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ORIGINAL ARTICLE

Nursing students' experiences of using a smart phone application for a physical assessment course: A qualitative study

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Abstract

Aim: It is important that nurses possess adequate clinical skills so that the patient receives safe and competent care. Smart phone applications (apps) can promote active learning and the long-term retention of knowledge of undergraduate students. Therefore, the aim of this study was to explore the thoughts and experiences of nursing students who received a smart phone, app-based physical assessment educational intervention.

Methods: A qualitative descriptive approach with in-depth interviews was considered as suitable to obtain a comprehensive understanding of students' experiences of a smart phone-enabled physical assessment course.

Results: Based on interviews with 16 nursing students following the intervention, five themes were derived from the analysis of the interview transcripts: "the APP's physical assessment scenarios are very close to real-life clinical situations," "watching physical assessment videos over the APP is a quick way to learn what to do," "the APP is a new way of learning that enhances thinking and reflection," "some nursing students felt that it was out of their depth to analyze the scenarios in the APP," and "the APP needs enhancements in stability and interactivity."

Conclusion: The findings of this study showed the mobile app as an effective learning aid that promoted transferability of the nursing students' knowledge and past experience. With the help of the APP, the teachers could offer timely guidance to the students.

Key words: physical assessment, qualitative study, scenarios, smart phone app.

INTRODUCTION

Assessing the competence of nursing students is critical to identifying areas for professional development and educational needs, while ensuring that competencies are put to use for quality care (Marshburn, Engelke, & Swanson, 2009). Physical examination and health assessment are two clinical skills that are required by nurses. A nurse conducts an average of 3.98 physical examinations and health assessments per day (Giddens, 2007). In nursing practice, it is important that nurses are able to solve clinical problems with foundational knowledge and comprehensive physical assessment skill (Lin & Lin, 2015). Koc and Saglam (2012) reported that, of the 362 nurses that they investigated, 41.5% lacked physical examination skills and 77.9% were unable to conduct a clinical physical examination because of a lack of knowledge. The nurses who were surveyed were well experienced in vital sign assessment, consciousness level assessment, peripheral vascular examination, and language function examination, but had no experience with thyroid examination, cranial nerve examination, and percussion of the patient's abdomen.

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In recent years, the concept of mobile learning has emerged to represent learning that occurs where mobile technologies have a central role (Walton, Childs, & Blenkinsopp, 2005). The applications (spps) on smart phones provide such an opportunity, as they are now used more than traditional media (Mitchell, Farrow, & Haycraft, 2013). Such technology offers point-of-care, bedside, or just-in-time information to support learning and practice (Hardyman, Bullock, Brown, Carter-Ingram, & Stacey, 2013). Thus, mobile learning allows teaching to extend beyond the walls of a traditional classroom (Kaser, 2009; Kolb, 2006; McGuire, 2005). Mobile learning is a type of learning model that allows learners to obtain learning materials anywhere and anytime by using all kinds of wireless handheld devices (Ozdamli & Cavus, 2011).

Dresselhaus and Shrode (2012) observed that ~50% of American students use mobile devices for a variety of academic tasks, such as reading electronic books, journals, and accessing library catalogs. A study indicated that the online game, Septris, was effective in helping medical trainees learn to recognize and treat sepsis (Evans *et al.*, 2015). However, mobile learning technology seldom has been applied in nursing education lectures and the research on it is even scarcer. Raman (2015) identified a need for nursing faculties to develop new technology-based pedagogy that would increase nursing students' proficiency.

Literature review

The apps on smart phones are so useful that they are now being used more widely than desktop computers with Internet access. Simulation-based training can provide students with systematic guidance and feedback and help them to relate simulation to real-life clinical practice as they build up clinical competence. This study's theme would allow students to gain a great deal of experience and knowledge in modern software development for mobile phones and deliver a software program for detecting health problems. The design of apps (mobile device) consists of two parts: the front end and the back end. The front end is a user interface that consists of the screens, menus, command buttons, and other objects that comprise what the user interacts with. The back-end system essentially is a management platform that puts together account management, user management, the settings of practices and tests, and video upload management.

