science, engineering and health studies

Research Article

Science, Engineering and Health Studies
https://lio1.tci-thaijo.org/index.php/sehs
ISSN (Online): 2630-0087

Optimizing learning experience in mental-health nursing education using virtual reality simulation with 360-degree video

Youngho Lee[1], Sun Kyung Kim[2] and Mi Hyun Park[3]*

[1] Department of Computer Engineering, Mokpo National University, Jeollanam-do 58554, Republic of Korea
[2] Department of Nursing, and Department of Biomedicine, Health and Life Convergence Sciences, Biomedical and Healthcare Research Institute, Mokpo National University, Jeollanam-do 58554, Republic of Korea
[3] Department of Nursing, Pohang University, Gyeongbuk 37673, Republic of Korea

***Corresponding author**:
Sun Kyung Kim
skkim@mokpo.ac.kr

***Received**: 19 November 2021*
***Revised**: 22 June 2022*
***Accepted**: 18 July 2022*
***Published**: 29 November 2022*

***Citation**:
Lee, Y., Kim, S. K., and Park, M. H. (2022). Optimizing learning experience in mental-health nursing education using virtual reality simulation with 360-degree video. Science, Engineering and Health Studies, 16, 22050016.

ABSTRACT

Virtual reality (VR) simulation can produce high-realism experiences that pose great potential for producing beneficial outcomes in mental-health nursing education. We conducted a pre- and post-test control group design and used a convenience sample of nursing students (n = 104). VR simulation, over 2 weeks using 360-degree video and a head-mounted device (HMD) were applied. Knowledge and problem-solving abilities prior to and at the simulation intervention's completion were measured. Learning satisfaction were also assessed. The results were compared against a control group using 2D video clips. There were knowledge improvements from those who completed the 2-week simulation program in both groups. In terms of problem-solving ability, improved areas varied according to those in the 360-degree video VR simulation group, which showed statistically significant decision-making, solution-applying, and evaluation-reflection improvement. The group using 2D video clips showed no statistically significant improvement in problem-solving ability. There was a statistically significant difference in the level of learning satisfaction in the VR simulation group. Significant improvement in knowledge acquisition and problem-solving ability among undergraduate nursing students was achieved through VR simulation. Providing a real-like experience with VR simulation produces more active engagement in learning activities, which ultimately leads to learning satisfaction.

Keywords: virtual reality; 360-degree video; head mounted device; mental health nursing; simulation

1. INTRODUCTION

The demand for mental healthcare has increased worldwide; one out of ten adults lives with mental illness, which causes tremendous economic burden (Brown, 2022; Ritchie and Roser, 2018). Mental disorders are characterized as dysfunctions of mood, thoughts, and behaviors, resulting in not only the deterioration of patients' personal health but also social problems. Thus, individuals with mental disorders are often viewed negatively and regarded as dangerous, unpredictable, and violent (Delahunt-Smoleniec and Smith-Merry, 2020). This negativity and stigma toward mentally ill patients are also problematic in nursing education (Chang et al., 2017; Choi and Byun, 2020). Findings from previous investigations revealed that few students intend to work in mental healthcare settings and do not believe they are prepared to work for mentally ill patients even after clinical placement during nursing courses (Lim et al., 2020). The current observation-based clinical placements, however, would not ease the stigma and fear of individuals with mental-health disorders (Kim and Kim, 2014; Lee, 2019). A strong educational foundation with quality educational resources is necessary for undergraduate nursing education to assist students in their readiness for mental-health nursing care (Bingham and O'Brien, 2018; Lee et al., 2021).

Simulation is an effective educational methodology as an alternative to conventional observation-predominant clinical placement, providing a safe and supportive learning environment to foster the best learning outcomes. As simulation is defined as an active learning method, students can practice clinical decision-making by re-enacting possible clinical situations (Fay-Hillier et al., 2012; Lee and Ryu, 2021). Having clinical experience via simulation, students practice recognizing patients' problems by inducing active participation in the problem-solving process. Students can implement their skills and knowledge up to their capacity, applying their critical-thinking and decision-making skills for the best possible quality of nursing care (Kim et al., 2021; Liaw et al., 2010).

Within the simulation environment, students can link theory to clinical practice, therefore developing the ability to apply integrated judgment and thinking skills, ensuring patient safety and quality care (Dix et al., 2021; Hur and Roh, 2013; McCaughey and Traynor, 2010). Educational strategies to establish students' problem-solving abilities are essential to properly conduct their clinical practice. Applying educational strategies to students' learning experiences ensures they achieve the proper problem-solving ability to respond to challenges they encounter during the simulation (Simanjuntak et al., 2021). Thus, nursing faculties must develop diverse educational strategies to optimize learning experiences for future healthcare providers.

