Effects of a patient safety course using a flipped classroom approach among undergraduate nursing students: A quasi-experimental study

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A B S T R A C T

Background: The nursing education system has changed with the increased emphasis on patient safety in healthcare settings. Early education in patient safety is crucial to preparing nurses to be competent in patient care. Therefore, providing undergraduate patient safety education courses using an innovative approach is essential to enhancing patient safety and quality in nursing care.
Objectives: This study aimed to examine the effects of a patient safety course using a flipped classroom approach on patient safety competency among undergraduate nursing students in South Korea.
Design: A pre- and post-test quasi-experimental design with a non-equivalent control group was adopted.
Settings: This study was conducted in the college of nursing at a university in Seoul, South Korea.
Participants: A total of 75 undergraduate nursing students participated. All students enrolled in the patient safety course comprised the experimental group (n = 32); those with similar characteristics to the experimental group (age, gender, and year) but did not take the course comprised the control group (n = 43).
Methods: A total of 14 sessions (28 h) addressing the topics from the World Health Organization patient safety curriculum guide were delivered using a flipped classroom approach. The teaching methods included online learning and quizzes, case studies, small and large discussions, incident report tasks, and group projects including the development of strategies for patient safety. A survey including a demographic questionnaire and the Patient Safety Competency Self-Evaluation tool was administered at the beginning and end of the fall semester.
Results: Pre- and post-test results demonstrated a significant increase in students' patient safety competency including attitude, skills, and knowledge. Mean scores of patient safety competency in the experimental group were significantly higher than in the control group.
Conclusions: The flipped-classroom patient safety course was shown to be effective in improving patient safety competency in terms of attitude, skills, and knowledge among undergraduate nursing students.

1. Introduction

Patient safety and quality improvement is a critical issue both globally and in South Korea (Lee et al., 2014). In 1999, the Institute of Medicine (IOM) released a report on "To Err is Human: Building a Safer Health System," and patient safety began to receive global attention, with increased awareness on preventing unnecessary errors in health care. IOM defined patient safety as the prevention of harm to patients (IOM, 2000). The World Health Organization [WHO] stated that patient safety involves the prevention of unnecessary errors and adverse harm to patients (WHO, 2017). Unexpected and unwanted events can take place in any setting where healthcare is delivered (WHO, 2017). Approximately, 42.7 million adverse events occur to patients during hospitalization and one in every three deaths are caused by medical errors

in USA (WHO, 2017). While healthcare has become more effective, it has also become more complex, with greater use of new technologies, medicines, and treatments (WHO, 2017). While healthcare systems change rapidly, the delivery of safer and higher quality care by healthcare professionals is expected and emphasized (Jang and Lee, 2017), especially for nurses, who are the largest healthcare workforce and provide direct patient care 24 h a day.

As the importance of patient safety and the need for ensuring it have increasingly been recognized, the importance of nursing education and how it affects the competencies of safety and quality of care have also been emphasized (American Association of College of Nursing [AACN], 2006; Barnsteiner et al., 2013). Nursing education serves as a bridge of quality and links to creating the required changes in the healthcare system (Sherwood, 2011). It is crucial for nursing students to

understand the importance of patient safety and be educated to ensure such safety and quality in their clinical practice (Lee et al., 2016). Therefore, early education of patient safety for nursing students, who will be working as nurses in the near future, is necessary (Mansour et al., 2018; Robson, 2009). In Korea, nursing schools have started including patient safety courses in undergraduate curricula. However, how patient safety courses are delivered varies by nursing school, and the effectiveness of courses being offered has rarely been assessed in Korea.

2. Background/literature

The nursing education system began to change as the importance of patient safety in healthcare settings was emphasized. The Quality and Safety Education for Nurses (QSEN) conceptual framework was developed in USA to facilitate changes in nursing education (Dolansky and Moore, 2013; Cronenwett et al., 2009; Jarzemsky et al., 2010). The QSEN project outlines six core competencies of knowledge, skills, and attitudes for quality and safety. Moreover, many efforts were made by the QSEN initiative to include the competencies of quality and safety in nursing education (Cronenwett et al., 2007; Cronenwett et al., 2009; McKeon et al., 2009; Lee et al., 2014). The WHO developed a patient safety curriculum guide in 2011 (WHO, 2011), and previous patient safety courses consisted of major topics recommended by WHO (e.g., key concepts and principles, culture of patient safety, human factors and systems approach, effective teamwork and communication, patient safety incidents and reporting, understanding and managing clinical risks, infection prevention and control, patient safety and invasive procedures, improving medication safety, and engaging patients and caregivers) to increase the patient safety competency of nursing students (Lee et al., 2016; Hwang et al., 2016). Nursing students will soon be providing direct patient care, and their readiness for safe, reliable care provision is critical (Hwang et al., 2016). Therefore, early education in patient safety is crucial to ensure nurses' competence when proving patient care, and undergraduate patient safety courses would be the first step to enhance patient safety and quality in patient care. Thus, innovations in nursing education are essential in order to keep pace with the growing needs to enhance patient safety through effective education program.