Mobile technologies are playing an increasingly important role in college students' academic life (Vázquez-Cano, 2014). Mobile devices are characterized by three important aspects, including portability, instant connectivity, and contextual sensitivity (Reychav, Dunaway, & Kobayashi, 2015). According to Gaskell (2010), these devices have resulted in learners becoming more involved and proactive in their own learning. The learner is mobile, is at the center of learning, and the technology allows the learner to learn in any context (Ally & Prieto-Blázquez, 2014). Mobile learning can transform pedagogy to cater for new generations of learners because it offers the opportunity to use active learning strategies and for learners to learn in their own context, which will result in higher level learning (Cochrane, 2013; Stoerger, 2013). Current mobile theories are associated with behaviorism, cognitive information processing, cognitive constructivism, and social constructivism. In cognitive constructivism, the main focus is on providing a learning context that supports the learning by constructing experience-based knowledge. Cognitive constructivism's implications for app designers include situatedness, models, and scaffolds (Miller & Doering, 2014). "Situatedness" refers to the context in which learning experiences occur. Situated learning is enhanced by problem-based learning, in which students work in groups to solve a problem (Rogers, 2011). Models also show students the processes or behaviors engaged in during the problem-solving process (Miller & Doering). "Scaffolds" are pedagogical supports that make certain tasks easier, such as templates (Miller & Doering).

Mobile technology can be a useful and powerful tool for educating students in higher education. Mobile technology, such as smart phones and tablets, provide a unique opportunity to place high-quality information directly into users' hands (Colton & Hunt, 2016). Smart phone apps can promote active learning and the long-term retention of knowledge of undergraduate students (George & DeCristofaro, 2016). An app called "Preparing for Caring" has been tested and found to have successfully helped students to get the most out of their placement experiences (Colton & Hunt). Although it is clear what educators and pedagogues think of mobile integration in the classroom, students' opinions are still underexplored (Seifert, 2014).

Scenario-based learning is one kind of authentic pedagogy that has been proven to be successful in the enhancement of learning outcomes in nursing and the facilitation of the applicability of nursing theories. Scenarios are designed and developed by professional instructors within the training domain to fit the learning objectives for each part of the training (Peeters, Van Den Bosch, Meyer, & Neerincx, 2014). Nursing

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professionals, whose work involves complex skills, cannot learn their profession from books and lectures alone. Complex skills are comprised of integrated physical and cognitive abilities for carrying out situational assessment and decision-making (Peeters *et al.*). There is an association between student nurses' positive reactions to a scenario and the effect of the scenario as a learning aid and scenario-based e-learning has been proven to be a positive reinforcement of learning outcomes (Tait, Tait, Thornton, & Edwards, 2008). In recent years, simulation-based nursing education has been introduced to enhance critical thinking, learning outcomes, and the self-confidence of learners and has made them able to handle clinical situations independently (Kaddoura, 2010). Clay (2011) describes short video demonstrations of clinical skills that are available for viewing on iPod as a useful learning aid, as nursing students' confidence would grow after finding themselves to be capable of carrying out the skill that has been modeled immediately after watching a clip (Clay).

There is a lack of research on how nursing students feel after experiencing a smart phone-enabled educational intervention for conducting physical assessment; thus, the purpose of this study was to explore the thoughts and experiences of nursing students who received a smart phone-enabled educational intervention for conducting a physical assessment.

METHODS

Study design and participants

The mobile app (APP) that runs on mobile devices is designed to train students in the field of physical examination and health assessment (abdominal, respiratory, cardiovascular, and neurological). The front-end interface enables user access to clinical scenarios, a practice scenario, physical examination footage, and the user's track record (Figure 1).

Clinical scenario

There are two scenarios (Case 1 and Case 2). Users can practice conducting the physical examinations repeatedly until they have mastered the whole process.

