ORIGINAL RESEARCH

Effectiveness of learning intramuscular injection techniques with aid of an interactive APP

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ABSTRACT

In this study, an interactive application (app) for learning intramuscular injection is developed through an interdisciplinary collaboration, and its effectiveness in learning is explored. APP is application software. The research object is a second-year student of the nursing department of a university of science and technology. The study results indicated that only 1 out of 57 students failed to obtain a score of 60 on a technical test, whereas the other students all scored 60 or higher (a score of 60 or higher is regarded as the acceptable range). For the self-assessment of learning effectiveness, the three items with the highest average scores were "It helps students to improve their self-confidence," "It helps the integration with practical operations," and "It enhances my after-school learning and meets my learning needs." Furthermore, the students indicated that the interactive app helped them clarify technical procedures and precautions, deepen their knowledge, and clarify clinical concepts. Moreover, more planning and communication is required for the teaching of nursing techniques and cross-disciplinary integration of technologies. This study aims to provide a reference for nursing educators and integrate technology applications in nursing teaching to enhance the learning effectiveness of students in relation to nursing techniques.

Key Words: Interactive APP, Intramuscular injection, Learning effectiveness

1. INTRODUCTION

Interactive media is widely used in the daily lives of the people in Taiwan. For example, children's storytelling activities originally required a combination of oral speech and body movements; however, the integration of interactive game media into such activities have produced highly favorable results.[1] Nevertheless, for interactive media applications, the design-to-application stage is still required to understand the applicability of the technology. A study of preschool books with interactive multimedia presentation elements reported favorable results with respect to the application of such books in preschool children's learning.[2] In addition, a study discovered that the learning attitudes and aesthetic experiences of students in relation to visual arts benefit from the integration of augmented reality into multimedia teaching; notably, in that study, the students with low academic achievement became more positive about learning the content of augmented reality materials than students with high academic achievement, and the students in the study were generally receptive to augmented reality multimedia materials.[3] Researchers have also applied interactive media to environmental advocacy to enable participants to reflect on the communicative effectiveness of their campaigns.[4] Through a series of processes (e.g., design), interactive media enable everyone from designers to participants to understand and internalize content and apply it to their daily lives, and this is a trend of the future. Because interactive technology is a future trend, universities and colleges are already setting up

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interactive technology–related departments, research centers, and laboratories to respond to future changes while gradually launching new research projects to explore its application in various fields. Other studies have suggested that interactive media can also be applied to amusement park-style entertainment facilities.[5] At present, interactive media are mostly applied in the context of teaching or experiences in several fields.[6] Experts have applied interactive media to the older adult community; in a pilot study, interactive devices were applied in the context of eco-tourism experiences for older adults.[7] In one study, interactive technology was applied to teach 12-year-old children how to brush their teeth, and the results indicated that the application of interactive technology created a straightforward and favorable learning experience for these children.[8] Outside of Taiwan, researchers have also explored the application of interactive apps, especially for teaching purposes.[9] For example, interactive apps were incorporated into cooperative learning activities to strengthen the learning process.[10] In addition, interactive media have also been applied in teaching processes, especially in the area of collaborative problem solving for students.[11] In Taiwan, researchers have applied interactive media to the field of entertainment to provide people with an enhanced sense of reality during theater performances.[12] A study also reported that interactive media interventions are effective in treating depression.[13] Taiwanese scholars have applied smartphone apps to help patients with alcoholism to overcome their psychological dependence on alcohol, and they have reported favorable results.[14] Interactive apps have diverse applications in both local and overseas contexts and in various fields from leisure and entertainment to the teaching of professional content (e.g., medical care). To date, the application of interactive media in education is focused on elementary and high schools. By contrast, few studies have explored medical or nursing education at the tertiary level. Most fundamental nursing practice courses use traditional lectures, demonstrations, and videos to supplement the teaching process; nursing teachers also often share their experiences during these courses. These teachers are consistently attempting to identify methods for guiding passive students to take the initiative in their pre-class learning. A fundamental nursing practice course teaches the basic concepts of nursing care, which are the foundation of nursing care and are tested in the national licensing examination that nursing students in Taiwan must take. Given that students frequently use consumer electronics and the Internet to integrate technology into the learning of nursing techniques, we converted traditional teaching materials into digital materials to enhance the teaching process. Interactive media are adopted in diverse applications (e.g., smartphone apps for teaching

sports biomechanics), and they have led to favorable learning outcomes.[15] Scholars have used an augmented reality app to teach heart failure to nursing units in a manner that generates interest in learning.[16] Therefore, in the present study, interactive media technology is applied to help nursing students to learn nursing skills in a manner that enhances their interest and engagement in learning and improves their learning outcomes.

