

Qualitative Assessment of Undergraduate Nursing Students' Perceptions of Combined Virtual Reality and Group Discussion Learning Interventions: A Focus Group Study

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Received October 21, 2024, accepted December 1, 2024, Published January 1, 2025.

ABSTRACT

Context: The coronavirus disease 2019 (COVID-19) pandemic has forced major changes in the learning environment. The author's institution created virtual reality (VR) learning content to enhance readiness for on-the-job training students by allowing them to enter situations and circumstances beyond traditional learning, experience simulations of target individuals, and think about the nursing assistance needed. The education combined VR and 360-degree video content with group discussions to increase learning depth. A qualitative analysis of the evaluations from the participating students' perception was performed to obtain suggestions for future educational methods.

Aim: This study aimed to elucidate how undergraduate nursing students perceive the effectiveness of education that combines VR learning content with group discussions.

Methods: This qualitative descriptive study summarizes the educational effectiveness from data obtained through focus group interviews (FGI). In the data collection process, two focus group interviews were conducted with five nursing students at a nursing university in the Tokyo metropolitan area in March 2023, using an interview guide that was independently created. The study subjects participated in the nursing practical training and exercises that combined VR learning content with group discussions.

Results: Based on the FGI of five participants, two main themes were identified, "educational effectiveness" and "challenges." Educational effectiveness" contains the following four subthemes as effects of the combination of VR learning content and group discussions: Opportunities to think about the experiences of patients receiving care and the ethical behavior of nurses, promotion of understanding of clinical situations that are normally inaccessible, opportunities for reflection through recollection of previous experiences, and expanding and deepening learning in group discussions. Moreover, "challenges" contains two subthemes: Introducing mechanisms and devices to enhance learning effectiveness and VR sickness while viewing the VR learning content.

Conclusion: The introduction of VR learning interventions allows for the simulated experience of three-dimensional reconstructed scenes of places and situations that are normally inaccessible and is provided for learners to be useful as a learning opportunity intended to reconstruct knowledge and understanding. Additionally, the emotional experience of VR learning content based on learners' different perspectives and sensitivities can be combined with group discussions to deepen learning through multifaceted opinions and realizations. An effective educational method for fostering critical thinking skills is to incorporate group work into VR-based educational programs.

Keywords: Focus group study, discussion, learning interventions, nursing students, virtual reality

Citation: Kuwabara, Y., Ogata, A., Tanaka, T., Nishida, T., & Sasaki, I. (2025). Qualitative assessment of undergraduate nursing students' perceptions of combined virtual reality and group discussion learning interventions: A focus group study. *Evidence-Based Nursing Research*, 7(1), 52-59. <http://doi.org/10.47104/ebnrojs3.v7i1.376>

1. Introduction

The outbreak of the novel coronavirus disease 2019 (COVID-19) forced significant changes in the learning environment. Nursing educational institutions introduced temporary school closures and distance learning based on the level of restrictions to activity required in the location. In response to this situation, in February and June 2020, the Ministry of Education, Culture, Sports, Science and Technology (MEXT) and the Ministry of Health, Labour and

Welfare (MHLW) issued the "Response of Schools, Training Institutes, and Training Facilities for Medical Professionals to the Outbreak of New Coronavirus Infections," which stated that instead of practical training, students could acquire the necessary knowledge and skills through exercises or in-school training (*Ministry of Education, Culture, Sports, Science, and Technology, 2020; Ministry of Health, Labour and Welfare (MHLW) 2011*).

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Meanwhile, Japan is also promoting digital transformation (DX). For medical personnel training, DX and other methods are being used to enable initiatives that were not possible in conventional training to upgrade educational methods. The author's institution developed VR learning content to enhance readiness for on-the-job training. Considering the challenges of VR reported in previous studies, such as potential lack of in-person feedback, sight problems, vertigo, dizziness, motion sickness, and risks of injury (Saab *et al.*, 2021), it was designed as a combined educational program that aimed to deepen learning through group discussions following individual learning using the VR learning content.