Practice scenario

The scenario (Case 3) allows users to practice step-by-step the whole process of health assessment.

Physical examination footage

The videos, produced by the organizers of this study, show the users the proper ways of conducting examinations clinically.

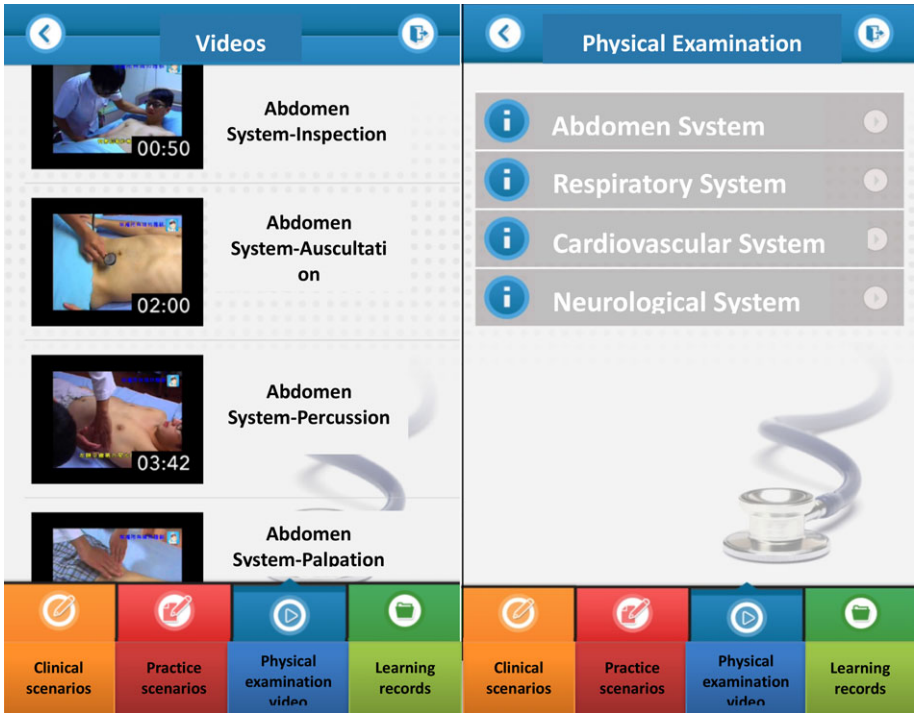

Figure 1 Mobile APP's user interface.

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Track record

The users can view the records of their practice and test results and also view the videos and concept maps that have been produced by other learners.

Scenarios (Cases 1, 2, and 3)

The three scenarios involve four fields of medicine (respiratory, abdominal, cardiovascular, and neurological). Case 1 includes two parts: Case 1-1 Patient history inquiry and Case 1-2 Physical examination. Case 2 is a case study. Case 3 is a practice case.

Case 1

1 Case 1-1, patient history inquiry: at the beginning of the case, a brief introduction is given to make the user understand the purpose of this case. The user then watches the patient history and takes a 5 min practice test by answering five random test questions about the patient's basic information, chief complaint, present history, and past history.
2 Case 1-2, physical examination: brief background data and the task that the user is expected to complete are given at the beginning. The user then practices conducting a physical examination through inspection, palpation, percussion, and auscultation. By clicking on the right place on the image of the patient's body, the user would be shown information related to that body part. After the 10 min practice, each group of users has to make a video of the whole process of physical examination, which would be sent to the back-end managers to be uploaded into the system.

Case 2

Case study, the details (e.g. sociodemographic data, chief complaint, present, past, personal, family, and psychosocial history, systematic review, physical examination, laboratory and examination findings, and medical interventions) and the purpose of the case are given at the beginning. Then, the user is given a case to be analyzed. The user is given the patient's basic information, chief complaint, and present history. The user then takes a practice test by answering five random questions about the case. The practice takes a total of 10 min. After understanding the case, the users are required to work in groups to draw a concept map of the nursing issues that are related to the case, which would be sent to the back-end managers to be uploaded into the system.

