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Experience Self-Directed Practice of Nursing Skills Using Augmented Reality-Based Simulation

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Objective: The purpose of this study was to identify the meaning and essential themes of nursing students' experiences after implementing nursing skills self-directed practice training using augmented reality simulation.

Design: Qualitative research with phenomenological methods

Methods: The participants of the study were 17 nursing students enrolled in a university, and in-depth interviews were conducted from December 1 to December 28, 2020. The collected data were analyzed by applying Giorgi's phenomenological research method.

Results: The analysis revealed four components of the simulation training experience: 'discomfort of unfamiliarity', 'motivating practice', 'dynamic screen', and 'learning effectiveness', and the analysis yielded up to 15 sub-components and 82 means of centrality.

Conclusions: This study provided an in-depth understanding of nursing students' self-directed practice education experience, which can be used as a basis for improving various self-directed practice methods in the future.

Key Words: Augmented Reality, Simulation, Education, Self-directed Practice

Introduction

Nursing is a practical discipline in which practical education plays a very important role[1], and it is a practical discipline that requires not only the acquisition of theoretical knowledge to achieve learning goals, but also the ability to cope with and solve health problems in practice based on the acquired theory[2]. Therefore, practical education plays a key role in developing professional nurses who can apply nursing knowledge and nursing skills learned in school to various clinical situations and perform clinical practice smoothly and skillfully[3]. In response, the Korean Agency for the Evaluation of Nursing Education has developed 20 standardized core basic nursing skills, which are reflected in nursing practice education[4].

Traditionally, lecture-based theoretical education in nursing departments has been conducted on campus, while field practice has been conducted in hospitals to cultivate human resources with clinical competence, but nowadays, due to the growing voice of patient rights, the clinical practice situation of nursing students is being replaced by observation-based practice rather than providing direct care to nursing patients[5]. In addition, the number of hospitals for clinical practice is insufficient compared to the number of nursing students, and the clinical practice environment for nursing students is becoming increasingly difficult[6]. To overcome this situation and improve the effectiveness of practical education, learning using standardized patients[7], augmented reality-based learning[8], and web-based learning[9], learning with simulators[10], and learning

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through self-directed practice[11].

Self-directed practice is a form of self-directed learning in which nursing students practice independently in an open laboratory setting[12]. In most nursing schools, students are allowed to observe and practice only once during the regular practice time to compensate for the lack of time to practice skills, but it has been reported that most students participate passively[13]. Therefore, it is necessary to develop educational contents that can improve students' confidence and practice satisfaction in performing nursing skills by themselves rather than the existing self-directed practice method[14]. Therefore, it is necessary to develop educational contents that can improve students' confidence and practice satisfaction in performing nursing skills by themselves, rather than the existing self-directed practice method.

Augmented Reality(AR) is a technology that superimposes virtual objects on the real world as seen by the user's eyes, blending the real environment with virtual objects to provide a better sense of reality and additional information[15]. By creating a mixed reality in which users can interact with virtual objects or information, objects and the real world coexist in a meaningful way to enhance the learning experience[16], augmented reality enhances the sense of presence in learning and has a positive effect on engagement and participation in training and performer confidence[17]. Recently, the Fourth Industrial Revolution has led to the development of various learning media utilizing new technologies in the field of education[18], and among them, an increasing number of contents utilizing virtual reality (VR) and augmented reality technologies have shown positive results in enhancing learners' interest and engagement[19]. In particular, augmented reality-based simulation training can be conducted at one's own pace, regardless of time, in a safe and controlled place[20], and can be learned repeatedly by standardizing the performance skills required in the clinical field[21]. In addition, it is effective in strengthening nursing competence by providing hands-on training without causing harm to real patients in a safe environment[22].

Therefore, in this study, we applied a blood transfusion simulation content based on augmented reality to nursing students' self-directed practice using smart glasses to increase the sense of immersion, and explored their various experiences in depth to provide useful basic data for improving nursing education.