Patient safety education has been previously implemented in nursing and medical programs. Aboumatar et al. (2012) implemented a 30-day clinically oriented patient safety education program for medical students and found a significant increase in safety knowledge, self-efficacy in communication, and safety skills. Myung el et. (2012) developed a 1-week classroom-based patient safety coursed for second-year medical school students in Korea, and found that awareness of the frequency of medical errors and awareness of adverse outcomes significantly changed after the course. Park and Kim (2016) examined the effectiveness of a 5-day quality improvement and safety education program for fourth-year nursing students and found that knowledge, skills, and perception of quality and safety competencies significantly increased in the experimental group compared with the control group. Hwang et al. (2016) examined the effects of a 1-day interprofessional patient safety education course among final-year health professional students including medical, nursing, and oriental medicine students, and found a significant increase in patient safety competency and knowledge. However, previous studies have several limitations: only a few used a pre- and post-test design to examine the effectiveness of patient safety education, they included only an experimental group (Hwang et al., 2016; Myung et al., 2012), one study used an instrument that was not validated (Myung et al., 2012), and the educational intervention was mostly provided as a classroom lecture (Hwang et al., 2016; Park and Kim, 2016; Myung et al., 2012). Hence, it is necessary to evaluate the effects of patient safety education programs using a more powerful research design with a valid and reliable tool.

Flipped classroom approaches allow instructors to shift traditional

in-class work to knowledge-level learning outside the classroom to help students synthesize, analyze, apply, and evaluate information (Abeysekera and Dawson, 2015; Horn, 2013; Maxwell and Wright, 2016), usually combining online and in-class activities. Several advantages of flipped classroom approaches are noted in the literature: they increase student-teacher and student-student interactions, enhance deeper understanding of the material, improve problem-solving skills, and foster self-directed learning in students (Bergmann and Sams, 2012; Critz and Knight, 2013; Della Ratta, 2015). Furthermore, students are more focused during the classroom activities and have the advantage of learning at their own pace (Goodwin and Miller, 2013; Maxwell and Wright, 2016). The results of a systematic review of 21 studies showed that the flipped learning approach increased students' satisfaction (Betihavas et al., 2016), and the results of a meta-analysis and systematic review of 29 studies showed that the flipped learning approach increased the academic achievement of knowledge, skills, self-learning abilities, and student satisfaction in nursing (Tan et al., 2017).

In Korea, nursing schools have started incorporating patient safety courses in their curricula as the importance of patient safety has been emphasized worldwide. However, the teaching methods vary widely by nursing school, and the course duration can range between 1 day and a few weeks. Moreover, the effectiveness of patient safety classes in nursing curricula has rarely been assessed in Korea. Only one study has examined the effectiveness of a patient safety course provided to nursing students (Park and Kim, 2016). Although the course used several teaching methods such as playing videos, group discussions, lectures, and role-plays during the class time, the course was only provided for five days (five hours each day), which may not be a sufficient period of time to thoroughly cover patient safety contents. Additionally, the course was only provided for fourth-year nursing students. Therefore, the purpose of this study was to examine the effects of a patient safety course provided over a semester (16 weeks) using a flipped classroom approach on patient safety competency among undergraduate nursing students in Korea. The specific aims were to assess the effectiveness of the flipped-classroom patient safety course by comparing patient safety competency (knowledge, skills, and attitude) before and after students attended the course, and between those who attended and those who did not attend the patient safety course. We hypothesized that patient safety competency in the experimental group (i.e., completing the patient safety course) would be higher than in the control group, and patient safety competency scores in the experimental group would increase after students completed the course.

3. Methods

3.1. Study design

A pre- and post-test quasi-experimental study was conducted using a non-equivalent control group to evaluate the effects of a flipped-classroom patient safety course on patient safety competence among undergraduate nursing students. Although a randomized clinical trial is one of the best ways to minimize bias and control for cofounding variables, a quasi-experimental design was selected to preclude ethical issues for testing interventions and to enhance the external validity of our study (Victora et al., 2004).