Case 3

Practice case, on completion of Cases 1 and 2, the user by now should be able to complete the whole process from patient history inquiry, physical examination, to case analysis. At the beginning of the practice case, the user is informed of the purpose of this practice case. The user also will be notified that the case is for practice only and that performance in the practice will in no way affect the final grade in the course.

A qualitative descriptive approach with in-depth interviews was considered to be suitable in order to obtain a comprehensive understanding of the students' experience of a smart phone-enabled physical assessment course. A sample of nursing students from a nursing university in central Taiwan participated in this study and 16 nursing students were interviewed for their comments on their learning experience. Their work experience and attitude towards professional nursing practice are given in Table 1.

Data collection

This study was conducted after receiving approval from the institutional review board at Taipei City Hospital (TCHIRB-10404113-E). The interviews with the participants were conducted 2–3 weeks following the intervention. The participants gave written

Table 1 Background information of the participants (n = 16)

Variable	N (%)
Sex	
Male	2 (12.5)
Female	14 (87.5)
Age group (years)	
Range: 20–21	
20	15 (93.8)
21	1 (6.3)
Work experience	
Medical-related	4 (25.0)
Others	6 (38.0)
None	6 (38.0)
Work experience (months)	
0	6 (38.0)
1–3	3 (18.8)
4–6	4 (25.0)
12	2 (12.5)
>12	1 (6.3)
Interest in nursing	
Very interested	1 (6.3)
Interested	8 (50.0)
Neutral	6 (38.0)
Uninterested	1 (6.3)

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consent for audio-taping of the interviews. The participants were interviewed about their personal background, perceived effectiveness of a mobile-app-based educational intervention to promote their capability of conducting physical assessments, perceived frustration and difficulties during the intervention, limitations and breakthroughs in their learning experience, comparison of the intervention with other physical assessment interventions that have been experienced previously, and willingness to use the APP in clinical applications. Each of the semistructured interviews lasted ~60–90 min and was conducted in a private location. The interview transcripts were compiled during and immediately after the interviews. The data were collected until sampling reached saturation. The interviews took place from October, 2015 to January, 2016.

Interview process

During the course of each interview, the interviewers asked the students to share their previous clinical or practical experience and their thoughts and experiences about a smart phone-enabled physical assessment course. The students also were questioned about their frequency of using the mobile APP, their comments on the mobile APP, and the differences (if any) between clinical scenarios in real practice and those in the mobile APP. All the interviews were audio-recorded, with the interviewers making additional field notes during the interviews.

Data analysis

The analytical process that was used was qualitative content analysis, which involves a systematic analysis of the transcribed data. Each transcript was read and written notes were made regarding codes and themes that emerged from the raw data (Burnard, 2006). The authors first examined the collected data and identified the contents that could be placed into five evaluation question categories. Similar contents that addressed the same theme then were combined. Next, the categories were analyzed for repeated and recurrent patterns, from which the major themes were derived.

Rigor of the study

To strengthen the rigor of this study, the authors agreed to check the collected data again to ascertain that the items were properly categorized by theme. Study rigor was accomplished by establishing credibility, dependability, confirmability, and transferability (Lincoln & Guba, 1985). In order to ensure credibility, the researchers transcribed the interview data word-by-word and then checked to ensure that the transcribed data accurately reflected the perspectives of the individual responses that had been expressed in the interview. To confirm dependability, the researchers reviewed the reflective thought of the interview process and analyzed the coded data to discover the inherent meaning. The authenticity of the transcribed data was confirmed through discussions between the researchers. In order to warrant transferability, some of the findings were found to be transferable to other learning situations where learners have learning attitude problems.

RESULTS

The nursing students' previous learning experience, and their feelings towards learning physical assessments, had a certain degree of influence over their experience with the smart phone-enabled physical assessment course. Those who were more familiar and skilled in making physical assessments delivered a stronger learning performance while using the mobile APP.

