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Nursing Students' Experience of Using HoloPatient During the Coronavirus Disease 2019 Pandemic: A Qualitative Descriptive Study

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KEYWORDS
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focus groups

Abstract

Background: This study examined nursing students' experiences of using HoloPatient to learn COVID-19-related patient care.

Method: In this qualitative descriptive study, focus group interviews were held virtually with 30 nursing student participants in South Korea. Data were analyzed using a mixed content analysis.

Results: Participants reported satisfaction associated with having gained patient assessment and critical thinking skills, self-confidence, and knowledge about the care of patients with COVID-19.

Conclusion: HoloPatient in nursing education can improve learning motivation, critical thinking skills, and confidence. Efforts should be made to engage users by providing an orientation, supplementary materials, and an environment conducive to learning.

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Introduction

Mixed reality (MR) is currently used in various educational and clinical settings (Kim, Choi, & Kim, 2021), and its importance is increasing given changes in the educational environment due to the Coronavirus disease 2019 (COVID-19) pandemic. Unlike virtual reality (VR), which creates a simulated environment that is not real, MR synthesizes virtual objectives or information with the real world, allowing users to experience a blended reality through devices such as HoloLens (Kaplan et al., 2021). MR differs from augmented reality (AR) as it creates a more immersive experience by combining elements of the artificial and real environment into an augmented version of reality with which users can interact (Mendez et al., 2020). This integration of virtual and physical elements creates a more dynamic and interactive experience, making it a promising tool for various applications. This sort of interaction can provide a sense of personal touch and immersion in situations that cannot be experienced face-to-face in the real

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Key Point Statements

- Due to the Coronavirus disease 2019 (COVID-19) pandemic, nursing practice education has adopted alternative teaching methods (e.g., synchronous online classes, and video data) that may present difficulties or limit learning.
  Care of COVID-19 patients is difficult for students to learn in a general clinical setting, but the use of Mixed Reality can provide an especially vital learning experience.
- HoloPatient use in nursing education can improve students' motivation to learn, critical thinking skills, and confidence.
- To prevent learning disparities, educators should consider students' individual circumstances such as personal challenges with technology, English, or motivation.

world (Yoo, Kim, Koo, & Song, 2018), and it can generate interest as users learn while operating the program themselves (Hauze & Marshall, 2020). MR is suitable for learning content that is difficult to observe directly or to explain in text and can be applied in risky experiments (Kaplan et al., 2021; Kim et al., 2021; Yoo et al., 2018).

Prior studies in nursing practice and education that evaluate the use of MR have demonstrated its potential benefits, including improved learning outcomes and satisfaction (Collins & Ditzel, 2021). Mixed reality has been shown to enhance knowledge and clinical skills, like health assessment, clinical judgment, and communication (Chen, Chen, Lee, Wang, & Sung, 2021; Frost, Delaney, & Fitzgerald, 2020; Kang & Kang, 2022). Additionally, MR has been found to be effective in interprofessional education for nursing students (Kang & Kang, 2022) and in training for operating room fire response (Wunder et al., 2020). Furthermore, MR has been demonstrated to be valuable in improving communication skills for pediatric transport teams (Peterson, Porter, & Calhoun, 2020) and peripheral intravenous catheter placement skills among healthcare providers, including nurses (Rochlen, Putnam, Levine, & Tait, 2022).

Nursing students must acquire and demonstrate not only major knowledge but also competency in clinical practice; it can be difficult, however, to provide opportunities for students to practice nursing skills in actual clinical settings while safeguarding patient privacy and safety (Ironside, McNelis, & Ebright, 2014). Alternative education methods implemented due to the COVID-19 pandemic have resulted in difficulties as well; it is recognized that the use of synchronous online instruction or video data present limits to learning (Ramos-Morcillo, Leal-Costa, Moral-García, & Ruzafa-Martínez, 2020). MR allows nursing students to learn in a safe environment and is especially helpful for providing students with a vital experience of caring for COVID-19 patients. The aim of this study is to provide basic data about nursing students' perception and experience of MR-based education to promote its effective application in the field of nursing education.