Research Methods

Research Design

This is a qualitative study that applied Giorgi's[23] phenomenological research method to explore nursing students' experiences of virtual simulation self-directed practice and to reveal the essential structure of their experiences.

Participants

The subjects of this study were 17 students enrolled in a university in Y city, who were in their second year or above, and who agreed to participate after hearing the purpose of the study and the confidentiality guarantee. The age of the participants ranged from 21 to 30 years old.

Data collection

The data for this study consisted of phenomenological texts and one-on-one interviews with the participants. The interviews were conducted between December 1 and December 28, 2020, and were all conducted online and non-face-to-face in order to comply with social distancing and quarantine measures. In order to collect sufficient data, the principle of saturation was applied and an average of two interviews were conducted per participant, lasting approximately 40 minutes per interview. An open-ended, semi-structured questionnaire was used in the interviews to avoid guiding or implying the participants' answers. All interviews were recorded, transcribed, and translated into text after informed consent. Data for phenomenological research is primarily obtained through in-depth interviews in which participants provide vivid and detailed descriptions of the phenomena they experience.

Ethical Considerations

This study was approved by the Institutional Review Board (IRB) of S University(IRB-NO: 2-1040781-A-N_012021**HR) before data collection. The researcher explained the benefits of participating in the study to

the participants and obtained their written consent. They were assured that all data collected would be used for purely research purposes and that their personal information would be protected and kept absolutely confidential.

Data Analysis

This study analyzed the data according to Giorgi's descriptive phenomenological method. Since Giorgi's descriptive phenomenological method starts from the descriptions of each individual, it can reveal the subjective experience relatively well compared to other methods[23]. In particular, it emphasizes the need to look at the technology before interpreting the data collected, so we tried to present the experiential essence of the university students as they were, without altering it. Giorgi's methodology is conceptualized as a four-step process in which the process of dealing with constructs is systematically organized in a step-by-step context, with each step described in detail[24].

The first step in the analysis is to recognize the whole. In this step, I listened to the recordings several times to get a general sense of the overall statements made by the participants.

The second step is to categorize the phenomena into units of meaning that are appropriate to the researcher's academic topic. Each unit of meaning was summarized in the participant's language without distorting or omitting the participant's statements, and the summarized units of meaning were uniquely numbered and placed side by side with the original data to derive components based on the summarized units of meaning. As a result, 158 meaning units were derived from the 17 participants.

The third step is to combine the divided meaning units into themes and transform the meaning units contained in the themes into academic terms. From the 158 meaning units derived in step 2, 82 central meanings were derived, excluding those that were deemed redundant or out of the context that formed the structure, and 15 sub-components were derived by reintegrating them into common meaning units among the participants.

The fourth step is "structural integration of the derived central meaning." The analysis resulted in four components.

Evaluation of the study

As this is a qualitative study, we endeavored to protect the findings from researcher subjectivity, which threatens the validity of the findings based on factual value, applicability, consistency, and neutrality[25].

- Factual value is about how close a study is to real life findings. In this study, we conducted a member checking process by sharing the findings with participants to review and confirm the content.
- Applicability is about whether the findings can be applied to other situations.
- Consistency means that the same process used by the researcher would lead to similar conclusions when conducted anew by another researcher using the same method. This study was reviewed by one professor of nursing(Doctor of Nursing Practice), one professor of simulation practice, and one doctor of education with experience in analyzing qualitative research data.
- Neutrality means that the results are free from all bias, i.e., the researcher's own stereotypes and biases are excluded from the research process or results. In this study, we aimed to secure neutrality by specifically examining the researchers' biases and theoretical knowledge and continuously excluding personal judgment.

Research Results

We derived 158 units of meaning from this study. We then derived 82 central meanings from the 158 meaning units by excluding meaning units that were repeated multiple times and meaning units that were not common across participants and were taken out of context. We then identified 15 sub-components and 4 components as experiences essentially shared by the participants in the study(Table 1).