2. MATERIALS

2.1 Research participants

The participants of the present study were sophomore nursing students from a university; both male and female students aged 20 years or older were enrolled. In total, 57 students who were taking a fundamental nursing practice course were enrolled. These students had already taken a basic medicine course and a fundamental nursing practice (I) course, and they could take a fundamental nursing practice (II) course if they had yet to take or pass the fundamental nursing practice (I) course; the fundamental nursing practice (II) course includes a session on intramuscular injection.

2.2 Research tools

The research tools used in this study included the Intramuscular Injection Instruction, the Intramuscular Injection Interactive App, and the Learning Outcome Self-Assessment Questionnaire. First, the content required to teach the intramuscular injection procedure was written, reviewed, and discussed by nursing faculty members in preparation for its application in the studied fundamental nursing practice course. Next, an interdisciplinary discussion-based collaboration with IT engineers was established to create an interactive app for learning intramuscular injection techniques; the app was then reviewed by the nursing-based faculty members before the student participants were allowed to use it.

3. METHODOLOGY

The present study was conducted using the instruction experiment method. An interactive app was created and applied to help students to learn intramuscular injection techniques. APP is "application program", is a kind of "application software".The interactive app was tested by nursing faculty members during and after the design process to verify the content pertaining to the intramuscular injection procedure before it is taught to the students. The students could practice before and after class without any time- and location-related constraints.

3.1 Research process

The teacher responsible for teaching the investigated course first performed demonstrations in class and subsequently

had the students form groups to perform practical exercises. The intramuscular injection content was taught over a 3-week period. In the first week, the researcher involved in the present study demonstrated the practical steps of intramuscular injection and introduced the interactive app; in the second and third weeks, the students practiced in groups. After the students were introduced to the interactive app for learning intramuscular injection techniques, the teacher demonstrated the operation of the app at the teaching site and let the students download and use the app through the school's information technology system; during this period, teaching assistants who were familiar with digital technology were assigned to assist students in using the interactive app. During this 3-week period, the researcher and teaching assistants assisted the students with problems relating to the use of the app.

3.2 Data analysis

Students anonymously completed a questionnaire after completing the intramuscular injection course; this anonymous questionnaire was administered to assess the effectiveness of the interactive APP application in helping the students to learn intramuscular injection techniques. The learning effectiveness self-assessment questionnaire, which was designed by the author of the present study, used a Likert scale. It had 14 multiple-choice questions and one open-ended question that covered three dimensions, namely the improvement in learning effectiveness, development of independent learning, and improvement in professional skills and knowledge. The data were analyzed and are presented as numbers (percentages) and averages using Microsoft Excel.

4. RESULTS

In total, 57 students participated in the present study, and 53 questionnaires were retrieved, representing a response rate of 92.98%. The results of the data analysis are as follows.

4.1 Improved motivation for learning

For the self-assessment questions regarding learning effectiveness, the average scores of the students for the questions "The interactive app helped to improve my motivation to learn," "The animations increased my desire to learn more actively," "The interactive app helped me to pre-study before my classes," and "The interactive app helped me perform reviews after my classes" were 4.33, 4.26, 4.35, and 4.40, respectively. The scores for the questions "The interactive app for learning intramuscular injection techniques helped me to increase my confidence in learning," "Practicing with the interactive app helped me to increase my sense of achievement in learning," and "The use of the interactive app to supplement my practice meets my learning needs" were 4.44, 4.33,

and 4.40, respectively. The number of times students used the interactive APP during the 3-week period ranged from 1 to 22 times, with the average being 11 times, indicating that at least 80% of the students perceived the interactive app–assisted learning of intramuscular injection techniques to have a positive and helpful effect on enhancing their learning motivation. The comments of the students regarding the use of the interactive app to supplement their self-learning include the following:

> "Of course, I like to use it. It's fun, and it helps me to learn."
> "It helps me to improve my grasp of the technique, and I can watch it online if I forget it."
> "I can watch it while practicing it."
> "It's convenient to re-watch it."

