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ORIGINAL ARTICLE

Effects of smartphone application education combined with hands-on practice in breast self-examination on junior nursing students in South Korea

So Ra Kang[1] | Hyewon Shin[2] | JungMin Lee[3] | Shin-Jeong Kim[4]

[1]Division of Nursing, Ewha Womans University, Seoul, South Korea

[2]School of Nursing, Clemson University, Greenville, South Carolina, USA

[3]School of Nursing, University of North Carolina at Greensboro, Greensboro, North Carolina, USA

[4]School of Nursing, Hallym University, Chuncheon, South Korea

Correspondence
Shin-Jeong Kim, School of Nursing, Hallym University, 1 Hallymdaehak-gil, Chucheon, Gangwon-do 24252, South Korea.
Email: ksj@hallym.ac.kr

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Abstract

Background: Breast self-examination is a convenient and effective way to detect breast abnormalities. Based on Dale's Cone of Experience theory, we hypothesized that the combination of a smartphone application with hands-on practice would have a greater impact than using a smartphone application alone. The purpose of this study was to compare the effects of different educational methods on (a) knowledge, (b) attitudes, (c) skills, and (d) students' satisfaction with the learning methods.

Methods: We conducted a pre- and post-test quasi-experimental design and developed a smartphone application using a video clip. One experimental group received smartphone-based education, another group received smartphone-based education combined with hands-on practice, and the control group received a one-time classroom lecture. We administered a pre-test, provided intervention, and conducted a post-test.

Results: Among the three groups, the knowledge and attitude of the experimental groups were significantly higher than that of the control group. In addition, the group using the combination of the smartphone application and hands-on practice showed the highest score changes in skills and satisfaction with the learning methods.

Conclusions: Smartphone application use combined with hands-on practice could be an effective education method for breast self-examination.

KEYWORDS

breast self-examination, health education, smartphone

1 | INTRODUCTION

1.1 | Breast self-examination

Breast cancer is the most common cancer among women; over 1.15 million people are diagnosed with breast cancer every year (World Health Organization, 2019). Breast cancer is ranked second among the leading causes of cancer death in women in Korea, and the average annual rate of increase is 5.6% (Korea Central Cancer Registry, 2016). In particular, the incidence rate for younger women in Korea diagnosed with breast cancer before menopause is more prevalent than in other countries; 11% of patients in Korea under 40 years old suffer from breast cancer, a number twice as high as that found in Western countries (Korea Breast Cancer Society, 2016).

Previous studies have shown that women who receive breast cancer screening tests have a 30% lower risk of

death from breast cancer than women who do not receive screening (Puliti et al., 2008). According to the breast cancer screening guidelines of the American Cancer Society (Oeffinger et al., 2015), all women should start having yearly mammograms by the age of 45, and after they turn 55 years, they need to have mammograms every other year. Also, breast self-examination (BSE) may play a role in the early detection of breast cancer. If women are familiar with performing BSE, they can detect unusual changes. Therefore, BSE is considered one of the easiest and most convenient ways to detect breast problems early (Amoran & Toyobo, 2015; Hocaoğlu, Erşahin, & Akdeniz, 2017).

Approximately 30% of Asian and Malaysian women regularly perform BSE (Al-Naggar, Bobryshev, & Al-Jashamy, 2012). However, with the most recent nationwide survey, about 87% of Korean women have heard about BSE through media; among these women, only 17% received BSE information through their healthcare providers (Yoo, Choi, Jung, & Jun, 2012).

In Korea, BSE education has been conducted in the community for women over 30 years of age (Korea Breast Cancer Society, 2016; Park, Hong, Kye, Jung, & Kim, 2011). However, educating younger women less than 30 years old can educate and prepare them as they near the age of 30. A few descriptive studies were conducted to understand the knowledge and practice of BSE for young women (Kim, 2013; Kim, Lee, Min, & Min, 2017; Lim & Jang, 2017). However, these studies are insufficient encouragement for young women to learn and practice BSE.

1.2 | Smartphone application education for health care

In modern society, smartphone applications (apps) are considered valuable alternatives and resources for patients and healthcare professionals in health education (Bush, Armstrong, & Hoyt, 2018; Deliverska, Vodenicharova, & Yanakieva, 2017). Smartphone apps have several advantages, including affordability, ability to engage learners anytime and anywhere in their learning context, and easy installation through downloads (Layton et al., 2014; Martin & Ertzberger, 2016). Some international studies have highlighted university students' positive attitudes toward using smartphones for educational (Koohestani, Arabshahi, Ahmadi, & Baghcheghi, 2019). Therefore, for the younger generation, including nursing students who have access to highly advanced technology, smartphones are indispensable accessories (Lee, Min, Oh, & Shim, 2018). The rate of smartphone usage in Korea reached 91% in 2016 (Gallup Korea, 2018; Korea Information Society Development Institute, 2017) and for individuals in their 20s, the rate of usage was as high as 99%. Since most people in Korea use smartphones, methods of education that employ smartphone apps may be effective (Kim & Park, 2019).