3.2. Setting and sample

This study was conducted in the college of nursing at a university in Seoul, South Korea. The university has a 4-year nursing program with 80 students in each academic year. During the first year, students mainly learn about liberal arts. In the second year, students learn the basic nursing subjects, fundamental nursing, and practicum in the simulation center. In the third grade, students learn the major nursing subjects and start with clinical practicum, and in the fourth year, the students are focused on the clinical practicums. The patient safety
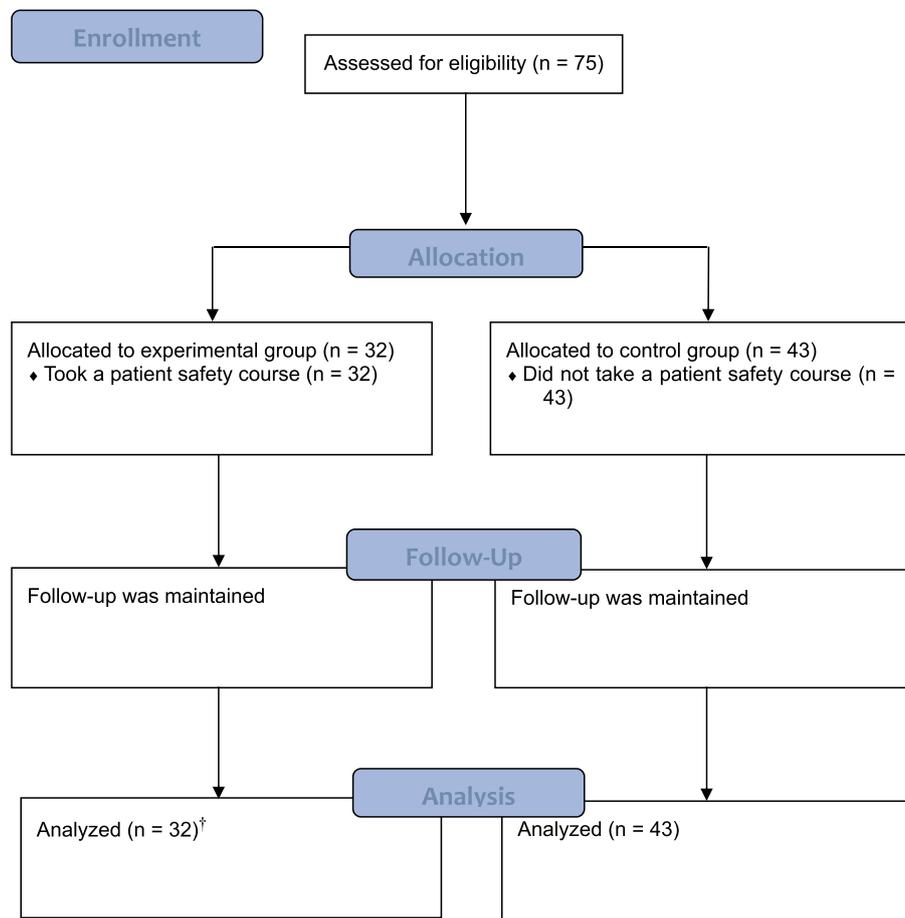
Fig. 1. Flow diagram of the current study. [†]Only 30 participants were included in within-group analysis.

course was newly developed and offered in fall 2018 as an elective course available to second- to fourth-year nursing students.

The participants were 75 nursing students in the second, third, and fourth years of the nursing program (Fig. 1). All 32 nursing students who had registered for the patient safety course in fall 2018 were recruited as the experimental group. The inclusion criteria for the experimental group were nursing students who (1) were enrolled and completed the patient safety course, and (2) provided written informed consent to participate in the study. The control group consisted of 43 students who did not take in the patient safety course. We recruited students similar to the experimental group in terms of age, gender, and year. Only the students in the experimental group completed the online educational modules and face-to-face discussions in the classrooms. No intervention was provided to the students in the control group.