Previous studies have reported on the effectiveness and barriers to using VR in nursing education (Choi *et al.*, 2021) and the usefulness of VR-based education compared to traditional teaching methods (Liu *et al.*, 2023). A study by the National Council of State Boards of Nursing in the United States of America reported that replacing up to half of traditional clinical training hours with simulation learning can achieve the same educational outcomes as completing the entire clinical training program (Hayden *et al.*, 2014). Clinical practice aims to integrate knowledge, skills, and attitudes through caring for diverse patients and fostering critical and creative thinking and problem-solving skills (Ministry of Education, Culture, Sports, Science, and Technology (MEXT), 2020).

Conversely, VR education has the issue of the cost of purchasing and maintaining VR headsets. It has been reported that while VR education improves the acquisition and retention of knowledge and skills and satisfaction with education, no significant results were seen in strengthening critical thinking skills (Liu *et al.*, 2023). Thus, clarifying how VR learning content contributes to developing critical and creative thinking and problem-solving skills will offer valuable insights for enhancing the quality of nursing education. This study aimed to qualitatively analyze and elucidate how undergraduate nursing students perceive the effectiveness of education that combines VR learning content with group discussions.

2. Significance of the study

Because of the spread of COVID-19, a MEXT (2020) survey found that 83.4% of nursing universities in Japan planned to alter their training methods. In response, MEXT launched a medical personnel training project in 2021, funded as a supplementary budget initiative, providing subsidies to selected schools. This initiative led to increased efforts to train medical personnel using DX as an alternative to onsite training. There have been reports on using VR to help learners understand target populations (Suzuki *et al.*, 2023) and acquire nursing skills (Shibuya *et al.*, 2020), as well as on the effect of introducing VR into on-campus exercises (Ishii *et al.*, 2021).

However, there are few reports on developing original VR teaching materials or analyzing learners' opinions about VR materials that simulate interactions between supporters and recipients. Additionally, although disaster simulation education is increasing in disaster nursing training, most reports are limited to initial responses in high-income

countries (Loke *et al.*, 2021). No education reports focused on understanding or supporting disaster victims in evacuation shelters.

In this study, we gathered evaluations from learners on education that combined original VR learning content with group discussions. The researchers clarified learning effects from the learners' perspectives and suggested improving future educational methods. This evaluation includes addressing challenges in VR-based learning, such as enhancing critical thinking skills.

3. Aim of the study

This study aimed to elucidate how undergraduate nursing students perceive the effectiveness of education that combines VR learning content with group discussions.

3.1. Operational Definitions

In this study, "education combining VR learning content and group discussions" refers to a series of educational programs and sessions where small groups of learners engage in discussions after viewing 360-degree videos and still images developed by institutions using VR headsets.

4. Subjects & Methods

4.1. Research Design

This qualitative descriptive study uses focus group interviews (FGI) to gather evaluations from undergraduate nursing students on education that combine VR learning content with group discussions. This approach offers a comprehensive summary of an event in the everyday terms of those events (Sandelowski, 2000). Therefore, it was selected to capture detailed aspects of learners' opinions, including usability and nuances, and to inform future educational methods.

4.2. Study setting

This study was conducted at a nursing university in a metropolitan area of Japan. The college also has a graduate school and accepts around 130 undergraduate students each year. As part of their nursing training curriculum, students undergo on-campus and clinical training at multiple general hospitals and welfare facilities in the surrounding area. Data were collected in March 2023.

4.3. Subjects

Five second-year nursing students participated in this study. Participants were recruited through convenience sampling based on verbal and poster explanations. From August to September 2022, 137 second-year undergraduate students who participated in nursing practical training were invited to join the study, and three students who provided consent became study subjects. The practical nursing training program combined VR learning content and group discussions. Recruitment targeted both the pre-clinical and post-clinical practicum groups, with participants secured from both groups.