Few health education programs using apps are provided to nursing students (El-Mohsen & El-Maksoud, 2015), and most of them are only intended to convey information about BSE. However, education using smartphone apps alone might not help an individual to practice skills but combining the apps with other educational strategies can be helpful in increasing their learning effects (Morrison et al., 2014). Nursing education involves not only the acquisition of knowledge but also the mastery of practical skills that are required in various clinical environments (Lee et al., 2018; Li, Lee, Wong, Yau, & Wong, 2019). Skill acquisition takes place in a variety of learning contexts, especially through reflection by experience. Therefore, nursing students need to be familiar with clinical procedures and improve their skills through practice (Li et al., 2019). Poore, Cullen, and Schaar (2014) also emphasized that experiential learning is fundamental and essential to prepare nursing students for professional practice.

In this study, we assumed that if we combined smartphone app education with hands-on practice, the education would have a greater impact. Regarding the efficacy of education in health behaviors, it is important for an individual to both understand procedures and practice the skills.

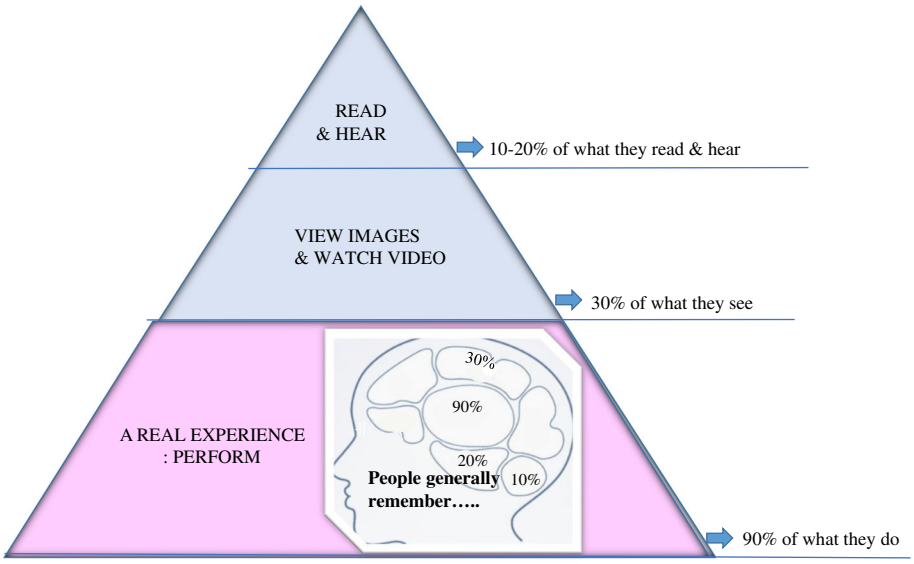
1.3 | Theoretical framework

Dale's Cone of Experience (Dale, 1970) was used as the theoretical framework for this study (Figure 1). This theory explains the effectiveness of various learning methods by measuring the amount of information remembered. Dale (1970) explained the degree of memorization after 2 weeks based on the learning method, as conical, like a pyramid (reading: 10%, listening to a lecture: 20%, watching moving pictures: 30%, real experience by performing practice: 90%). The experience of practicing a skill, may be related to an increase in the individual's memorization. The high degree of memorization may be attributable to individuals experiencing practice themselves. Therefore, this theory guided us to design an educational framework.

1.4 | Purpose

The purpose of this study was to develop a smartphone-based BSE app and to compare the effects of different

FIGURE 1 Theoretical framework: Edgar Dale's "cone of experience"