Based on the interviews with the 16 nursing students following the intervention, five themes were derived from the data analysis: "The APP's physical assessment scenarios are very close to real-life clinical situations," "Watching physical assessment videos over the APP is a quick way to learn what to do," "The APP is a new way of learning that enhances thinking and reflection," "Some nursing students felt that it was out of their depth to analyze the scenarios in the APP," and "The APP needs enhancements in stability and interactivity."

Five themes of the study

APP's physical assessment scenarios are very close to real-life clinical situations

After the intervention, the students remarked that the scenarios in the APP were comprehensive and special enough to enhance their ability to clinically apply previously learned knowledge. The findings highlighted a parallelism between real-life and situated scenarios. According to the nursing students:

Case scenarios in the APP were well-presented, which I found rather helpful. There were many details which we could use to make medical decisions … The scenarios were very different … But all of them resembled real-life clinical situations and offered clear instructions on medication.

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I used to read textbooks alone without consulting other materials, which did help but not very much. The APP, as a learning aid, effectively put together theories and practice … (The quizzes) were rather close to real-life clinical situations … The APP also had videos of physical assessments, which I could watch if I needed to make sure about certain details of physical assessments.

First came the case scenarios, which told us how to collect information about the patients. Then, came the quizzes … I felt comfortable with this sequence in which materials were presented in the APP, like a step-by-step guide..

I recalled my grandfather after seeing the case of a stroke patient. My grandfather personally experienced some of the things depicted in the scenario, with same signs and symptoms.

Watching physical assessment videos over the APP is a quick way to learn what to do

After video-watching and simulation drills, the nursing students had a better idea of how physical assessments should be conducted, instead of following a protocol of assessment before understanding the concept. The nursing students can repeatedly practice conducting physical assessments according to standardized operating procedures that are presented in the scenarios and build up their motivation to learn and their skills:

The APP was such a useful guide that I could rely upon when I came across problems in practice, especially when there was no classmate or teacher around.

The APP taught me quite a lot of techniques of examining the nervous system. The videos in the APP are classified under different types of physical assessments. I can watch them when I need to know how to conduct a certain examination.

Sometimes, I have trouble understanding written instructions. That is when I access the APP to watch the videos to see how to assess physical condition of the patients.

APP is a new way of learning that enhances thinking and reflection

The APP, as an educational intervention, enhanced the ability of the nursing students to understand their learning experience, beliefs, and values. The intervention effectively transformed the nursing students' way of thinking, enhanced their self-awareness, facilitated their acquirement of professional knowledge, improved their ability to conduct clinical practice, and increased their problem-solving capability:

The good thing was that the APP had videos, especially the one about inspection, palpation, percussion, and auscultation, which was particularly helpful. I previewed the materials before class, then did the simulation drills, which helped me understand more about the standard operating procedure of physical assessments …

This [APP] really taught us the skill of critical thinking … which was important because assessing a patient involved more than just looking at the clinical signs of [myocardial infarction] MI. There might be other symptoms as well … 'Concept mapping' was something I had not heard of back in my junior college days.

The APP made learning easier for me … I know I can use it to practice whenever possible. It is an alternative way of learning … accessible all the time … I think the students would have more opportunities for critical thinking, rather than just pick knowledge out of textbooks, if the APP was to be used in every class.

Using the APP makes me think more systematically … I used to take things at face value, now I like to think a little bit more.

Some nursing students felt it was out of their depth to analyze the scenarios in the APP

Feelings of frustration and pressure that could be experienced in the process of using the APP would affect the willingness to continue using it. Frustration and pressure might result from a number of reasons: a failure to meet the expected standards of learning, a lack of confidence to administer physical assessments, a lack of background knowledge, or an excessively heavy course load:

The content of APP was different from what I had previously learned in class. I answered all the test questions based on what I had learned in class, but I was not sure whether my answers were correct.

Simulation drills could be difficult for me sometimes. I needed to first identify the disease and then saw what kind of physical assessments should be conducted.