Discussion

The first component of self-directed practice for

Table 1. Self-directed practice experience for nursing skills

Component	Sub-components	Central meanings
The discomfort of unfamiliar experience	Difficulty in operating the device	• You'll need to watch the video at the same time as performing the skill, so someone else will need to hit the pause button for you. • You'll quickly move on to the next step before you've finished reading the subtitles. • The video shakes and moves around a lot, which is a bit confusing. • The sound is too loud for me to hear and my glasses are too heavy. • I wish you could adjust the speed so I can follow along. • I wish you could freeze the video movement and text to compensate for what I can't see. • I can see it, but I can't seem to touch it. • I would like more detail and a slower pace when preparing items. • I need more training on how to use the equipment. • I think the pace is too fast for beginners.
	Heaviness of equipment	• The glasses were heavier than I expected. • Heavy for people wearing glasses. • The device was a little heavy and went down well...
	Adaptation Difficulty to do	• For people who are really new to video, there's a lot of pausing, and I think that can be frustrating. • The video is moving and distracting. • The wide field of view of the video screen takes some getting used to. • I misplaced the video and didn't do well on my first try. • The screen position was difficult to adjust to at first.
	Difficult to focus	• I was frustrated by the lack of focus and felt inadequate because the field of view was too narrow. • It was frustrating to look down at the glasses and not see the actual device screen. • I think you need to adjust your perspective.
Motivating Practice	Curiosity about AR	• It was very interesting and I think it will be used for good self-study in the future. • When I followed the actions of the nurse in the video, I was overwhelmed by the freshness, curiosity, and fun of experiencing AR for the first time. • It was very fresh and I was very curious to try it out.
	Interest trigger	• It was nice to study in a slightly different way • It was very exciting and created a huge appetite for self-directed learning. • It was refreshing and fun to try to utilize the machine. • It's similar to VR, which I've only done in games, so it wasn't hard to use, and it was fun and exciting. • At first, I had a hard time figuring out how to use it, but after using it about 3 times, I found it easy and interesting. • It was interesting because it was a new system... I think I was able to do difficult skills well. • I think it's a really good program to engage users because the screen is not fixed like a computer screen, but I can freely change the screen according to my perspective. • You're excited about trying your hand at an AR program for the first time... • I had a lot of fun participating in the lab.

	Novelty of practice	• It was refreshing to be able to watch the tutorials from the beginning and follow along. • I was excited to try a new way to do self-study. • It was exciting and refreshing to experience something I hadn't been exposed to before.
Dynamic screens	Video from an observer's view	• It's effective because it's hands-on, real-world training. • It was easier to remember prescriptions, consent forms, and blood bag checks with actual eye contact. • I felt like I was participating from an observer's point of view, watching a skill video through an AR device. • The hands-on approach to learning the procedures made it easy to understand. • I think the first-person perspective kept me focused. • When I put on the glasses, the screen is fixed in front of my eyes...
	Feeling present	• It was nice to see more detail in three dimensions than normal videos. • I was able to recognize that AR is different from VR in that it involves a real view of the real world, • Unlike a simple video, the sense of presence made me pay more attention and focus. • It was a hands-on experience for the students, not just a book, and it made the learning process easier. • It was exciting to see the space where I was practicing in front of me, and I felt like I was practicing with my professor because I could hear and see, and there were subtitles. • I think filming from above the nurse's head helped me remember the action more mentally because I felt like I was washing my hands with her. • The realism of AR and the details I couldn't see in the training videos helped me understand the technology. • I felt like I was actually participating in the practice.
Learning efficiency	Concurrent labs	• After watching the video, you can pause the AR video to practice without missing anything. • After watching the video and following along, I got good at asking questions of the subjects. • Being able to watch the video and perform the skill simultaneously made me feel like I was able to keep the action going without stopping. • I learned the skills quickly by watching the video with AR. • It was easy to understand because I could see it and hear it and do it right away. • Make eye contact with the nurse in the video to demonstrate the skills... • It's convenient to watch videos and practice at the same time... • AR is great because I can do it as I watch. • It was nice to be able to practice at the same time as the video through AR.
	A simple explanation	• I could see right in front of me what I needed to do in order, so I was able to follow along. • After doing it about 3 times, I felt like I could do the lines by myself. • It was nice to see that this video made it easy to do a verbal explanation. • While watching the video, I was able to follow along with the explanations and refine my skills.
	Easy to follow	• It seems like I can get 1 wrong instead 2 wrongs, and learn the sequence without getting confused from the beginning. • It's different from 2D video because you can move your head and get a feel for