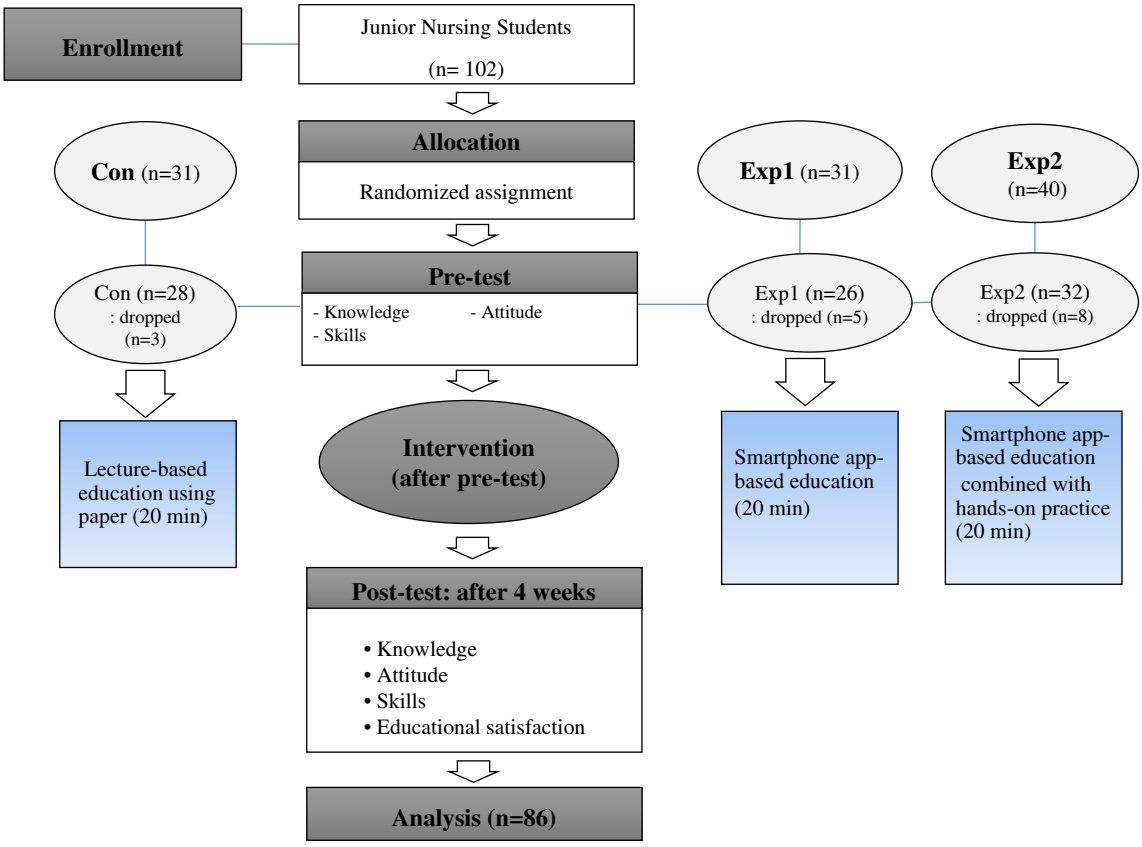


FIGURE 2 Research flow

educational methods on three groups. Our research sought to determine the differences in the degree of (a) knowledge, (b) attitudes, and (c) skills among three groups of students before and after the intervention. Furthermore, we sought to determine the difference in (d) students' satisfaction with the learning methods utilized in the three groups.

2 | METHODS

2.1 | Design

This study used a pre- and post-test quasi-experimental design with two experimental groups and a control group (Figure 2).

TABLE 1 The contents of the educational intervention

Learning objective

- Performing breast self-examination successfully

Learning goals

Students can

- Understand the symptoms and prevention of breast cancer
- Understand the procedure of breast self-examination
- Perform the breast self-examination
- Know the abnormalities when performing breast self-examination
- Know the appropriate timing of breast self-examination

Learning themes

Breast cancer	Methods of BSE	Practice of BSE
- Status of breast cancer - Classification of neoplasms - Progression of breast cancer - Outbreak site of breast cancer - Risk factors of breast cancer - Breast cancer screening recommendation	- Procedures for performing breast self-examination • Visually checking in front of mirror • Standing or sitting and palpating by hand • Lying down and palpating by hand - Appropriate timing of breast self-examination - What to observe when performing breast self-examination	- Example of breast self-examination • Visually checking in front of mirror • Standing or sitting and palpating by hand • Lying down and palpating by hand

2.2 | Setting and participants

This study was conducted at a university in Chuncheon, South Korea. Included participants were female university students who (a) owned a smartphone and (b) had never received any education on BSE, and (c) healthy woman. In addition, we did not include participants who had breast-related or any other chronic diseases. We considered nursing students as representative of typical adults who might not yet know about BSE. Junior nursing students were particularly chosen because they had limited hands-on practice performing breast examinations and were not yet fully trained as professional nurses.

For participant recruitment, we posted an explanation of the study using the bulletin board on the homepage of a nursing school. The first author explained the study purpose to 102 students who met the eligibility requirements and asked if they were willing to participate in the study. Consent forms were obtained from the students who volunteered to participate. Participants were divided into three groups: smartphone app education group (Experimental: Exp 1), smartphone app-based education combined with hands-on practice group (Experimental: Exp 2), or lecture-based education (Control group: Con). We prepared 35 pieces of paper for each group, Exp 1, Exp 2, and Con, and students were assigned to each group by drawing lots. Using the power analysis (G* Power 3.0; Faul, Erdfelder, Lang, & Buchner, 2007), a medium effect size of 0.50 and a power of 0.80 (significant p-value of .5), at least 26 participants are required for each group. Sixteen participants were excluded because they did not complete the questionnaires (n = 7), did not take a skill test (n = 8), or dropped out of school (n = 1). The final number of participants was determined at 86 (Exp 1 = 26, Exp 2 = 32, Con = 28), which was considered an acceptable.

2.3 | Instruments

2.3.1 | Knowledge of BSE

The assessment used to measure participants' knowledge of BSE was revised by the study authors and based on Choi (2006) and information from the Korean Breast Cancer Society (2016). It consisted of 22 questions to assess knowledge of the signs and symptoms of breast cancer (nine items) and skills of BSE (13 items). Each correct response received a score of one while an incorrect response received a score of zero. The possible highest score was 22 points. The Cronbach's alpha was .72 for the current study.