The greatest challenge was interpreting assessment results and understanding medical jargons. I knew little else besides blood chemical. The English abbreviations bothered me a lot. I had to look it up whenever I saw one.

My classmates had different ideas of priority in a medical situation. Some said acute pain should be treated first, while others thought fevers should be brought down first. We were a little bit confused about what should come first and could not sequentially assess patients' condition by their symptoms.

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I needed extra textbooks to finish the test, since my knowledge was not enough to deal with the test.

I believe I needed evidence to back my theories about a patient's condition and I needed the insight from my classmates before making decisions about medical treatment.

APP needs enhancements in stability and interactivity

Most of the nursing students reacted positively to the APP and would have liked to make more use of the scenario-based APP in class. The nursing students recommended the scenarios to be simplified in order to eliminate redundancy of information. Also, the students recommended enhancements in the system stability of the APP, wider applications of the APP as an educational intervention in other courses, and expansion of the APP's database for greater usability. The students pointed out:

The APP did not appear to be so useful, probably because it was a poor match with the course we were doing … I think we should just … do Case 1 in class. The teacher could lead a discussion of it in class. I think that would be fine too.

We'd better hire professional engineers to design a better software program for us, one that won't flash back easily.

I'd like the APP to tell us more about listening to heart sounds. Many of my classmates said in class that they had never heard the sounds of S3 and S4 … Showing us X-ray images of cardiomegaly would help too.

I think the APP would benefit from the addition of something like [an] online tutor … I want to ask the teachers about the things I don't know about the APP … I think the teachers would succeed if they want to mass-produce the APP … to be used in the future, as a teaching aid for the Department of Nursing … Before the start of practicum, the teachers should upload the case scenarios to the APP for us to have a preview.

The downside of the APP is that the font size is too small. The video subtitles are almost unreadable because the screen is a little too small. The smart phone screen is too small for me to read the subtitles clearly.

The APP suddenly flashed back before we finished the quizzes. We had no choice but to start all over again. I was a little irritated at having to retake a quiz I had almost finished. Besides, using the APP required wireless connectivity, which caused a lot of trouble for us.

DISCUSSION

Nursing practice usually begins with assessing a patient's physical condition. A study described that 67% of the nursing techniques that were carried out routinely by 30 Italian nurses included examining a patient's abdomen by inspection and palpation (Cicolini *et al.*, 2015). Thus, more effective educational methods need to be developed in order to improve nursing skills in clinical practice and nursing students' acceptance of undergraduate nursing curricula (Lee & Shin, 2016). This study showed that the thoughts and experiences of nursing students who received a smart phone-enabled physical assessment educational intervention could be generalized into five themes: (i) The APP's physical assessment scenarios are very close to real-life clinical situations; (ii) Watching physical assessment videos over the APP is a quick way to learn what to do; (iii) The APP is a new way of learning that enhances thinking and reflection; (iv) Some nursing students felt that it was out of their depth to analyze the scenarios in the APP; and (v) The APP needs enhancements in stability and interactivity.

Similar findings were reported by Willemse (2015), who administered a What's APP application as a healthcare educational intervention to 21 undergraduate nursing students. Seven themes were concluded from the interview transcripts and excerpts from the students' reflective diary. Of the seven themes, "Good combination of theories and practice," "Positive learning experience," and "Opportunity to make oneself clear" were similar to Themes One and Two that were identified in this study. The similarity was attributed to common factors, including the use of smart phone APPs and timely instructions being provided to the students over group chat. In this study, the students said that when conducting physical examinations, they realized they were recalling and applying what they had learned in the case study activities. Moreover, the smart phone APP was found to be useful in patient history inquiries, physical examination, and clinical scenario analysis. Some students described the mobile APP as supplying too little information to be considered as a useful examination study kit.