Material and Methods

Study Design

This is a qualitative descriptive study using focus group interviews. This approach lies within the naturalistic philosophical inquiry and acknowledges the concept that reality is subjective (Sandelowski, 2000). The Standards for Reporting Qualitative Research (SRQR) checklist (O'Brian, Harris, Beckman, Reed, & Cook, 2014) was used for reporting.

Participants

Thirty senior nursing students were recruited from a nursing college in a private University in South Korea. Convenience sampling was used to recruit the participants based on their experience of using HoloPatient to practice care of COVID-19 patients. A research assistant placed a recruitment announcement in a KakaoTalk group chat for senior nursing students after the completion of all semesters and grading. Although the research assistant and one researcher were familiar with the participants, participation in the study was completely voluntary, and students were informed that there would be no consequences for declining to participate. The study included senior nursing students who had prior experience with the HoloPatient for COVID-19 case study, while students without such experience were excluded.

HoloLens

HoloLens is a head-mounted MR device introduced in 2016 (Microsoft HoloLens 2, Microsoft, Redmond, WA). In this study, HoloPatient was implemented in the classroom setting using Microsoft's HoloLens headset. "HoloPatient: COVID-19," created by the National Health Service (NHS) in England and Health Education England (HEE), comprises four stages of the illness, which helps learners recognize signs and symptoms typical of COVID-19 (GigXR, 2020). Figure 1 depicts the use of HoloLens by a model with the HoloPatient application for a COVID-19 case. The HoloPatient simulation lasted for 150 minutes, including pre-briefing, briefing, simulation (1 hour), debriefing and evaluation. The MR sessions with the HoloPatient were conducted by nursing professors.

Figure 1 HoloLens use by a model: HoloPatient for a COVID-19 case. Published with permission from GIGXR (www.gigxr.com/applications/holopatient).

Data Collection

Data were collected using ZOOM through seven focus group interviews between January 25 and February 8, 2022, until data were saturated. The interviews were conducted in Korean, approximately five to six weeks after the participants' exposure to the HoloLens. The participants' sociodemographic characteristics, like gender and age, were collected. Two authors served as moderators and co-moderators for all interviews, with one of them being familiar with the participants. The interviews lasted between 60 and 120 minutes (mean 100). A semistructured interview guide was used. The main research questions designed by the research team were the following:

- What have you experienced using the HoloPatient?
- What were the advantages of using the HoloPatient for COVID-19 case studies?
- What were the challenges of or concerns about using the HoloPatient?
- What needs to be improved?

Data Analysis

The researchers transcribed the interviews verbatim and checked the content for accuracy. Data were analyzed using a mixed approach that combined deductive and exploratory qualitative content analysis (Elo & Kyngäs, 2008; Krueger & Casey, 2014) with the NVivo 12 Plus software (QSR International, Melbourne, Australia). The researchers read each transcript several times and identified meaning units (words, phrases, and sentences) related to the study's aims. Identified codes were grouped into categories, and subthemes and overarching themes were derived from the data through abstraction. One researcher coded each transcript that was confirmed by the other authors. All discrepancies were resolved by discussions until achieving consensus. Final analysis was translated into English by bilingual experts.

We used criteria provided by Lincoln and Guba (1985) to ensure the study's rigor. The credibility of the findings was established through member checking. To ensure credibility in the data collection process, one author (YS) with extensive experience in MR education conducted the interviews using a structured interview guide. The participants were given the opportunity to repeat and clarify information during the interviews. The dependability of the findings was strengthened through shared responsibility of the research team in collecting, transcribing, and analyzing all study data. To increase the transferability of the results, the research process, participant characteristics, and setting were thoroughly described. The confirmability of the findings was established through the use of verbatim transcripts and the inclusion of quotes to support the results. Furthermore, the researchers engaged in ongoing communication with each other both before and after the interviews for debriefing purposes. The participants' sociodemographic characteristics were analyzed using IBM SPSS statistics version 26 for descriptive statistics.

Ethical Consideration

This study was approved by the institutional review board (WS-2021-20). Before the interview, participants were informed about the purpose of the study and voluntarily agreed to participate and provided informed written informed consent.