4.2 Enhanced professional skills and knowledge

With respect to the use of animations to improve professional skills and knowledge, the average self-assessment scores of the students for the questions "It helps me to improve my professional skills," "The interactive app helps me to improve my professional knowledge," "The interactive app helps me to apply my knowledge in practical situations," and "I find the interactive app to be helpful in learning fundamental nursing skills" are 4.42, 4.35, 4.44, and 4.30, respectively. In addition, the average self-assessment score for "Satisfaction with design of the interactive app" was 4.44, indicating that the students were satisfied or very satisfied with the design of the interactive app. The average score for "The interactive app stimulates diverse and innovative ideas" was 4.37. The average score for overall self-assessed learning effectiveness was 4.37, with most of the students' responses being above average and positive feedback. In addition to the students' responses to the multiple-choice questions of the learning effectiveness self-assessment questionnaire, their feedback on the open-ended question included the following:

> "I found it interesting and wanted to play it a few more times to reinforce my knowledge."
> "It helps me to go through the movements and precautions of the technique repeatedly",
> "It helps me to develop a correct concept of the clinical situation and deal with an unexpected situation effectively."
> "I can develop a better understanding of the overall process."
> "I can develop a clearer understanding of the process again."
> "I have a deeper impression of the technique."

4.3 Use of interactive app for pre-study before class and review after class

A total of 46 students (81%) reported that the interactive app was helpful for their pre-study before class. The average score for "The interactive app allows me to do a review after class" was 4.40. The comments from students included the following:

> "I can familiarize myself with the steps first."
> "It will more or less deepen my impression."
> "I will have an initial impression."
> "I won't worry about missing anything when I can watch the teacher's actual demonstration."
> "I can understand the steps explained by the teacher better."
> "I can pay more attention to what I don't understand and clarify my doubts."

The aforementioned comments indicate that most students agreed that the use of the interactive app helped them to pre-study the relevant technical operations and better understand the operational steps.

4.4 Improving the teaching ability of teachers

The nursing and digital-media-design teachers participated in an interdisciplinary collaboration for the first time. The software tool was designed to be more user-friendly for students. A digital-media-design teacher made the following comment:

> "It is designed from the perspective of a project that can be completed in a short period of time, with digital materials providing a self-learning channel for students. In the face of technological advances, the development of self-learning skills is a basic ability that modern people must have. When a person develops the habit of self-learning, he or she can naturally learn the latest knowledge through online resources and improve at any time."

The participating nursing teachers were researchers; reflecting on their previous teaching process, one teacher made the following comment:

> "In addition to the practical aspects of nursing techniques, technology should also be adopted to assist teaching."

However, the teachers' lack of understanding of interactive media initially made it difficult for them to conduct any planning. A teacher made the following comment:

> "The process required continuous cross-disciplinary communication and a mutual understanding of the production process; we learned together while going along with the plan."

5. DISCUSSION

A fundamental nursing practice course is a nursing student's first exposure to technical nursing courses during the learning phase of nursing education. In the classroom, the teacher demonstrates a technique step by step and then divides a class into three demonstration classroom groups to practice the technique. Students often do not fully remember the steps after watching their teacher's demonstration. Even if they record a demonstration and watch it afterward, the learning outcome is generally not favorable. If students intend to practice in a classroom, two to four students are assigned to practice at each bed; however, classrooms are often fully booked and these students have to wait; thus, the developing solutions that provide students with more time and space for practice is crucial. For the learning of practical operations, improving the self-confidence of students in learning is essential. In the present study, an interactive APP was used to help students to pre-study and review their lesson content before and after class. The aforementioned study results indicated that students practiced up to 22 times by using the interactive app. Crucially, the students gave the highest score for the self-assessment item "It helps students to improve their self-confidence." More than 80% of the students indicated that the use of interactive apps can help enhance their learning motivation, improve their sense of achievement in learning, and meet their learning needs. In the present study, the students became more motivated to learn techniques with the help of the interactive app. In professional nursing education, teachers have always focused on practical demonstrations and student exercises. Although practical exercises can enhance the techniques of students, space and time constraints limit the opportunities for students to practice. For their first-time exposure to interactive app–assisted practice, 20% of the students felt doubtful about the effectiveness of using an interactive app to assist their learning, whereas the majority of the students agreed that the interactive app–assisted learning technology provided benefits, especially for enhancing professional skills and operations. Furthermore, the app can also be integrated into clinical practice. Relatedly, improving the self-learning ability of students through training is a key task. In addition to the use of the app to supplement their after-class learning, most of the students could engage in self-learning before attending classes. The long-term adoption of this training format can enhance the ability of students to learn independently. If technology is commonly applied in teaching, it can help students to learn, allow for the acquisi-