	what you're seeing by looking at the actual video. • When washing my hands, the camera is looking down, which makes it more realistic and easy to follow. • When I was preparing to give a blood transfusion, the camera composition was easy to see and follow...
Easy to repeat	• I believe that students will improve their skills as they watch the video over and over again. • After repeated practice, I was able to perform blood transfusions in the same order as the AR video. • It was nice to be able to look at the visuals repeatedly and carefully. • I liked that I could watch as much or as little as I wanted and practice over and over again.
Easy for self-study	• I want to do a lot of real-world independent practice, but I think it's good for students who struggle... • There are detailed hands-on videos that show you exactly what to do, so you can learn on your own without asking questions. • At first, I thought, "Would it be more convenient to practice the skills on my own just because I'm doing an AR program?" but I'm glad I did it. • I thought it would be great to try this at home on my own. • It helped me practice on my own more than I was able to before. • I think it will be very useful and helpful for practicing on my own because I can follow the AR tutorial at the same time.
Moderate learning pace	• In the water and soap handwashing scene, the simulated nurse demonstrated the skill in a very specific and moderate pace so that the process or method was memorized longer. • It's not a big deal to wear clean gloves, but you can forget, and I was able to do it because I watched the video and followed along... • I was able to keep track of the details, such as skin checks between procedures and the training I needed to provide to my subjects. • Follow the video so you can get good at doing it step by step.

nursing students was "discomfort with the unfamiliar." Unlike clinical practice, participants in the study reported feeling confused in their first experience with virtual simulation practice. This is because communication and judgment with unfamiliar software and virtual patients are unfamiliar environments that are different from conventional hospital practice[26]. In addition, when foreign-developed virtual and augmented reality contents are applied to practice, language barriers, inconvenience of operation, difficulty in understanding the situation, and resistance to exotic characters are the main problems that reduce immersion in hands-on training[27]. However, in a study by Kim[26], nurses reported that they felt confused in the virtual reality at first, but gradually adapted over time and became an active nurse in a safe virtual reality, so it is necessary to secure sufficient orientation time and time to adapt to the environment on the computer.

The second component was "practice motivation." Researchers have found that participants are more likely to remember complex skill processes when they are provided with timely information along with visualizations of each step of the skill, rather than just images[28]. This is because augmented reality-based education is a new alternative teaching method for students who lack hands-on experience, and it has been shown to increase learning motivation and interest, as well as learning engagement and concentration, as shown in a study by Heo[29]. The core of nursing education is to produce competent nurses who can satisfactorily solve patients' health problems by applying theoretically acquired knowledge to clinical practice[30]. In particular, as the

COVID-19 pandemic has brought more constraints to clinical practice environments in recent years, simulation practice has become more necessary as an alternative practical education strategy that can complement clinical practice[31].

The third component was the “dynamic screen”. The augmented reality-based simulation screen displayed on the smart goggles can be seen directly in front of the eyes, increasing the sense of realism and immersion in the practice and enabling self-directed learning[32]. In a study by Shim[33], it was reported that learning immersion and learning confidence are positively correlated, so it is thought that it can have a positive effect on self-directed practice.

The fourth component was “increased learning efficiency”. This is because augmented reality simulation exercises allow students to check the situation and voice information in real time through goggles without an instructor[34]. In addition, learners can freely select the time they want to practice, which can increase learning efficiency. However, despite the increasing effectiveness and need for simulation training, there are reports of a lack of non-technical competencies such as teamwork, communication, leadership, and decision-making skills[35], and the importance of teamwork, the ability to collaborate through communication among learners, has been emphasized to solve this problem[36].