Results

Participants' Characteristics

Thirty senior nursing students participated; their mean age was 25.7 years (range: 23-39 years); 23 were female, and 7 were male. All participants had experience using virtual simulation (vSim® for Nursing) as part of clinical practice during the COVID-19 pandemic.

Main Themes

Three themes were identified from the interviews: (a) benefits of using the HoloLens for learning; (b) barriers encountered while using the HoloLens; and (c) suggestions for improvements. The themes, subthemes and sample codes are presented in Table 1.

Theme 1. Benefits of Using the HoloLens for Learning

Learning With a Hologram and Building Self-Confidence

When participants wore HoloLens, they felt able to see the patient clearly in 3D. They reported that HoloLens was helpful for assessing the patient as it allowed them to hear breathing and listen to an organ repeatedly, see muscle movement vividly, and observe and evaluate changes in condition. HoloLens helped participants stay updated about the patient's condition by displaying charts, vital signs, SpO2, and electrocardiograms next to the patient. Because the situation was virtual but felt real, participants reported that they were able to focus clearly on patient care, become familiar with the environment, and feel comfortable making mistakes in a safe situation. Some participants pointed out that the hologram presented only foreign patients not often seen in clinical practice, and some expressed that they might learn better if Asian or mainly Korean cases were introduced; however, the participants recognized that as their society was gradually becoming more multicultural, they needed to be able to respond confidently when meeting new populations in a clinical setting.

Caring for Patients With COVID-19 in an Immersive Virtual Environment

Participants felt that HoloLens was beneficial as it allowed them to practice COVID-19 care realistically yet safely. The practice was so immersive that they experienced the gravity of the patient's situation yet were able to identify the kind of care needed and respond quickly without panicking, thus improving their ability to respond similarly in real situations. One participant reflected,

> "It was good to be able to see the symptoms of the patient before my eyes, depending on the degree to which the patient's condition deteriorated from Stage 1 to Stage 4. At first, the patient just couldn't breathe, but later, I was able to see several changes even while [the patient was] on the ventilator and with an oxygen mask."

Collaborating With Peers

Participants stated that it was very helpful to discuss the HoloLens, patient's situation, and contents of the nursing intervention with their colleagues. One participant reported that she was reading the abnormal values displayed on the monitor when she witnessed her peers observing abnormal breathing patterns and "knew what to check carefully." Moreover, collaborating with teammates was deemed by participants to be "an opportunity to broaden perspectives" through consideration of the emotional impact of COVID-19, such as fear and anxiety, on patients. The participants expressed appreciation for their ability to display the HoloLens simulation on a large TV screen and sync it with an application so that it could be viewed together with their peers. Although sounds on the app are harder to hear, they found the app helpful because they tended always to carry their phones with them. Peers were able to zoom in and out to discuss patients while looking at their smartphones without wearing the HoloLens device.

Theme 2. Barriers Encountered While Using the HoloLens

Difficulties With Operating Unfamiliar Equipment

The participants reported difficulties using HoloLens due to their unfamiliarity with it and insufficient time to practice using it. It was difficult for them to gauge how far they needed to stretch their hands to touch the virtual space. Although all participants attempted to use the device, when time was short, students embraced practicality in order to complete the task and not lag behind other teams. Those who were machine-savvy, proficient in English, and had already used HoloLens attempted to use the device while their peers used a connected TV or app. One participant reported a situation in which he was asked to observe content using the app; it had been introduced only recently, and thus students and professors lacked proficiency in using it, which was causing time delays. One student stated,

> "It was my first time . . . so I didn't know how to use it, and it took too much time to log in, so I guess I couldn't do anything in earnest. It got better with time, but at first, it was difficult to access things like QR codes."

Lack of Environmental Support

Participants faced some difficulties: poor Wi-Fi connectivity, screens turned off, delayed connection, slow app downloads on mobile phones, incompatibility between the app and mobile phones, or poor app performance such as stopping when running, making it impossible to sync.