Additionally, 18 second-year undergraduate students who attended disaster nursing exercises in 2022 were invited to participate, and two students who consented became study

subjects. These two students were distinct from the three who participated in the nursing practical training program combining VR learning content and group discussions. The participants were second-year students in a four-year nursing program, eligible for the national nursing examination upon graduation.

4.4. Tools of data collection

4.4.1. Interview Guide for FGI

The interview guide for the FGI was independently developed through repeated discussions among five researchers specializing in nursing and nursing education concerning *Krueger (1998)* and *Anne (2010)*. In line with the study's purpose, the guide included questions on the following aspects: Participants' impressions of the education combining VR learning content and group discussions, the awareness and learning they gained from the education combining VR learning content and group discussions, and how they connected this awareness and learning to their understanding of the subject and their examination of nursing practice.

4.5. Procedures

Ethical considerations: This study was conducted with the approval of the Research Ethics Review Committee of the author's institution (Approval No.2022-094). Both verbal and written consent were obtained from the participants, stating that their cooperation in the study was of their own free will. Moreover, verbal and written statements mentioning that the participants' cooperation in the study and their withdrawal or interruption during the study would not affect their grades in the classes (practical training and exercises) were provided. The FGI was conducted in the presence of a researcher who was not directly involved in the practice or exercise.

Combination of VR Learning Content and Group Discussions:

First, from the second half of 2021 to the first half of 2022, each specialized area of nursing created its 360-degree video content aligned with the learning objectives of each field. In adult health nursing, faculty members and nurses at the hospital recreated and recorded scenes from the operating room, intensive care unit, rehabilitation room, night shift, and patients' lives in multi-bedrooms.

In disaster nursing, faculty members and graduate students recorded simulations of care for disaster victims living in evacuation centers. For creating these learning contents, the researchers aimed to enhance readiness for on-the-job training by providing the students with the opportunity to think about necessary nursing care through simulated experiences of the target individuals and the nurse's involvement by entering into situations and circumstances rarely encountered in non-disaster times.

Next, in the 2022 practical training and exercises, the researchers implemented an educational program to develop learning through individual study using the created VR learning contents, followed by small group and all-participant discussions. Mitigating the issues related to

learning in VR. The researchers made it possible for students who cannot watch VR content due to VR sickness to watch the videos on YouTube®.

Additionally, the researchers prepared materials on how to start VR content and on problems that may arise while watching the content. After viewing the 360-degree video content of scenes of patients in multi-bedrooms during their second-year undergraduate nursing lab work (from August to September 2022), group discussions were held on how to relate to patients as caregivers and on the perspective from which to perceive the target individual.

In November 2022, in the second-year undergraduate Disaster Nursing Practice Course, group discussions were held on supporting victims in evacuation centers by having them watch 360-degree video content of evacuation center support.

Data collection method: A total of two groups of two to three nursing undergraduates participated in an in-person FGI once per group. FGI was selected because researchers and participants are routinely in an evaluator–evaluated relationship. Compared with a one-on-one interview, in a group interview, the comments from group members were presumed to inspire and help participants recall experiences from the events. Additionally, each FGI included one researcher who was not directly involved in grading or evaluating student performance. In the FGI, one researcher gave an orientation on the purpose of the FGI and how to proceed at the beginning of the interview and then facilitated the interview so that each participant could speak actively. Notes were taken during the interview with the participant's consent, and the interview was recorded on a digital voice recorder also with the participants' consent to capture aspects of group dynamics (i.e., each participant's mannerisms and mood in their respective group),

4.6. Limitations of the study

Given that the participants in this study were nursing students with varying prior knowledge and experience, particularly regarding onsite practical training, there may have been differences in their learning outcomes. Because this study reflects the opinions of five second-year undergraduate participants students, further research is required to generalize the results.

4.7. Data analysis

Verbatim transcripts were created from the FGI content and cross-checked against the original recordings to ensure accuracy. The data analysis was based on *Krueger's (1998)* qualitative content analysis in which verbatim transcripts of the data obtained at the FGI were repeatedly read, paying attention to the expression and frequency of the participants' comments as well as how the participants interacted with each other to determine whether a participant's opinion was limited to an individual or was the common view of several or all of the participants.