tion of learning resources without any limits to the scope of learning, and stimulate the learning of innovative skills. The students in the present study gave mostly positive feedback on the role of the interactive app in stimulating diverse and innovative ideas, indicating that diverse teaching methods can inspire students to produce innovative ideas. Most of the students agreed that the interactive app helped them to learn nursing techniques, and only a minority (less than 20%) of the students in the present study held an opposing opinion. For example, several students made the following comments:

> "I think watching a live demonstration performed by a teacher is clearer than watching videos."
> "But I still hope that the teacher can perform a live demonstration first."
> "I will practice at home using the video."

"But I hope that a teacher will lead the first self-study session during the teaching of new techniques." In the present study, the techniques were taught in a classroom. Although the students were asked to use the interactive app to pre-study lesson content, actual demonstrations were still conducted in the classroom, and the learning was supplemented by the interactive app and practical exercises. A small number of students did not adapt well to or did not like the interactive app, and the reasons that caused this phenomenon warrant further exploration. Teaching is a process that requires planning and design, and it changes over time. A teaching process can be changed on the basis of various relevant factors, but the teaching ability of a teacher is crucial for such changes to take place. The teachers in the nursing schools of universities have extensive nursing expertise but lack training in teaching, and their teaching strategies often involve learning by doing and participation in teaching seminars. Teachers must reflect on their teaching. Through reflections, teachers can understand their teaching process, such that they can improve their teaching and prepare for their future classes. During the interdisciplinary collaboration established in the present study, the participating teachers reflected on the process of interdisciplinary collaboration and agreed that two elements were necessary. The first element is that students must be provided with channels for self-learning. The self-learning ability of students is a basic ability that every individual should have. After students develop the habit of self-learning, they can then learn the latest knowledge through online resources and improve continually. The second element is that nursing education should also integrate cross-disciplinary collaborative

teaching because this has become a trend. The teaching of nursing knowledge through lectures and demonstrations is no longer sufficient to meet the learning needs of students in this era of rapid technological and information development. Moreover, the ability of students to acquire information is also improving. Nursing teachers and teachers from other fields should communicate and collaborate to create a new vision for innovative teaching and learning. When technology is applied to support teaching processes, cross-disciplinary collaboration is required whenever a gap in the understanding of interactive media exists; to produce teaching materials that meet the needs of students in an era of advanced technological and information systems, continual communication and a mutual understanding of the production process of interactive media are required.

6. CONCLUSION

The present study is the first to use an interactive app to support the teaching of a hands-on nursing course. Most of the students in this study gave positive feedback on the use of the app. They indicated that the app increased their self-confidence and sense of accomplishment, met their learning needs, and increased their motivation to learn the techniques taught in their course. With respect to professional nursing competence, the students felt that they could enhance their professional knowledge and skills and integrate them into clinical practice to develop diverse and innovative ideas. In addition, the students could use the app to conduct their pre-study and after-class learning, such that they improved their independent learning ability. The present study represents a small step forward for the participation of nursing faculties in interdisciplinary teaching collaborations, and the use of information technology media in nursing education should be further refined. The results of the present study indicated that the production of interactive apps can be further improved; for example, the speed of video demonstrations can be reduced, more interactive functions can be added, and videos can incorporate more vivid elements. For cross-disciplinary teaching collaborations, more preparation and planning are required from a nursing faculty, which must also engage in more communication and discussions with a media design faculty.

CONFLICTS OF INTEREST DISCLOSURE
The author declares that there is no conflict of interest.

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