Table 1 – Study Themes, Subthemes and Sample Codes

Themes	Subthemes	Sample Codes
Benefits of using the HoloLens for learning	Learning with a Hologram and building self-confidence	• able to see the patient clearly in 3D • able to hear breathing and see muscle movement vividly • helpful for assessing the patient • freely observe and evaluate patients repeatedly • be comfortable making mistakes in a safe situation
	Caring for patients with COVID-19 in an immersive virtual environment	• allowed to practice COVID-19 care safely • could hear labored breathing sound vividly • help in improving the ability to care for actual COVID-19 patients
	Collaborating with peers	• It was very helpful to discuss with teammates. • an opportunity to broaden perspectives • getting to know how to operate the hologram with colleagues
Barriers encountered while using the HoloLens	Difficulties with operating unfamiliar equipment	• very heavy and could not see the patient • I didn't know how to use it. • insufficient time to practice using it
	Lack of environmental support	• Wi-Fi did not work well • limited number of machines • lack of space
	Language barriers	• feeling pressured • difficult to hear and concentrate • uncertain whether correctly understood
Suggestions for improvements	More content and functions	• more patient information and a broader range of cases (e.g., children and pregnant women with COVID-19) • functions to provide nursing interventions to patients directly and receive feedback
	Preparation (orientation and debriefing)	• needs orientation before using a HoloLens • needs detailed guidance of professors • needs feedback or debriefing

Participants were unable to complete the entire process in enough time due to the limited number of machines. One student said,

> "Because we were using the wireless network installed in the school, it cut off frequently, and mirroring was often cut off or delayed even when connected to the TV. There were classmates who took a long time to log in because Wi-Fi did not work well."

Students were not free to move or manipulate patients' bodies due to a lack of space in classrooms. In addition, caring for patients who had infections did not feel real because there was no patient bed nearby and participants were not wearing protective suits. Female participants said that they needed a disposable face cover because they were wearing makeup.

Language Barriers

Participants perceived the use of English to be a barrier to different degrees. Some expressed feeling pressured because the hologram spoke in English; others felt it contributed to their learning as all medical terms are in English in real clinical settings. Although some participants felt comfortable with using a translator such as Naver Papago, most expressed that the application guide was "unfamiliar" and "difficult" and required detailed guidance in

the beginning because it was completely in English. Participants suggested that it would be helpful to distribute translations of the medical terms used in the program—in both Korean and English scripts, subtitles, and image manuals before class.

Theme 3. Suggestions for Improvements

More Content and Functions

Participants expressed that although HoloPatient enables "assessment to the extent of hearing and seeing," it is "a little difficult to confidently operate nursing skills because there is no direct intervention." One participant expressed that although "it was good to be able to perform the nursing intervention and see changes in vSim," it would be better if the program allowed users to talk, touch, and provide nursing interventions to patients directly and receive feedback.

An important concern in caring for COVID-19 patients is the safety of nurses, so students recommended adding information on isolation precautions and protective equipment to the system, and perhaps linking education on infection control, including how to wear protective equipment, before the practice. They also wanted the practice program to include (a) the contents of the patient's nursing record after their transfer to the intensive care unit in the fourth stage, (b) a broader range of patient cases (e.g., children and pregnant women with COVID-19), (c) a function for subjective data (e.g., wherein the patient could convey the location of their pain or the activities they found physically difficult or painful), (d) the possibility of operating a machine used for patient care (e.g., ventilator, infusion pump), and (e) a preview of possible responses when an alarm goes off.

Preparation (Orientation and Debriefing)

Some participants had received information before the practice and thus did not find it difficult to get started; however, most expressed that a video orientation is necessary before using HoloLens, and feedback (debriefing) time is needed after class. Regarding usage instructions, participants felt that they needed to know the order of operation, the information that could be obtained by pressing various buttons, and how to move people adequately. Some other participants stated that it would be beneficial if (a) feedback could be integrated; (b) the purpose and practice of nursing interventions could be discussed with professors and peers; and (c) an explanation of nursing interventions that take priority in given situations could be added, perhaps as a separate commentary in the program.

