL scenarios to improve self-directed learning ability and academic self-efficacy stage by stage, obtaining learning outcomes for each year of the nursing curriculum. It is necessary to come up with an SIM-PBL education plan for utilizing reliable and useful information ethically.

6. Conflicts of interest

No potential conflict of interest relevant to this article was reported.

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