In the case of opinions held by some of the participants, the shared characteristics of the participants were focused on it. Next, from the data collected, it was attempted to code and categorize what was being described, what was learned, and

what was utilized in the clinical practicum and on-campus exercises as well as what was considered future issues. Finally, the educational effects and challenges of combining VR learning content with group discussions were identified based on the created subthemes, and five researchers discussed these to explore future educational methods. Five researchers specializing in nursing science and nursing education examined a series of analytical processes using triangulation in qualitative research to ensure the validity and reliability of the results.

Quotation marks (“ ”) indicate codes generated from participants' statements, whereas parentheses () denote words supplemented from the surrounding context during code generation.

5. Results

The study participants were five consenting second-year undergraduate students (four females and one male; all were 20 years old) from College A. Three of them gave their opinions of the nursing practical training and the other two gave their impressions of the disaster nursing practicum course in the FGI. The average time for the FGI was 62.4 minutes. From the data obtained in the FGI, 514 codes related to the research objectives were extracted, and six subthemes were further extracted from the associations between the codes. Based on the sub-themes extracted from the opinions of research participants, two main themes - educational effectiveness and challenges - were identified and organized.

Table 1 lists the subthemes and some of the raw data. **The first main theme** is “Educational Effectiveness of Combining VR Learning Content and Group Discussions.” The four aspects of educational effectiveness identified were as follows: Opportunities to reflect on patients' experiences and the ethical behavior of nurses, enhanced understanding of clinical sites that are typically inaccessible, opportunities to reflect on past experiences, and expansion and deepening of learning through group discussions.

The first subtheme: Opportunities to reflect on patients' experiences and the ethical behavior of nurses.

All participants said, “When I enter a hospital room, I can hear what they are talking about. I was surprised to hear it more than I expected.” “I was really bothered by the curtains swaying even a little and the clattering noise when they were carrying the cart. I also thought it was incredibly scary that the nurse or someone else would close the door without saying anything. I wished they would say something,” they said, describing their emotional experiences of surprise and confusion, in addition to referring to the environment in which it is difficult to maintain the privacy of patients in multi-bedrooms and the ethical considerations required of medical personnel in dealing with such patients.

The second subtheme: Enhanced understanding of clinical sites that are typically inaccessible.

Video content allows students to view scenes and situations they would not normally have access to. The 360-degree video further enhances this advantage as an experience of a space where the three-dimensional environment and sounds are simultaneously present, as

exemplified by one participant who said, “I cannot see (the shelter) in real life, so VR is a great tool to give depth to the image. I thought it would be great to use it so that kind of valuable experience could be relived.” Feedback from all participants suggested that it was possible to have a realistic simulated experience from the first- or third-person perspective.

The third subtheme: Opportunities to reflect on past experiences

One of the study participants commented, “When I was on site, I was so busy with my own work that I did not realize that my voice was echoing when I was talking with patients. So I went to the site after I saw this VR video and realized it, and was able to be very aware of it. Conversely, I also tried to see how well I could hear other patients talking in the same room to adjust my own volume,” suggesting that they gained new insights from their past practical training experiences and used them in subsequent onsite training. The VR study provided an opportunity to view the patient care environment in advance, which helped prepare the students for knowledge and attitude for future onsite training.

The fourth subtheme: Expansion and deepening of learning through group discussions

In the combined VR and group discussion learning interventions, the program was structured to share opinions and impressions within the group after viewing the 360-degree video. “I enjoyed seeing so many different opinions.” said one participant, summarizing the participants' input as a whole that the exposure to various ways of thinking was an opportunity for them to expand and deepen their own learning. All participants expressed such opinions. Conversely, there were opinions that the participants were hesitant to express as they were different from what the other group members thought, and thus, were unable to share their thoughts within the group, which made them feel that the group discussion was insufficient.