3.3. Intervention

The patient safety course was offered in the fall semester of 2018 (September 7 to December 21). The course employed a flipped classroom approach including online learning and face-to-face discussions. The implemented course was designed using the topics listed in the WHO patient safety curriculum guide (WHO, 2011): Topic 1, What is patient safety?; Topic 2, Why applying human factors is important for patient safety; Topic 3, Understanding systems and the effect of complexity on patient care; Topic 4, Being an effective team player; Topic 5, Learning from errors to prevent harm; Topic 6, Understanding and managing clinical risk; Topic 7, Using quality-improvement methods to improve care; and Topic 8, Engaging with patients and carers. Table 1 presents the content of each course module and its connection with the WHO patient safety curriculum guide. The intervention contents were

provided in a series of four modules. The course consisted of 14 weekly sessions of 2 h each (28 h in total): nine sessions of online learning and five sessions of face-to-face discussion. Students were expected to complete each session of online learning at any time within a 1-week period. The online learning program provides a management system that monitors students' compliance of viewing videos and completing quizzes by the end of each weekly session. A text message was sent to students who did not complete the online learning and/or an assigned quiz before the beginning of the next weekly session. The teaching methods included lectures using online learning and quizzes, case studies, small and large discussions, tasks with incident reports, and group projects including the development of strategies for patient safety. The instructor of the course was a faculty member with a PhD degree in nursing and specialized in nursing management and patient safety. The teaching assistant was a PhD student who had received training on the main principles of patient safety.

3.4. Measures

Data were collected using a survey containing a demographic questionnaire and the Patient Safety Competency Self-Evaluation (PSCSE). Demographic information included students' age, gender, school year, previous experience of patient safety and quality improvement education or seminars. We used the PSCSE, developed by Lee et al. (2014), to measure nursing student's patient safety competencies. The PSCSE has been used in previous studies (Ahmed, 2015; Cho and Choi, 2018; Lee et al., 2016), and has been validated with nursing students in Korea (Lee et al., 2014). The PSCSE is a self-reporting tool consisting of 41 items rated on a 5-point Likert scale in three subscales: attitude (14 items), skills (21 items), and knowledge (6

Table 1
Description of the intervention.

Week	Contents	Classroom type	Teaching methods	Topics[a]
1	Module 1. Introduction to patient safety Introduction to patient safety	In class	Lecture (class orientation) Audiovisual materials	–
2	Key concepts and principles of patient safety	Online	Online lecture Quiz	Topic 1
3	International Patient Safety Goals	Online	Online lecture Quiz	–
4	Module 2. Understanding patient safety Understanding human factors and system approach in patient safety	Online	Online lecture Quiz	Topics 2–3
5	Culture of patient safety	Online	Online lecture Quiz	–
6	Effective teamwork and communication	Online	Online lecture Quiz	Topic 4
7	Engaging with patients and caregivers (including error disclosure)	Online	Online lecture Quiz	Topic 8
8	Activity 1: Poster presentation of International Patient Safety Goals	In class	Group presentation 1 (poster) Discussion	–
9	Activity 2: Identifying human and system factors in safety incidents	In class	Case study Small and large group discussion	Topics 2–3
10	Module 3. Improving patient safety Clinical risk management	Online	Online lecture Quiz	Topic 6
11	Quality improvement methods	Online	Online lecture Quiz	Topic 7
12	Reporting system of patient safety incidents	Online	Online lecture & quiz Incident report (a near miss case)	Topic 5
13	Module 4. Implementation of strategies to improve patient safety Activity 3: Innovative strategies to improve patient safety	In class	Group presentation 2 Small and large group discussion	Topics 1–8
14	Activity 4: Quality improvement project	In class	Group presentation 3 (final project) Discussion and reflection	Topics 1–8

[a] Topics listed in the WHO patient safety curriculum guide (World Health Organization, 2011).

items). Respondents rate their level of agreement with the attitude items from "strongly disagree = 1" to "strongly agree = 5" regarding recognition and behaviors associated with patient safety. The skills items measure the level of comfort from "very uncomfortable = 1" to "very comfortable = 5" in performing tasks relevant to patient safety. The knowledge items determine the level of knowledge of patient safety from "not knowledgeable = 1" to "very knowledgeable = 5." The calculated mean PSCSE scores range from 1 to 5, with higher mean scores indicating greater competency regarding patient safety on each subscale. Cronbach's alpha for the original scale was 0.91 for undergraduate nursing students (Lee et al., 2014) and 0.94 for nursing educators in Korea (Jang and Lee, 2017). In this study, Cronbach's alpha was 0.91 for the total scale.