2.3.2 | Attitude toward BSE

Participants' attitudes toward BSE were measured using a scale based on that of Lee (2003) and revised by the study authors to accurately match the purpose of the current study. The scale consisted of 16 items scored on a four-point Likert scale (1 = not at all, 2 = rarely, 3 = moderate, 4 = very). Total scores ranged from 16 to 64, with a higher score indicating a more positive attitude toward BSE. The reliability test yielded a Cronbach's alpha of .79 for the current study and .91 for the study by Lee (2003).

2.3.3 | Skills in performing BSE

A checklist was developed by the study's authors based on guidelines from the Korean Breast Cancer Society (2016). The checklist consisted of 11 items: observation (three items), palpation in a sitting or standing position (seven items), and palpation in a lying down position (one item). Each item was scored using a three-point Likert scale (0 = poor, 1 = moderate, 2 = accomplished), with higher scores indicating a better skill level in BSE performance. The highest possible score was 22 points, and Cronbach's alpha for the scale was .92.

2.3.4 | Satisfaction with the learning method

Yoo's (2010) satisfaction scale was used to measure satisfaction with the learning method. The current study authors revised the instrument to better match this study's purpose. It consisted of 10 items scored on a four-point Likert scale (1 = not at all, 2 = nearly disagree, 3 = agree, 4 = strongly agree). A higher score indicated a higher level of satisfaction with the learning method that participants received. The Cronbach's alpha for the scale was .93 for this study, compared with .92 for Yoo (2010).

2.3.5 | Validity

Validity was carried using content validity. Five experts, including three team manager nurses with at least 20 years of clinical experience who worked in the breast cancer units of three hospitals, examined the content validity of all instruments used in this study. The other two experts were university nursing faculty who majored in women's health. Each expert checked the content validity using a four-point Likert scale (1 = not relevant, 2 = somewhat relevant, 3 = quite relevant, and 4 = highly relevant). In this study, the content validity index of the instruments was above 80%, which is considered acceptable (Davis, 1992).

2.4 | Development of the smartphone app for BSE

The smartphone app was developed to educate nursing students. The learning objectives and goals were based on “Breast Cancer Facts & Figures” published by the Korean Breast Cancer Society (2016). We also reviewed women's health nursing textbooks and several nursing journals to verify updated information about BSE. After three in-depth discussions, we selected the contents for the intervention and established three topics including information on breast cancer, methods, and practice of BSE.

The app was developed for both Android and Apple phones and was available through the Apple App Store and Google Play Store (Figure 3). We created graphic-based materials and instructions that were attractive and readable for university students. We used Korean for video narration. The same five experts who reviewed the instruments also approved the contents of the app.

2.5 | Educational intervention

The educational intervention consisted of understanding breast cancer (classification, progression, outbreak site, risk factors, screening recommendation), methods of BSE (procedures, best time, what to observe), and practice of BSE (example of practice) (Table 1). Two weeks after the pre-test, we provided the different interventions for the three groups.