Table 2 lists the subthemes and some of the raw data. **The second main theme:** “Challenges in education combining VR learning content and group discussions.” The two main challenges identified were as follows: The need to examine introductions and devices to enhance learning effectiveness and VR sickness (increased discomfort due to images moving while the student remains stationary).

The first subtheme: The need to examine introductions and devices to enhance learning effectiveness.

Concerning impressions of learning using VR learning content, a participant remarked, “It was objective. It really felt like just me standing in a realistic video,” commenting that it remained a mere experience from a third-party perspective. Additionally, all participants expressed the need for more interactive learning where learners could explore, think independently, practice, and receive feedback. One participant commented, “If we could have conversations, it might also create a sense of tension similar to what we experience in real practice.”

Furthermore, although VR learning content can be expected to deepen students' understanding by viewing clinical sites that are normally difficult to access, prior understanding of the structure and function of clinical sites does not necessarily mean that students will have the

opportunity to come into contact with the clinical site they viewed, as exemplified by a participant's comment, "I cannot usually see, people being sent to an intensive care unit (ICU) or operating room, or something like that, and so on the contrary, it is not as if that was a learning experience that they could apply onsite." They stated that the reality of learning is that difficult to build up as a learning experience, saying, "I just deepened my knowledge and insight."

The second subtheme: VR sickness (increased discomfort due to images moving while the student remains stationary)

A research participant who had difficulty with sickness while viewing VR said the following about his experience, "It is sick that I am not moving, but the images are moving. It would be fine if I could walk and go there too, but it is so nauseating to control it with this on the controller and have myself go forward."

Table (1): Educational effectiveness of combining VR learning content and group discussions. (The representative codes are presented following the subtheme.)

The first subtheme: Educational Effectiveness of Combining VR Learning Content and Group Discussions

- "I can hear you when I enter the hospital room, like what you are saying. Even if you are doing elimination care behind the curtains. I can hear the sound of water or something. I was surprised that I could hear more than I thought I would." (Participant A recalled the time when they experienced onsite training after on-campus training using VR).
- "When the nurse was doing elimination care, she was like, 'Oh, I think this might be leaked.' to my patient. That means they could hear that too, in full. That is not good." (Participant B; recalling the time when they experienced onsite practice after on-campus exercises using VR).
- "I actually tried sleeping like that, and the slight swaying of the curtains bothered me a lot, as well as the clattering sound of the cart being carried. I also thought it was incredibly scary that the nurse or someone else would close the curtains silently. I wished they would let me know. They close it without saying a word." (Participant C recounting their own on-campus exercise experience).
- "Young people may find it harder to think about (the support they need). They may be lonely (at the evacuation shelters), or they may be using their cell phones but not keeping in touch." (Participant D; about the exercise using VR after attending the lecture on disaster nursing).
- "Homeless people are no exception; they all panic when a disaster happens. So, I did think that when they lose their place and a stranger comes by, it is normal that they will say, 'What the heck?'" (Participant E; about the exercise using VR after attending a lecture on disaster nursing).

The second subtheme: Enhanced understanding of clinical sites that are typically inaccessible

- "The night shift was interesting, but I did not realize it was that quiet." (Participant B).
- "It was darker than I thought it would be (so it was scary)." (Participant C).
- "I had no experience at all, and I really thought, 'Oh, this is what it is like.' It was quite a shock to me to see what a bustling place it was, and to see people's lives so vividly as if it were their own home made me wonder about their privacy. I now understand why you said it is important to know where to go for shelter in the Shelter Management Game during the exercise." (Participant E).
- "I cannot see (an actual shelter), and VR is intended as a teaching tool to see it. I thought it would be great to use it for that kind of valuable experience, like reliving it." (Participant D).