3.5. Data collection

The experimental group completed the survey twice: in September (pre-test, beginning of the fall semester) and December (post-test, end of the fall semester), 2018. Students provided informed consent and completed the pre-test survey consisting of demographic data and the PSCSE on September 7, which was the first day of class. The questionnaires were in pen-and-paper format. The 14 sessions of intervention (patient safety course) took place from September 7 to December 21, and the post-test data were collected in December 21, at the end of the last class. The control group completed the post-test survey only, between December 10 to 21, 2018. Students in the control also provided informed consent and completed the same survey as the experimental group. Students in both control and experimental groups were given a meal coupon (worth five dollars) after completing the surveys.

3.6. Data analysis

We analyzed the collected data using the IBM SPSS 23.0 statistical package (IBM Corporation, Armonk, NY, USA). Descriptive statistics were used to test whether the data were normally distributed. We used both parametric and non-parametric statistical tests, since attitude and knowledge did not meet the normality assumption. Independent t-tests, chi-square test, and Fisher's exact test were used to test homogeneity. We used independent t-test and Mann Whitney U test to compare the post-test results between the groups, and paired t-test and Wilcoxon signed rank test to examine the effects of the intervention within the experimental group. The results presented in the tables are from parametric tests, as the significance of parametric and non-parametric tests were the same. In the within-group test, we analyzed data from only 30 experimental group students, as 2 students in this group registered after the first class began.

3.7. Ethical considerations

This study was approved by the institutional review board at the participating university (No. Y-2018-0101). The study was conducted in accordance with the Code of Ethics of the World Medical Association (Declaration of Helsinki). In order to protect students' rights in research participation, the consent procedure was conducted by a research assistant trained in ethics.

4. Results

4.1. General characteristics and homogeneity of participants

A total of 75 students participated in this study (Table 2). The mean age was 27.8 years and most students were female (90.7%). There were more students with less experience of participation in patient safety education, patient safety seminars, and quality improvement seminars. General characteristics and experience of participation in patient safety education, and patient safety and quality improvement seminars were not significantly different between the experimental and control groups. Thus, the homogeneity between the groups was confirmed.

Table 2
Homogeneity of the study participants (N = 75).

Characteristics	Total (n = 75) $M \pm SD$ or n (%)	Exp. (n = 32) $M \pm SD$ or n (%)	Con. (n = 43) $M \pm SD$ or n (%)	χ^2 or t	p-Value
Age (years)	21.77 ± 1.83	21.66 ± 1.68	21.86 ± 1.96	0.47	0.637
Gender					
Male	7 (9.3)	1 (3.1)	6 (14.0)	2.54	0.227[a]
Female	68 (90.7)	31 (96.9)	37 (86.0)		
Year of school					
Second	9 (12.0)	5 (15.6)	4 (9.3)	1.30	0.523
Third	52 (69.3)	20 (62.5)	32 (74.4)		
Fourth	14 (18.7)	7 (21.9)	7 (16.3)		
Experience of PS or QI education during clinical practicum					
Yes	27 (36.0)	11 (34.4)	16 (37.2)	0.06	0.800
No	48 (64.0)	21 (65.6)	27 (62.8)		
Participation experience in PS seminars					
Yes	7 (9.3)	5 (15.6)	2 (4.7)	2.61	0.129[a]
No	68 (90.7)	27 (84.4)	41 (95.3)		
Participation experience in QI seminars					
Yes	10 (13.3)	6 (18.8)	4 (9.3)	1.42	0.309[a]
No	65 (86.7)	26 (81.3)	39 (90.7)		

Exp. = experimental group, Con. = control group, PS = patient safety, QI = quality improvement.
  [a] Fisher's exact test.

4.2. Differences in patient safety competency between groups and within experimental group

As shown in Fig. 2, patient safety competencies including attitude, skills, and knowledge in the experimental group significantly increased after completing the patient safety course. The average attitude score increased from 4.00 ± 0.28 to 4.19 ± 0.25, t(29) = 3.66, p = 0.001, the average skill score increased from 2.89 ± 0.73 to 4.31 ± 0.47, t (29) = 11.00, p < 0.001, and the average knowledge score increased from 2.32 ± 0.86 to 4.31 ± 0.60, t(29) = 10.59, p < 0.001. A supplemental analysis was carried out to examine the differences between academic years and degree of acquired patient safety competencies in the experimental group (Table 3). All of the patient safety competency scores increased for all year groups. The average skill score (F = 7.30, p = 0.003; year 2 < year 3, year 4) and average knowledge score (F = 3.33, p = 0.051; year 2 < year 4) were statistically different among year 2, 3, and 4 student groups in the pre-test, whereas the average attitude score (F = 0.75, p = 0.928) was not statistically different (refer to Supplemental File 1). Regarding the post-test scores, there was no statistically significant difference among year groups with respect to attitude (F = 0.83, p = 0.448), skill (F = 0.66, p = 0.525), and knowledge (F = 0.44, p = 0.649).