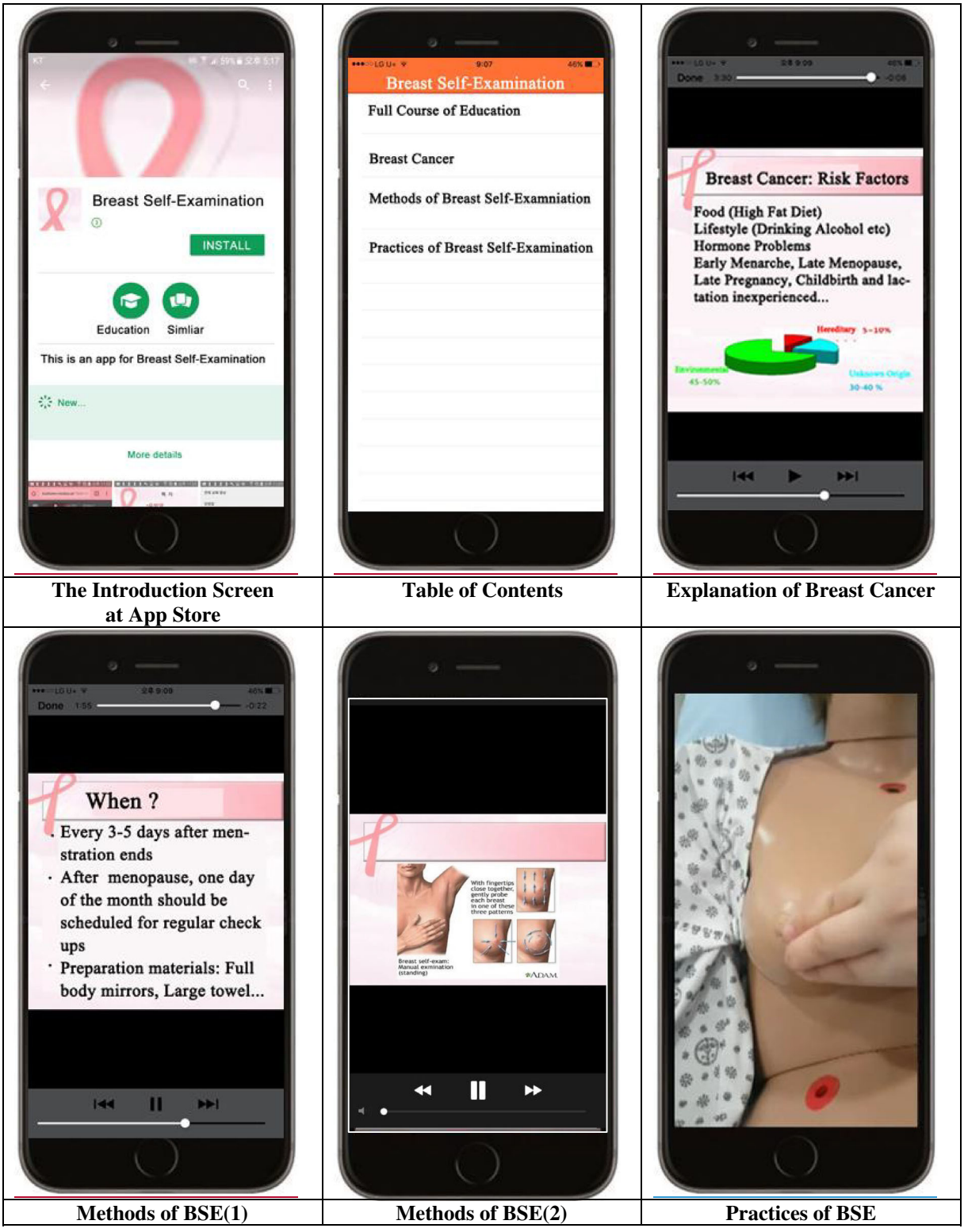


FIGURE 3 Screenshots of developed smartphone-based app

The Exp 1 group received the education using video clips in the smartphone app. The Exp 2 group received the same video clips in the smartphone app, along with the opportunity to practice BSE using a breast model made of silicone (Model No: 7007BR, Emson, NY, manufactured in China), a material similar to a human breast. We provided a silicone breast model to each student in the Exp 2 group and demonstrated the BSE procedure. Students practiced

the BSE procedure following the video clips during 20 min, and errors in procedure were immediately corrected by the instructor. We provided a password for the app to the two experimental groups (Exp 1 and Exp 2) only; the control group learned using a lecture-based method. The different intervention was applied once to all three groups while the experimental groups (Exp 1 and Exp 2) were encouraged to use the video clips for about a month. We provided handouts to accompany the lecture; this included pictures offering the same contents provided digitally to the experimental groups.

One author of this study instructed the three groups using the same educational content but different methods. The total presentation time was approximately 20 min for all three groups. Following completion of this study, we also provided smartphone-based educational intervention for the control group to provide equal learning opportunities for all participants.

2.6 | Data collection

Data were collected between April 9, 2018 and May 21, 2018. Two research assistants who had no knowledge of the student group assignments distributed the questionnaires. Participants completed the questionnaires measuring the knowledge and attitude concerning BSE 2 weeks prior to (pre-test) and 2 weeks after (post-test) the intervention. Researchers video-recorded participants performing skill tests that included displaying the students' behavior as well as their communication regarding BSE, and used a checklist to measure participants' skills. Three researchers evaluated each participant's performance separately and the average duration of evaluation time was 5 min. Post-test included the same instruments (knowledge, attitude, and skills concerning BSE), but also added a participants' satisfaction with the learning method they received. After the post-test, the researchers watched the recorded videos and discussed the score differences until they agreed on a score for each participant. The researchers then calculated the average score from the three raters.

2.7 | Ethical considerations

Prior to the start of the study, approval was granted by the H University Institutional Review Board in Korea (HIRB-2017-003). Students were informed about all aspects of the study and were assured that there was no disadvantage for non-participation. After students were informed, those who were willing to participate in this study signed a consent form, giving written permission for videos to be recorded while their skills were tested.