The third subtheme: Opportunities to reflect on past experiences

- "When I went to the field, I was so occupied with myself that I did not realize that my voice resonated unexpectedly when I talked with patients. So, I went to the site after I saw this VR video and realized it, and I was able to become very aware of it. I would also try to hear what other patients in the same room said to see how my voice sounded. When I was a first-year student, I was assigned to a patient with hearing loss. So, as soon as I remembered that I was talking very loudly, I got scared. I thought it was bad, and when I went to the actual field, I could tell which nurse came just from how they walked. I could tell by hearing their footsteps" (Participant A).
- "It would be a pretty normal voice, but it sounded normal when you saw it in VR, like the meaning of curtains. You may not be able to see them, but you can hear their voices really well. I have to think about my language when I realize how little privacy there is. Things like 'How is your bowel movement?' and 'I guess you have not had any?' can be heard, too?" (Participant B).

The fourth subtheme: Expansion and deepening of learning through group discussions

- "What left a strong impression on me was the blood collection. The nurse frequently talked to the patient to ensure they did not become anxious. I thought it would be scarier to be silent, so I told the group that I was glad I did not have to be silent, but everyone else said it was actually oppressive and scary. So, I realized I had a different opinion from others, and I thought that was pretty interesting because I noticed that afterward, in the exchange of opinions, that some people had the same opinion as me and others did not." (Participant A).
 - "I enjoyed hearing so many different opinions. We can discuss things closely within the group, and then we can exchange ideas on a group-by-group basis so that you can hear the opinions of everyone in the classroom at the end. That was nice." (Participant B).
 - I thought, "Homeless people, everyone said it was pretty annoying, but I am glad they evacuated properly, and I also wanted to have a discussion with group members." (Seeking consent from Participant D).
 - "That was pretty different, wasn't it, member's opinion?" (Participant E).
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Table (2): Challenges of teaching combining VR learning content and group discussions. (The representative codes are presented following the subtheme.)

The first subtheme: The need to examine introductions and devices to enhance learning effectiveness
- <i>“Like the eye of God. It is just that they are there. Things move along unobtrusively.” “Being able to have a conversation would create a sense of tension in clinical settings. A real conversation does not wait for us because it would become silent if I did not speak up. It would be great if VR could provide the same experience to get us to use our heads quickly and keep up with the tempo, something we feel with all our senses, with our sixth sense.”</i> (Participant B).
- <i>“It felt objective. Really, it is like I am just standing there in a real video. I did not really feel that I had provided much nursing care. Would it be better if the patient's reactions varied a bit more depending on the plans I came up with? Because in clinical practice, there are many things to do, like simultaneously while doing something else.”</i> (Participant A).
- <i>“At the beginning of the class, we learned about evacuation goods to take to an evacuation center. Did not just watch; it might be pretty fun to have the group do a quiz, focusing on just one person, to see if that evacuee has it right or if anything is missing.”</i> (Participant E).
- <i>“I saw things I would not normally see, such as going to the night shift, the ICU, and being sent to the operating room. Did it actually help us gain knowledge that we could use in clinical settings? Not really. Just something like ‘Oh.’”</i> (Participant B).
The second subtheme: VR sickness (increased discomfort due to images moving while the student remains stationary)
- <i>“I am not moving, but the video is moving; it is sickening. So that movement is fine if I can walk and get there, too, but it is so darn intoxicating to control it with this thing on the controller and have myself go on.”</i> (Participant A).
- <i>“It is nauseating, isn't it? I think for some people, it could be really bad. It made me want to walk. If you change that, you should have people stand in the hall or at the four corners and say, 'You can walk as much as you want within this square,' so they can move around to some extent.”</i> (Participant B).

6. Discussion

Based on the feedback on the education combining VR learning content and group discussions obtained via FGI from three second-year undergraduate students who participated in the nursing practical training and two second-year undergraduate students who participated in the disaster nursing practicum course, the learning effects compared to onsite learning and the implications for future educational methods will be discussed in the following sections. This study aimed to elucidate how undergraduate nursing students perceive the effectiveness of education that combines VR learning content with group discussions.