After completion of the patient safety course, a statistically significant difference in patient safety skills and knowledge between the two groups was noted (Fig. 3). The mean skill score in the experimental group (4.28 ± 0.47) was higher than in the control group (3.73 ± 0.56), t(74) = 4.53, p < 0.001, and the knowledge score (4.30 ± 0.58) was higher than in the control group (2.82 ± 0.93), t (74) = 8.43, p < 0.001. The patient safety attitude score was slightly higher in the control group (4.24 ± 0.29) than in the experimental group (4.19 ± 0.25), but this was not statistically significant, t (74) = −0.82, p = 0.417.

5. Discussion

The purpose of this study was to examine the patient safety competencies (knowledge, skills, and attitude) of undergraduate nursing students who completed a patient safety course using a flipped learning approach. We utilized a pre- and post-test quasi-experimental design with a non-equivalent control group to examine the effectiveness of the course, provided over 14 weeks. The major findings from this study were that 1) the level of patient safety attitude, knowledge, and skills significantly increased after completing the course, and 2) the level of patient safety knowledge and skills was significantly higher in students who completed the course compared with those who did not.

Consistent with previous reports, we found higher scores on patient safety attitude and lower scores on skills and knowledge (Lee et al., 2016; Schnall et al., 2008; Sullivan et al., 2009), which indicates that
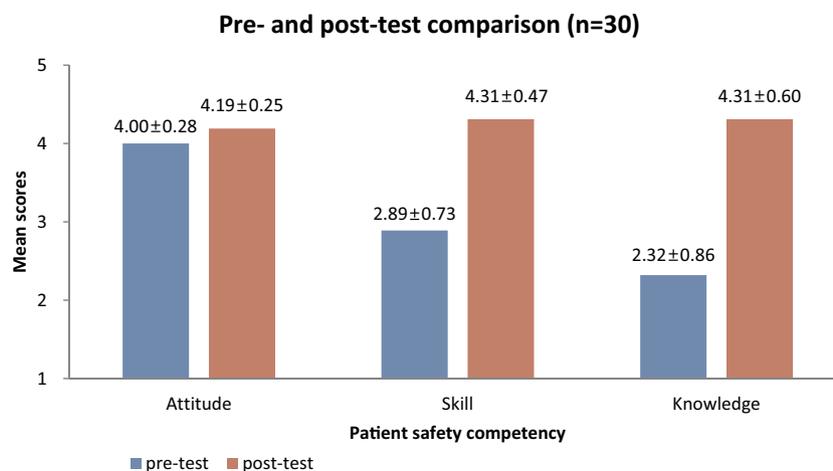

Pre- and post-test comparison (n=30)

Fig. 2. Within-group comparison of mean scores of patient safety competency (n = 30).

Table 3
Within-group analysis of patient safety competency by academic year (*N* = 30).

(A) Parametric analysis

Academic grade	PS competency	Pre-test (M ± SD)	Post-test (M ± SD)	Difference (M ± SD)	t (*p*-Value)
Second	Attitudes	4.01 ± 0.28	4.21 ± 0.17	0.20 ± 0.13	3.50 (0.025)
(n = 5)	Skills	1.93 ± 0.12	4.30 ± 0.29	2.36 ± 0.33	15.80 (< 0.001)
	Knowledge	1.57 ± 0.35	4.23 ± 0.76	2.67 ± 1.06	5.62 (0.005)
Third	Attitudes	4.01 ± 0.30	4.22 ± 0.26	0.21 ± 0.29	3.21 (0.005)
(n = 20)	Skills	3.07 ± 0.70	4.34 ± 0.48	1.27 ± 0.64	8.79 (< 0.001)
	Knowledge	2.38 ± 0.90	4.38 ± 0.57	1.99 ± 0.99	9.03 (< 0.001)
Fourth	Attitudes	3.96 ± 0.22	4.07 ± 0.28	0.11 ± 0.41	0.62 (0.569)
(n = 5)	Skills	3.10 ± 0.39	4.21 ± 0.63	1.10 ± 0.44	5.65 (0.005)
	Knowledge	2.83 ± 0.53	4.10 ± 0.60	1.27 ± 0.81	3.48 (0.025)