2.8 | Data analysis

Data analyses were performed using SPSS version 21.0 (SPSS Inc., Chicago, IL, USA). Descriptive and inferential statistics were used to describe the demographic

TABLE 2 Homogeneity test among the three groups' demographic characteristics and baseline of knowledge, attitude and skills levels (N = 86)

Demographics	Classification	Con (n = 28) n (%)	Exp 1 (n = 26) n (%))	Exp 2 (n = 32) n (%)	χ^2	*p*
Menarche age (years)	≤12	13 (29.5)	17 (38.6)	14 (31.8)	3.060	.217
	13≤	15 (35.7)	9 (21.4)	18 (42.9)		
Having an acquaintance suffering from BC	Yes	5 (27.8)	6 (33.3)	7 (38.9)	.249	.883
	No	23 (33.8)	20 (29.4)	25 (36.8)		
Having a family member(s) suffering from BC	Yes	3 (30.0)	2 (20.0)	5 (50.0)	.912	.634
	No	25 (32.9)	24 (31.6)	27 (35.5)		
Variables		**M (SD)**	**M (SD)**	**M (SD)**	**F**	***p***
Knowledge of BSE		0.68 (0.12)	0.65 (0.10)	0.66 (0.17)	0.41	.66
Attitude toward BSE		2.70 (0.31)	2.81 (0.30)	2.75 (0.42)	0.58	.56
Skills in performing BSE		1.70 (0.55)	1.92 (0.61)	1.91 (0.44)	1.48	.23

Abbreviations: BC, breast cancer; BSE, breast self-examination; Con, control group = lecture-based education; Exp 1, Experimental group 1 = smartphone app education; Exp 2, Experimental group 2 = smartphone app-based education combined with hands-on practice.

TABLE 3 Differences in knowledge, attitude, and skill levels among the three groups (N = 86)

Variables	Groups	Pre-test M ± SD	Pre-test F (p)	Post-test M ± SD	Post-test F (p)	Mean difference (post − Pre) M ± SD	Mean difference (post − Pre) F (p)	Effect size Con (1), Exp 1 (2), Exp 2 (3) 1 vs 2	1 vs 3	2 vs 3
Knowledge of BSE	Con. (n = 28)	0.68 ± 0.12		0.70 ± 0.13[a]		0.02 ± 0.13[a]	6.04** (.004)	0.96	0.63	−0.27
	Exp 1. (n = 26)	0.65 ± 0.10	0.41 (0.66)	0.80 ± 0.10[b]	5.25** (.007)	0.15 ± 0.14[b]				
	Exp 2. (n = 32)	0.66 ± 0.17		0.77 ± 0.11[b]		0.11 ± 0.15[b]				
Attitude toward BSE	Con. (n = 28)	2.70 ± 0.31		2.67 ± 0.34[a]		−0.03 ± 0.30[a]	4.16* (.019)	0.19	0.69	0.64
	Exp 1. (n = 26)	2.81 ± 0.30	0.58 (0.56)	2.83 ± 0.21[b]	3.36* (.039)	0.02 ± 0.20[b]				
	Exp 2. (n = 32)	2.75 ± 0.42		2.88 ± 0.37[b]		0.13 ± 0.14[b]				
Skills in performing BSE	Con. (n = 28)	1.70 ± 0.55		2.23 ± 0.27	62.84*** (<.001)	0.52 ± 0.56[a]	4.52* (.014)	0.15	0.84	0.55
	Exp 1. (n = 26)	1.92 ± 0.61	1.48 (0.23)	2.55 ± 0.23		0.62 ± 0.73[a]				
	Exp 2. (n = 32)	1.91 ± 0.44		2.87 ± 0.14		0.95 ± 0.46[b]				

Abbreviations: BSE, breast self-examination; Con., Control group; Exp 1., Experimental group 1; Exp2., Experimental group 2.
[a,b]Post-hoc Duncan test (a < b).
*<.05.
**<.01.
***<.001.

characteristics of participants and their scores on the questionnaires. One-way analysis of variance with Duncan post-hoc was used to test for differences in scores among the three groups. Statistical significance was defined at a *p*-value <.05.

3 | RESULTS

3.1 | Homogeneity test among the three groups' baseline variables

Eighty-six junior nursing students participated. All participants were female and aged 20–22 years (mean: 20.7 ± 0.76). There were no statistically significant differences among the three groups regarding typical characteristics or the baseline level of knowledge, attitude, and skills (Table 2). Therefore, the three groups were considered homogeneous.

3.2 | Mean differences in knowledge, attitude, and skills

3.2.1 | Knowledge of BSE

There were statistically significant mean differences among the three groups' knowledge of BSE (Table 3). After the intervention, the post-hoc analysis showed that the knowledge level was significantly higher for the two experimental groups (Exp 1 and 2) than for the control group (F = 6.048, $p = .004$). Thus, the smartphone-based education was considered to have the potential to improve scores concerning knowledge about BSE in junior nursing students.

3.2.2 | Attitude toward BSE

The attitude toward BSE among the three groups showed significant differences and at the post-hoc test, it was

TABLE 4 Satisfaction with the learning method among the three groups (N = 86)

Categories	M (SD)	F	p
Con.	3.10 (0.51)[a]	15.87	<.001
Exp 1.	3.21 (0.41)[a]		
Exp 2.	3.64 (0.23)[b]		

Abbreviations: Con., control group; Exp 1, experimental group 1; Exp 2, experimental group 2.
[a,b]Post-hoc Duncan test (a < b).

shown to be better for the experimental groups than for the control group (F = 4.168, p = .019). In addition, the Exp 2 group score was higher than the Exp 1 group score. Thus, hands-on practice, regardless of smartphone app education, resulted in a more positive attitude toward performing BSE compared to the attitude of the control group.