Learning effects of education combining VR learning content and group discussions compared to onsite learning: The opportunity to view simulated patients' living environment and nurses' actions using VR made the learners think about the patient's experience in medical care and the ethical behavior of nurses, including nursing care and how to behave about the patient. Experience of slipping into places that are normally inaccessible, like an invisible person. The simulated experience, which is generally considered a feature of VR, led to an understanding of the clinical site that is normally inaccessible for the learners. Viewing places and situations that are difficult to experience during onsite learning, such as night shifts and evacuation centers, made a strong impression on the learners and increased their interest in nursing. With VR, in addition to simultaneously receiving information from the visual and auditory senses, it is possible to visit the site with the sensation of entering a three-dimensional screen (subtheme 2), as exemplified by a participant's comment, “It was quite a shock to me to see what a bustling place it was, and to see people's lives so vividly as if it were their own home.”

Previous studies have shown that the interactivity and immersion of VR make it more memorable than traditional

educational methods (Saab et al., 2022). Nursing students were able to build confidence by providing a safe environment through VR, which allows for trial and error in ways that are not possible with actual patients (Saab et al., 2021). Thus, VR makes it easier to immerse oneself in an unknown place or situation than with a still image or video recording, and it is possible to safely enter and observe as if one were invisible without affecting the scene.

Conversely, in onsite learning, since the patient is the subject of care and the nurse is the instructor and evaluator, the learner is considered to be learning in a constantly tense and anxious environment. According to the MHLW (2011), the current situation and challenges in nursing education include the following: It takes a certain amount of time for students to adapt to new training sites, lack of time to think and learn independently because of the extensive curriculum, and difficulty in securing learning experience opportunities that meet their objectives due to shorter patient stays in the hospital. Under the current circumstances, it is a challenging experience for learners to openly and critically express their opinions about what they feel through their experiences and to think independently, especially in the context of individualized and valuable experiential learning. It is believed that the ability to provide opportunities for learners to experience the situation without feeling tense or threatened, freely express their impressions and observations, and improve their learning experiences through sharing. Also, repetition is an advantage of learning using VR learning content.

Awareness of diverse perspectives, including those of supporters and recipients' individuals: Video recordings and demonstrations used as teaching materials for technical educational purposes make it easy to focus on the perspective of the nurse, the individual performing medical care. However, since VR contents can be viewed from the patient's and the nurse's perspectives, it is possible to simulate the

experience of a patient undergoing treatment and to learn by observing the nurse's involvement, which will enable thinking with a feeling closer to practice. Therefore, the opportunity to reflect on previous experiences as they were recalled was experienced from viewing the VR learning content, such that some participants developed a deeper understanding and thoughts about the impact on not only the patients they received but also on the patients in the same room, which led to their subsequent actions in the onsite training. This point is an effect of increasing readiness for onsite training, which was one of the initial aims of the program.

Previous studies have reported that nursing students can use VR to put themselves in the patient's shoes (Saab *et al.*, 2021), and in Japan, the effect of first-person experiences of dementia on nursing students' attitudes toward dementia patients (Suzuki *et al.*, 2023) have been studied; however, there have been no reports on the effectiveness of learning from the perspective of consideration for patients in the same room. This finding suggests that simulating patients' living conditions in multi-bedrooms effectively prompts consideration of nursing from both individual and holistic perspectives. Although lectures and on-campus exercises address considerations for patients with hearing loss, it is crucial to understand the impact on patient privacy and surrounding noise in real medical settings. The students' insights from this study are valuable for developing the appropriate attitudes to interact with patients during clinical training. Additionally, using VR can enhance students' preparedness for professional conduct.

Learning support intended to transition from ideas to connections and extensions: The rich insights gained by individual learners from the VR learning content were further enhanced through group discussions, which expanded and deepened their learning. All participants noted that opportunities to explore different perspectives and interpretations during group discussions were particularly valuable. For example, after watching a scene where a nurse takes a blood sample, one participant commented, "I thought it was nice that the nurse talked a lot to the patient, but another person said it felt overwhelming and scary. Even though we watched the same scene, our impressions were different." This experience was noted as enriching and insightful.