(B) Nonparametric analysis

Academic grade	PS competency	Pre-test (Median ± IQR)	Post-test (Median ± IQR)	*p*-Value
Second	Attitudes	58.00 ± 6.50	59.00 ± 4.00	0.042
(n = 5)	Skills	41.00 ± 5.00	91.00 ± 10.00	0.043
	Knowledge	10.00 ± 3.50	28.00 ± 8.50	0.043
Third	Attitudes	54.50 ± 6.75	60.00 ± 5.75	0.008
(n = 20)	Skills	64.00 ± 20.25	89.50 ± 19.00	< 0.001
	Knowledge	12.00 ± 7.00	26.50 ± 6.75	< 0.001
Fourth	Attitudes	54.00 ± 5.50	56.00 ± 7.50	0.498
(n = 5)	Skills	66.00 ± 16.00	90.00 ± 26.00	0.043
	Knowledge	18.00 ± 5.50	25.00 ± 7.00	0.042

PS = patient safety, M = mean, SD = standard deviation, IQR = interquartile range.
The sum of the patient safety competency scores was used for nonparametric analysis in this table. The possible range of patient safety competency scores are as follows: Attitudes: 14–70, Skills: 21–105, Knowledge: 6–30.
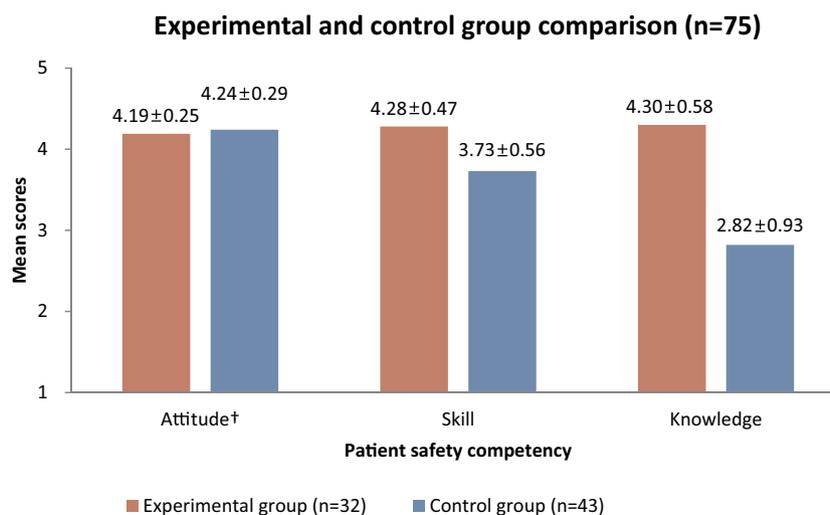

Experimental and control group comparison (n=75)

Attitude†: Experimental group 4.19±0.25, Control group 4.24±0.29
Skill: Experimental group 4.28±0.47, Control group 3.73±0.56
Knowledge: Experimental group 4.30±0.58, Control group 2.82±0.93

■ Experimental group (n=32) ■ Control group (n=43)

Fig. 3. Between-group comparison of mean scores of patient safety competency (n = 75). †Attitude scores did not show a significant difference between the two groups.

perception or attitude levels regarding patient safety were higher than the actual skills and knowledge (Lee et al., 2016). The scores on knowledge were the lowest, which may indicate that participants had few opportunities to learn about patient safety in current curriculums. Compared with the study by Lee et al. (2016), who examine patient safety competencies among 234 nursing students, pre-test scores of our participants were generally lower. This difference may be due to the fact that the participants in the study by Lee et al. (2016) were all fourth-year senior students, who may have had more chances to be exposed to patient safety by attending classes, seminars, clinical practicums, or via the media compared with our participants, who were second- to fourth-year students. However, the post-test scores of the

experimental group were higher than those in Lee et al. (2016)'s study, except for attitude score. Our results may indicate that a patient safety course conducted over a certain period of time using the flipped learning method could be promising for increasing patient safety competencies in nursing students. However, more studies are necessary to confirm our study results.

Ours is one of few studies to use a pre- and post-test design with experimental and control groups to examine the effectiveness of a patient safety course. Consistent with previous research by Aboumatar et al. (2012), who examined patient safety knowledge and self-efficacy among medical students, the knowledge scores significantly increased from 2.32 ± 0.86 (pre-test) to 4.30 ± 0.58 (post-test) in our

participants. It is difficult to compare the scores on patient safety skills and attitude with other studies, as there are scarce studies including these measures. However, our study findings indicate a significant increase in skills and attitude after completing the patient safety course. Further research needs to include studies measuring attitude, skills, and knowledge, which are part of the QSEN six core competencies.