Since this study confirmed the skill experience of nursing students when applying augmented reality simulation of blood transfusion to self-directed practice, it is expected that various augmented reality-based studies will be continued in the future to help provide the basis for developing programs for virtual simulation education for nursing students.

Conclusions

The augmented reality simulation program for blood transfusion provided in this study allowed students to experience self-directed practice by themselves, and the visual equipment enhanced the sense of realism and immersion, allowing them to focus on hands-on training. Therefore, when developing future educational programs, it is expected that various augmented reality educational contents using smart glasses can be created and used to improve the educational effectiveness of nursing students.

Conflict of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Reference

1. Park SN, Lee SK. Factors influencing basic nursing skill competency in nursing students. The Korean Journal of Fundamentals of Nursing. 2008;15(1): 6-13.
2. Yoo MS. The effectiveness of standardized patient managed instruction for a fundamental nursing course. Journal of Korean Academic Society of Nursing Education. 2001;7(1):94-112.
3. Chung SE, Shin SJ. Learning experiences of essentials of fundamental nursing skills among nursing students: focused on lab self-directed training. Journal of Qualitative Research. 2017;18(1):105-113.
4. Korean Accreditation Board of Nursing Education. Core basic nursing skill items. Korean Accreditation Board of Nursing Education; 2017 [cited 2023 12/03]; Available from: http://old.kabone.or.k/HyAdmin/upload/goodFile/120180126142812.pdf
5. Lee SO, Eom MR, Lee JH. Use of simulation in nursing education. The Journal of Korean Academic Society of Nursing Education. 2007;13(1):90-94.
6. Medley CF, Horne C. Using simulation technology for undergraduate nursing education. Journal of Nursing Education. 2005;44(1):31-34.
7. Sok SH, Kang HS, Kim WO, Hyun KS, Lee JA, Park SH. Effects and development of clinical competency evaluation using standardized patients among nursing students: based on abdominal surgical patients. The Journal of Korean Academic Society of Adult Nursing. 2009;21(5):468-476.
8. Kim KS, Jeong HC. Effect of self-directed practice using augmented reality simulation on nursing students’ performance confidence, ability, and practice satisfaction.of Korean Society for Simulation in