In addition, the results are partially supported by Wu and Lai (2009), who administered a Personal Digital Assistant (PDA)-based educational intervention to six psychiatry nursing students and identified three themes and seven subthemes following an analysis of the interview transcripts and excerpts from the students' reflective diary. Two of the three themes were "Positive

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learning experience" and "Cooperative learning through group discussion was helpful," which were similar to Theme Three that was identified in this study. The similarity was caused by allowing students in both studies the use of easy-to-use, portable, and accessible mobile devices as learning aids, and to provide a different way of learning that enhanced their understanding, problem-solving, and critical thinking capability. Besides, the APP shows test results and answer keys, enabling the students to review their errors.

However, some nursing students felt that it was out of their depth to analyze the scenarios in the APP. Frustration and pressure might result from a number of reasons: a failure to meet the expected standards of learning, a lack of confidence to administer physical assessments, a lack of background knowledge, or an excessively heavy course load. If student nurses are inadequately prepared to conduct patient assessment, then no amount of critical thinking will lead to better clinical decisions (Douglas, Windsor, & Lewis, 2015). Like the traditional collection of vital signs, a checklist approach promotes rote memorization and task-based routine without critical thinking (Uchida, Farnan, Schwartz, & Heiman, 2014). The students used diagnostic reasoning and critical decision-making when they integrated their knowledge and skills to assess complex scenarios (Fennessey & Wittmann-Price, 2011). As a result of limited critical thinking ability, the students were frustrated and stressful when analyzing the case scenarios.

User complaints about the mobile APP in this study included a "Constant need for wireless connectivity" and "System and software incompatibility." The issue of the system instability of the smart phone APP causing disturbances in the learning process occurred not just in this study, but in a number of other studies, as well (Green *et al.*, 2015; Martyn, Larkin, Sander, Yuginovich, & Jamieson-Proctor, 2014; Willemse, 2015). The barriers to efficacy included technical software issues and non-transferability to different mobile devices (Green *et al.*). The nursing students used different mobile devices (e.g. LG, ASUS, iPhone, Samsung, and HTC smart phones) with different basic settings. Once the APP (which was not available in Google Play or Apple stores) was installed on their mobile devices, a system upgrade was likely to be followed by problems like incompatibility or the APP was missing from the home screen after the upgrade. Sometimes, the students had to constantly upgrade the APP software or reinstall the APP, which disturbed their learning. Another complaint from the students in this study was that the smart phone screens were too small to allow for reading comfort. Additionally, that the APP could not be opened on computers made the students less inclined to use it for a prolonged period. The small screen of the mobile devices has indeed caused user discomfort before (Martyn *et al.*). The design of the APP should be based on the principle that support must be simple and accessible, so that students are able to usefully engage with it (Colton & Hunt, 2016). The students recommended enhancements in system stability of the APP, wider applications of the APP as an educational intervention in other courses, and the expansion of the APP's database for greater usability.

In summary, smart phones as a mobile learning tool can effectively combine theories and practice and enhance positive learning. In this study, the key to the intervention's success was the APP being a good complement to classroom lectures. But, problems such as a small screen, connectivity, and system instability negatively affected the learning experience.

Limitations of the study

There are two limitations in this study. First, this qualitative study only considered a sample from one area in Taiwan, so the findings might not be generalizable to other populations. Second, technical issues surrounding the mobile APP might have, in some ways, affected the results.

CONCLUSION

The findings of this study indicated the mobile APP as an effective learning aid that promoted transferability of the nursing students' knowledge and past experience. But, technical issues need to be addressed to facilitate a better user experience. The APP should be built to support offline access for maximum user convenience. Based on the findings, this study makes the following recommendations: (i) mobile learning should continue to be implemented in nursing education, as the nursing students found it useful; and (ii) the scenario-based APP, or its improved versions, may be implemented in clinical in-service education with materials with different levels of difficulty in order to cater for nurses' different demands.

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DISCLOSURE

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

L. L. H. was responsible for the study's conception and design; H. L. H., Y. H. T., and S. Y. H. collected the data; L. L. H. and S. I. H. drafted and revised the manuscript.

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