According to *Active Learning Lab* (2014), in terms of the ICE (Ideas, Connections, Extensions) approach, which is an evaluation and learning method for developing critical thinking skills, opinions, and awareness (ideas) in the VR learning content, were reconstructed (connections) in group discussions. Some learners were expanded (extensions) through actual onsite learning. A previous study conducted by Liu *et al.* (2023) reported no significant impact on critical thinking skills was identified in VR-based learning compared to traditional learning. However, education to improve readiness for clinical training needs to emphasize learning support intended to transition from ideas to connections and extensions, and it is believed that the combination of group discussions as one educational method can be expected to have the effect of cultivating critical thinking skills through the sharing of realizations and

deepening of meaning among learners.

Implications for future educational methods: In light of the objectives of nursing practice in the *MEXT's* (2020) Guidelines for Nursing Practice, it believes that the use of VR learning content will have the effect of deepening students' understanding of the diverse realities of patients as they unfold in diverse settings by reproducing realistic clinical situations and will enable the students to reflect on the concept and challenges of nursing from the perspective of the patient and of ethical aspects through experiencing the nurses' interactions.

From the FGI, the investigation of introducing and devising mechanisms to enhance the effectiveness of learning and VR sickness while viewing the VR learning content were identified as issues in learning with VR. Regarding VR sickness, it supported the findings of Choi *et al.*'s systematic review on the effectiveness and challenges of immersive VR in nursing education (Choi *et al.*, 2021). The need for interactive learning in which learners explore and think by themselves to obtain the patient's response through VR viewing and the increase in VR sickness caused by the gap between moving images and immobile learners are aspects that can be focused on to improve the quality of VR materials and educational programs in the future.

In the future, it is believed that it is necessary to aim for more interactive learning content by devising content and functions that enable proactive participation, such as reproducing realistic clinical situations and incorporating everything from intervention to reaction to the situation. Additionally, to take advantage of the features of VR learning, which helps understand scenes and situations that are difficult to experience during non-disaster times from various perspectives, increase understanding of the subject, and devise necessary nursing assistance from the immersive and realistic feeling of using a headset, it is necessary to introduce mechanisms and devise tools that lead to a common understanding of learning goals and encourage a proactive learning experience among learners. Furthermore, to develop critical thinking skills, considered an advanced challenge in VR learning, it is necessary to emphasize the role of the facilitator in drawing out diverse opinions from the learners during the group discussions and creating opportunities for multifaceted learning.

7. Conclusion

The learners' opinions from the FGI revealed the benefits and challenges of education by combining VR learning content and group discussions. The use of the VR learning content provided an opportunity to think about the experiences of patients undergoing treatment and the ethical behavior of nurses to promote the understanding of clinical sites, which are normally inaccessible, and to reflect on previous experiences by recalling them.

The program also facilitated broadening and deepening learning during group discussions following viewing the VR learning content. It is believed that the introduction of the VR learning content had the effect of reconstructing students' knowledge and understanding through opinions and realizations based on emotional experiences of diverse perspectives and sensibilities that differ between students in

the scenes and situations that are reconstructed three-dimensionally, which is a characteristic of VR.

Conversely, the need to consider how to introduce and design mechanisms to enhance learning effectiveness and address VR sickness became evident as issues in education combining VR learning content with group discussions. One effective approach to fostering critical thinking skills is incorporating group work into VR educational programs. However, when using VR in educational content, it is necessary to devise methods, such as conversational strategies, to create an interactive learning experience. Additionally, conducting longitudinal studies on how learning acquired through VR can be applied in actual clinical practice could help develop educational methods that align VR learning content more closely with practical training.

8. Recommendations

An effective educational method for fostering critical thinking skills is to incorporate group work into VR-based educational programs. In group work, facilitators are crucial in supporting students' freedom to express their insights and learning, which is essential for reconstructing knowledge and meaning. Simulated experiences of patient life in multi-bedrooms can offer opportunities to consider ethical behavior from the patient's perspective and the impact on the surrounding environment. However, strategies must be devised when using VR in education to ensure learners have an interactive and engaging learning experience.

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