Nursing.9(1):57-68.
9. Nam HS, Son KA, Kim SH, Song YS, Kwon SH, Oh EH. The effects of online nursing education contents on self efficacy, knowledge, and performance of nursing skills. Journal of the Korean Data & Information Science Society. 2014;25(6):1353-1360.
10. Lee HS, Song CS, Yoon SJ. A experiences on simulation education program for unplanned endotracheal extubation of nursing students. The Journal of Learner-Centered Curriculum and Instruction. 2021;21(11):717-730.
11. Hong SH, Kwon YS. Nursing student's practice scores, confidence and satisfaction in fundamentals of nursing according to teaching method for self-directed practice. Keimyung Journal of Nursing Science. 2010;14(1):1-10.
12. Ko IS. Measurement of competency through self study in basic nursing lab. Practice focused on cleansing enema. The Korean Journal of Fundamentals of Nursing. 1999;6(3): 532-543.
13. Paik HJ. Educational evaluation of competency in nursing skills through open laboratory self-directed practice. The Korean Journal of Fundamentals of Nursing. 2004;11(1):13-20.
14. Kim SH. A study on relationship between stress of clinical practice and clinical competency in nursing students. Journal of Korean Public Health Nursing. 2002;16(2):64-76.
15. Azuma RT. A survey of augmented reality. Teleoperators and Virtual Environments. 1997;6(4): 355-385.
16. Arvanitis TN, Petrou A, Knight JF, Savas S, Sotiriou S, Gargalakos M, et al. Human factors and qualitative pedagogical evaluation of a mobile augmented reality system for science education used by learners with physical disabilities. Personal and Ubiquitous Computing. 2007;13(3):243-250.
17. Padilha JM, Machado PP, Ribeiro AL, Ramos JL. Clinical virtual simulation in nursing education. Clinical Simulation in Nursing. 2018;15:13-18.
18. Chang HY, Wu HK, Hsu YS. Integrating a mobile augmented reality activity to contextualize student learning of a socioscientific issue. British Journal of Educational Technology. 2013;44(3):E95-E99.
19. Noh KH, Jee HK, Lim SH. Effect of augmented reality contents based instruction on academic achievement, interest and flow of learning. The Journal of the Korea Contents Association. 2010;10(2):1-13.
20. Hyland JR, Hawkins MC. High-fidelity human simulation in nursing education: A review of literature and guide for implementation.and Learning in Nursing,4(1):14-21.
21. Cant RP, Cooper SJ. Simulation-based learning in nurse education: systematic review. Journal of Advanced Nursing. 2010;66(1): 3-15.
22. Hur HK, Park SM. Effects of simulation based education, for emergency care of patients with dyspnea, on knowledge and performance confidence of nursing students. The Journal of Korean Academic Society of Nursing Education. 2012;18(1):111-119.
23. Giorgi, A. Qualitative research. Thousands Oak: Methodology; 2004
24. Sin GL. Theory and practice of phenomenological study in nursing science. Journal of Nursing Query. 2003;12(1), 49-68.
25. Guba EG, Yvonna SL. Effective evaluation: Improving the usefulness of evaluation results through responsive and naturalistic approaches. New San Francisco: Jossey-Bass Publications; 1981.
26. Joo GE, Kim BN, Park MJ, Park SU, Bang AR, Lim YJ, et al. Awareness, current educational state and educational requirements of virtual reality and augmented reality among nursing students. The Journal of Kyungpook Nursing Science. 2020;24(2): 1-9.
27. Kim YJ, Kim WJ, Min HY. Nursing students' experiences in virtual simulation practice. The Journal of Korean Academic Society of Nursing Education. 2020;26(2):198-207.
28. Kim SK, Lee Y, Yoon H, Choi J. Adaptation of extended reality smart glasses for core nursing skill training among undergraduate nursing students: Usability and feasibility study. Journal of Medical Internet Research. 2021;23(3):1-12.
29. Heo SH. The effects of augmented reality simulation based personal protective equipment practice on nursing students' knowledge, performance confidence, practice immersion and practice satisfaction. Jinju: Gyeongsang National University; 2022.
30. Lee JY, Lee SH, Kim JH. A review of the curriculum development process of simulation-based educational intervention studies in Korea. Nurse Education

Today. 2018;64:42-48.
31. Tomietto M, Comparcini D, Simonetti V, Cicolini G. Nursing education: challenges and perspectives in a COVID-19 age. Professioni Infermieristiche. 73 (3):131-132.
32. An JW. Technology acceptance and influencing factor of anatomy learning using augmented reality : Usability based on the technology acceptance model. Journal of the Korea Convergence Society. 2019; 10(12):487-494.
33. Shim CS. Study on the effects of flip learning-based simulation education on the learning flow, learning confidence, communication skills, and clinical competence of nursing students. Journal of Korea Entertainment Industry Association. 2019;13 (8):541-549.
34. Kim MS, Jeong HC. The effects and adaptation of augmented reality-based intradermal injection practice education for nursing students. Journal of Korean Society for Simulation in Nursing. 2022; 10(2):93-104.
35. Welp A, Tanja M. Integrating teamwork, clinician occupational well-being and patient safety-development of a conceptual framework based on a systematic review. BMC Health Services Research. 2016; 16(1):1-44.
36 Sezgin MG, Bektas H. Effectiveness of inter professional simulation-based education programs to improve teamwork and communication for students in the healthcare profession: A systematic review and meta-analysis of randomized controlled trials. Education Today.120:105619.