3.2.3 | Skill in performing BSE

Participants in the Exp 2 group showed the highest enhancement of their skills compared to the Exp 1 or control groups (F = 4.521, p = .014). The post-hoc analysis revealed that the Exp 2 group had gained a higher mean score on skills when compared with that of the Exp 1 and control group. This means that the method utilizing the smartphone app combined with hands-on practice was effective in improving BSE skills.

3.3 | Satisfaction with learning method

In the mean score for satisfaction with the learning method, there was a significant difference among the groups (F = 15.587, p < .001). The post-hoc test revealed that the satisfaction levels of the smartphone app combined with hands-on practice group was the highest when compared with the other groups (Table 4).

4 | DISCUSSION

Early detection of breast cancer is an important factor for decreasing mortality and improving prognosis. Among the breast cancer screening methods, BSE is regarded as a cost-effective and convenient method for individuals. However, many women do not use this technique because they are embarrassed to touch their breasts, they lack confidence or time, or they do not know how to correctly perform BSE (Amoran & Toyobo, 2015; Nde, Assob, Kwenti, Njunda, & Tainenbe, 2015). Smartphones are a convenient way to access a variety of apps regardless of time or location. Heo et al. (2013) suggested that an intervention combined with a smartphone app could enhance BSE practice. Additionally, Dale (1970) suggested that direct performance in education has more of an impact on learners. One of the strengths of this research project is that we assessed participants' abilities, so the accuracy of their BSE skills could be checked.

In the present study, BSE knowledge was significantly improved in both groups. This result is in line with the study by Hawkes, Walsh, Ryan, and Dempsey (2013) that showed that knowledge of pediatric trainees significantly increased in a group that underwent smartphone-based education as compared to a group that experienced traditional training methods. Similarly, a study was conducted providing online education about BSE to 1,769 women (aged 17–42 years), showing online education as an effective method for delivering knowledge (Tuna et al., 2014). In our smartphone-based education, we actively used video clips, which was identified as an effective way to improve knowledge about BSE (Tomar, 2019). Furthermore, in our study, the hands-on practice of the Exp 2 group contributed to the increase in knowledge, which is similar to the result of a 2018 study that demonstrated a significant increase in knowledge when students practiced BSE on mannequins (Raithatha, Mangalampalli, Patel, Kumar, & Tapadiya, 2018). Martin and Ertzberger (2016) suggested that using mobile learning, such as a smartphone, is the best way to help learners understand, compared to a traditional model. In our finding, smartphone education as well as hands-on practice can be considered an effective method for acquiring knowledge of BSE.

In this study, the attitude toward BSE was significantly better in the group that experienced the smartphone app combined with hands-on practice than in the group experiencing lecture-type education. In another descriptive study of female undergraduate students, 34% showed positive high overall attitudes toward BSE and 63% showed moderate attitudes toward BSE after performing a BSE (Nde et al., 2015). The authors of the aforementioned study addressed that there were significant associations between participant attitudes and their practice of BSE. Thus, having a positive attitude toward BSE could impact the practice of BSE, while negative attitudes toward BSE could decrease the practice of BSE and weaken the motivation to practice BSE (Tuna et al., 2014). These studies' findings imply that performing hands-on practice by oneself may stimulate development of a more positive attitude toward BSE.

In this study, it was found that education delivered through a smartphone app in combination with hands-on practice has the most potential to improve participants' skills. In a study by Miyoshi et al. (2019), medical students' hands-on experience of touching actual human organs provided them with a deeper understanding. Zwislewski et al. (2019) also reported that participants who engaged in hands-on practice were more proficient than those who only heard the lecture. Their study demonstrates the need for hands-on practice. These studies support the idea that people learn from practical experience. Kolb (1984) reported that experience plays a significant role in the learning process. This was exemplified by Dewey who stressed the importance of learning through experience and based on Piaget's theory which suggested

that cognitive development is influenced by experience. According to the experiential learning theory proposed by Kolb and Kolb (2009), what individuals learn in active experimentation directly influences future practice, thus significantly enhancing outcomes. Lee et al. (2018) reported that nursing students who applied mobile technology (smartphones) alone did not improve their Foley catheterization skills. This finding is in line with previous studies. Wood, Duffy, Morris, and Carnes (2002) used a breast model with lumps in their practice, and the intervention groups had significantly improved BSE skills. Similarly, Secginli and Nahcivan (2011) targeted women over 41 years of age in their study, which found that those participants who had received breast health education in conjunction with hands-on practice using a silicone breast model were significantly more skilled in finding breast abnormalities such as lumps. As a person becomes familiar with the techniques of checking their breasts, it can increase the chance of finding an abnormality. As such, we should not overlook the importance of BSE skills (Johnsen, Blom, Lee, & Nørgaard, 2018).