Our participants in the experimental group showed a significant increase in patient safety skills and knowledge, but similar scores on attitude compared with the control group. These results are similar to the following studies: Maxwell and Wright (2016), who evaluated the effectiveness of patient safety education for nursing students in USA; Park and Kim (2016) who evaluated the competencies of undergraduate nursing students in Korea; and Hwang et al. (2016), who examined the effects of a 1-day interprofessional patient safety education course among final-year health professional students. These study findings are encouraging, as the level of patient safety attitude, skills, and knowledge were shown to increase with education. We found that the duration, contents, qualification of instructors, and teaching methods of patient safety education varied in the literature, and there is no research comparing effects of the different interventions; thus, it is difficult to determine which would be best option for patient safety courses.

According to the study by Lee et al. (2016), who evaluated patient safety courses delivered in Korea, most nursing schools offered patient safety education as a part of other courses such as fundamental or adult nursing. Moreover, the course was provided in a lecture format in most nursing schools. On the other hand, our patient safety education was provided as a separate course over 14 weeks covering all six QSEN core competencies. We also utilized a flipped classroom approach combining both online leaning and face-to-face discussions. A flipped classroom has been shown to increase students' knowledge and satisfaction (Betihavas et al., 2016; Maxwell and Wright, 2016; Tan et al., 2017), and we also found a significant increase in knowledge and students were satisfied with the course overall (4.4/5) (details are not included in Results as this was not our primary interest). It is noted that the use of lectures alone is not enough to increase the competencies of nursing students when they are in clinical practice (Bligh, 1998; Mansour et al., 2018), as it is important for students to experience real clinical cases using various teaching methods such as case studies, small and large group discussions, and presenting topics related to quality improvement by analyzing patient safety issues.

Based on our major study findings, there are several areas for future research. Ours is one of few studies to use a pre- and post-test quasi-experimental design with a non-equivalent control group. Thus, it was difficult to compare the study outcomes (attitude, skills, knowledge) both before and after the intervention was delivered with other studies, especially in Korea. Thus, further research is needed using a similar study design. Additionally, the length of interventions varied across studies and we could not determine which duration was more effective. Future studies may be needed to compare the effectives of interventions based on their length. We also recommend that future studies use reliable interventions such as those based on topics listed in the WHO patient safety curriculum guide and incorporate real case-studies related to patient safety. Moreover, nurses are interdisciplinary team members; however, Hwang et al. (2016) reported that students showed low confidence when working with other healthcare team members, which could be an obstacle when delivering safe patient care. Thus, a patient safety course including students from other healthcare majors could be helpful. Jang and Lee (2017) reported that nursing educators received insufficient education on patient safety. Therefore, programs including current principles and trends in patient safety as well as how to deliver this knowledge to students are needed for nursing educators in both nursing schools and clinical practice.

This study has some limitations. First, the study outcomes were measured on the last day of the patient safety course and we did not remeasure them at a later time. Therefore, we are not certain about the long-term effects of the intervention provided. We recommend using time-series measurement in future studies. Second, the study was conducted in a single university in Korea, therefore the study findings may not be generalized. Third, the patient safety course was elective. Therefore, there is a possibility that students choosing the course were more interested in patient safety issues and had higher levels of knowledge, skills, and attitudes than those who did not choose to take this course. There is also a possibility that students who were in an experimental group had higher levels of attitude, skills, and knowledge compared to the control group before the intervention was provided. Fourth, the PSCSE is a self-reported tool. Therefore, differences may exist between students' self-evaluated competency scores and actual competency scores (Lee et al., 2016). Moreover, the PSCSE evaluates self-reported knowledge, attitude, and skills, and does not evaluate actual skills. Future studies should investigate how to objectively evaluate patient safety competencies and evaluate actual skills of nursing students.

6. Conclusions

Our study utilized a pre- and post-test quasi-experimental design with a non-equivalent control group to examine the effectiveness of a patient safety course using a flipped classroom approach. The results showed that the level of patient safety competencies increased after completing the course, and was significantly higher in students who attended compared with those who did not attend the patient safety course. As ours is one of the few studies in Korea to implement a patient safety course over 14 weeks and utilize a flipped classroom approach using the WHO patient safety curriculum guide, further research is needed to confirm our study findings.

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