Discussion

Due to the COVID-19 pandemic, many nursing schools have integrated virtual learning into their curriculum. This study explored nursing students' experiences with MR learning using HoloLens, revealing that it can positively affect participants' learning experiences, including regarding care of COVID-19 patients. Most participants opined that HoloLens was helpful for learning; however, the results indicate that factors such as unfamiliarity with the English language version and lack of environmental support can negatively affect students' immersive learning experience. Similar to studies in New Zealand and Ireland (Collins & Ditzel, 2021; Saab, Hegarty, Murphy, & Landers, 2021), this study demonstrates that nursing education with MR learning has advantages, especially in allowing students to visualize a holographic image of a patient and practice care provision in a safe environment. Additionally, this finding highlights the potential of MR as a tool for enhancing patient care in nursing practice (Saab et al., 2022). Participants stated that they built confidence in nursing practice and gained an opportunity to broaden their perspectives through collaboration with peers during MR learning, consistent with the findings of a systematic review by Ryan et al. (2022).

The advantage of immersive simulation in nursing education is that it is possible to create situations that cannot be commonly experienced during clinical practice or occur rarely but are fundamental for ensuring safe, high-quality care (Hauze, Hoyt, Frazee, Greiner, & Marshall, 2019). The findings of this study reveal that MR learning can help nursing students learn how to provide patient care in a safe environment, a top priority given the current spread and emerging strains of COVID.

The participants expressed that they encountered some difficulties related to unfamiliarity with HoloPatient and HoloLens. These challenges in adjusting to new MR technology are consistent with a previous study on Taiwanese nursing students who reported needing time to adjust to VR (Chang & Lai, 2021). The participants in this study also perceived that this technology was new and unfamiliar to educators. They reported that the limited number of machines was a barrier. The need for students to share expensive devices is inevitable when budgets are tight; however, arrangements for sufficient time and more headsets would allow students more opportunities to practice MR technology. The lack of an environmental support system for MR use was also a barrier. Furthermore, the participants described that there were difficulties, like slow or intermittent Wi-Fi connections, longer download time for the mobile app, and device incompatibility. Our results are consistent with those of a study on Irish nursing students' views of using VR in healthcare, which emphasized the importance of proper preparation before utilizing the technology (Saab et al., 2022). Thus, the technical support system should be checked, advanced preparations should be made, and devices such as lap pads should be provided for students who experience difficulties with their phones.

The burden of using English, which was not the participants' primary language, presented a further barrier. It is

essential, therefore, to provide either supplementary material in English or narrations about how to use and navigate the device in the users' native language. Assigning students to work in groups with peers who are tech-savvy or proficient in English may be beneficial. Finally, the participants pointed out the lack of HoloLens's functions for providing interactive intervention and personalized feedback . Similar to our results, a study on Taiwanese nursing students' VR experiences highlighted the need for a better interactive function for practical teaching (Chang & Lai, 2021). This result indicates that adding interactive functions and personalized feedback would motivate students to engage in active learning.

Limitations

This study has some limitations. First, this study employed convenience sampling, which raises the possibility of self-selection bias and reduced trustworthiness. This study was conducted among senior nursing students at a single university, and thus, additional research is needed to confirm these results. Participants were students who had experience with the HoloPatient. Thus, our findings may not be transferable to students with no prior experience of HoloPatient/HoloLens. Additionally, one of the interviewers was familiar with the participants, which may have influenced their responses (Tong, Sainsbury, & Craig, 2007). However, the interviews were conducted after the semester ended to ensure that participation was entirely voluntary. The focus group interviews were conducted online, which may have limited the interaction between the researchers and participants than face-to-face interviews (Weller, 2017). Additionally, HoloLens was used in a classroom setting. Because this device supports remote learning, further studies regarding nursing students' learning experiences in remote settings are required. Future studies could explore the experiences of educators involved in MR learning to provide a more comprehensive understanding.

Conclusion

The findings of this study indicate that while participants had a positive learning experience, they expressed dissatisfaction with the lack of interactive features for patient care. The study emphasizes the importance of preparing for MR learning at both the individual and institutional levels, including orientation for students and educators, technical support to create immersive learning, and debriefing to provide student-centered learning. To prevent disparities in learning, educators should play a critical role by taking individual circumstances into account and focusing on students who may face difficulties with technology, English language proficiency, or low motivation.

Declaration of Competing Interest

There are no conflicts of interest to declare.

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