In the current study, satisfaction with the learning method was higher in those participants who used the smartphone app combined with hands-on practice. Similarly, in a study using a silicone training model and video clip for medical students, the satisfaction with the learning method was higher for those students who were able to use the training model than for those only using the video clip (Grynberg et al., 2012). Therefore, in addition to hands-on practice with a video clip, it might meet students' needs and expectations more appropriately.

The findings of our study support the necessity of hands-on practice as a primary method for BSE intervention. In a study using theoretical education combined with an active face-to-face practice, participants' knowledge and practice skills were improved (Malak & Dicle, 2007). Additionally, in Gucuk and Uyeturk (2013), participants who received BSE education with a simulation practice from healthcare professionals showed greater BSE awareness and practice than those who simply heard about BSE from media sources such as television and the Internet. This greater awareness and practice is because hands-on practice is a well-known method for increasing self-efficacy and confidence; having a positive attitude toward learned skills may influence the enhancement of those skills (Bambini, Washburn, & Perkins, 2009). Therefore, we can infer that BSE education in conjunction with hands-on practice improves BSE awareness and practice and may therefore improve the identification of breast health problems. In addition, the satisfaction level of the group that used the combination of the smartphone and hands-on practice was the highest of the three groups identified in the present study.

In the current study, both experimental groups (Exp 1 and 2) showed significantly improved knowledge about BSE compared to the control group. In addition, attitudes toward BSE, skill in performing BSE, and satisfaction with the learning method were significantly higher in the experimental group (Exp 2) than in the other two groups. These results indicate that a smartphone education combined with hands-on practice can be considered an effective method.

Therefore, the current study that includes hands-on practice combined with the smartphone app-based intervention may have greater effects than app-based intervention alone. Also, this combined method would possibly lead to increased efficiency in education by providing more opportunities for self-directed and repetitive learning.

4.1 | Implications for nursing education

Healthcare providers are responsible for providing information to effectively educate patients or general populations. Smartphone apps are increasingly important as useful health tools in nursing education. The findings of the present study could contribute to the education of patients and the general population regarding learning and practicing BSE. Previous research has demonstrated that incorporating the smartphone in teaching strategies could support learner experiences and understanding among nursing students, which can also be extended to the clinical setting (Raman, 2015).

Another important area of implication for nursing education highlighted by the present study involves the importance of performing accurate BSE as it relates to the early detection of breast abnormalities. Based on the findings of the current study, nursing students are encouraged to further evaluate BSE training by combining apps with hands-on practice in future studies. For example, Carter-Templeton, March, and Perez (2018) found that the use of a simulated laboratory practice for nursing students offers a safe space for students to practice nursing skills and communication where faculty members can observe their work. Additionally, the authors found that adding mobile devices in conjunction with hands-on practice helps students gain skills and use accurate information from the mobile devices. Therefore, further studies will be required to focus on the role of health personnel, the uptake, and the skills of BSE in women. Using an educational model combining a smartphone app with hands-on practice training may contribute to positive outcomes in other health areas as well. We expect that the findings of this study will contribute to improved learning about BSE and the practice of BSE methods for students and young women. In

addition, it will support the nursing faculty in incorporating more active methods to educate their students about BSE as well as nursing skills.

4.2 | Limitations

Although we reveal the effectiveness of education using a smartphone app combined with hands-on practice, this study had a few limitations. First, only Korean participants from one province were selected. Future studies could include participants from various geographic areas and ethnic groups. Second, convenience sampling was used for this study, which could threaten internal validity. Third, the sample size was enough for the effect size, but we only administered the post-test once. To better understand the retention effects of education with a smartphone app and hands-on practice, it is necessary to do more testing to follow-up after the intervention. In addition, the other limitations of this study included: selecting only one nursing school, 16 drop-out subjects, as well as not using a randomized controlled trial. Therefore, it is necessary to consider these points in future studies.

5 | CONCLUSIONS

This study provides evidence that using a smartphone app combined with hands-on practice is an effective method for providing information and imparting skills to undergraduate nursing students about BSE, resulting in high satisfaction. Therefore, providing education using a smartphone in combination with hands-on practice for BSE could be a creative and useful method for students. Further, this learning method could more broadly be expanded to young women.

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CONFLICT OF INTERESTS

No potential conflict of interest was reported by the authors.

AUTHORSHIP CONTRIBUTIONS

Conception and design: S.R.K., H.W.S., J.M.L. and S.-J. K. Provision of study materials or participants: S.R.K., J.M.L. and S.-J.K. Data collection and intervention implementation: S.R.K., J.M.L. and S.-J.K. Data analysis and interpretation: H.W.S. and S.-J.K. Manuscript writing and or revision of the manuscript: S.R.K., H.W.S., J.M.L. and S.-J.K.

ORCID

So Ra Kang https://orcid.org/0000-0003-3783-8854
Shin-Jeong Kim https://orcid.org/0000-0003-2582-3436

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