Various methods are used in mental-health nursing education, such as video clips, role plays, and standardized patients (SPs). SPs, in particular, prefer trained people to simulate patients with medical or disease conditions in an accurate and consistent manner. The SP simulation allows students to experience the interaction between nurses and patients in clinical settings, with the opportunity to provide nursing intervention wherever applicable. Because this simulation provides the opportunity of real-like interaction with mentally ill patients, previous studies reported high learning satisfaction, which motivated active learning (Stephen et al., 2022; Goh et al., 2016). In addition, previous studies have reported that this learning experience effectively lowers levels of anxiety and stigma, enabling students to lower their emotional barriers towards mentally ill patients (Alexander et al., 2018; Goh et al., 2016).

Technology development has facilitated a more engaging educational method. VR creates learning opportunities for undergraduate nursing students, allowing repetitive access to educational content. In addition, previous studies reported that students concentrate better on educational content (Casso et al., 2019) and see an improvement in recall accuracy for nursing skill training (Krokos et al., 2019). The barriers, including space restriction and lack of manpower, have been reduced, ameliorating learning environments with higher user satisfaction in nursing education (Kim et al., 2019; Krokos et al., 2019).

Recently, there has been a growing interest in VR technology in response to the high maturity and falling cost of hardware devices. As a viable technology for educational simulations, several simulation programs have developed from simple nursing-skill training to complex post-operative nursing simulation (Choi et al., 2022; Kim et al., 2019). There is another new emerging technology, 360-degree cameras, which enables users to experience the feeling of being present in a virtual world.

The virtual world provides users with enticing opportunities for real-like experiences, and previous reviews identified the superior outcomes of VR simulation compared to conventional methods (Rourke, 2020). The importance of learner motivation for successful learning environments was suggested by the self-determination theory (Ryan and Deci, 2000), which suggests that motivated behavior is associated with psychological satisfaction in learning and that VR simulation contributes to intrinsic motivation and engagement in the context of entertainment (Huang et al., 2019). The experiential-learning theory (Kolb and Kolb, 2009) empathizes learning from partaking in clinical events. VR simulation poses great potential as an educational platform, offering experiences of various events within a virtual environment. In addition, given the advantages of VR (i.e., no time or space restriction), VR simulation allows greater opportunities for clinical experience without endangering the patients or students.

Until now, 2D video has been widely used for understanding the signs and symptoms of psychiatric disorders among undergraduate students. With technological advancements, 360-degree video can provide a 3D experience with head-mounted displays (HMDs; Shafi et al., 2020). An HMD is a display system in the form of glasses that shows immersive content. HMDs are popular for medical applications in virtual and augmented reality (Rahman et al., 2020). Watching video in the 360-degree format allows users to experience a higher sense of presence and engagement as their view goes unrestricted and they can view every degree of the virtual world that was filmed with a 360-degree camera and an HMD (Vettehen et al., 2019). Users are likely to have a sense of presence within 360-degree video as it tracks head orientation, which allows them to be immersed in the virtual story. Traditional 2D video, on the other hand, provides a less immersive experience, as users can only view a partial aspect of the scene. The 2D video does not

provide changes in gaze direction using head tracking and cannot produce opportunities for user interactions.

Due to its infancy, few studies have evaluated VR simulations constructed with 360-degree video for their effectiveness in nursing education. The objective of this study was to examine the effectiveness of mental-health nursing using VR simulation on knowledge acquisition, problem-solving ability, and learning satisfaction with undergraduate nursing students.

2. MATERIALS AND METHODS

2.1 VR simulation using 360-degree video and HMDs

The VR simulation of patients with schizophrenia was developed by a team consisting of two nursing faculties and one mental-health nursing professional with 10 years of working experience in psychiatric units. The goal of this simulation was to improve the knowledge and ability of a nurse's problem-solving skills by providing a realistic experience of caring for schizophrenia patients using VR technology. The scenarios were developed for learners to identify problems and the best possible nursing interventions, as well as planning, prioritization, communication, and treatment options. Five different scenarios were developed from thorough consults with nurses in acute mental healthcare settings, including scenarios for the most problematic symptoms in patients with schizophrenia (Figure 1).

2.2 The VR environment for nursing care of patients with schizophrenia

The researcher designed this VR environment using a 360-degree camera (Gear360, 2018) and a VR HMD (Oculus Go; Yoo et al., 2020). One professional actor played the role of schizophrenia patients with problematic behaviors des-cribed in five scenarios. The VR environment included two rooms (a patient room and a space for communal use) in a 3D psychiatric ward. We selected the Oculus Go, a stand-alone device that provided an immersive VR display with one 3D controller. When participants wore the VR HMD, they stood in front of the 3D space for communal use. They could select one of the rooms, then a 360 video was played as shown in Figure 1.

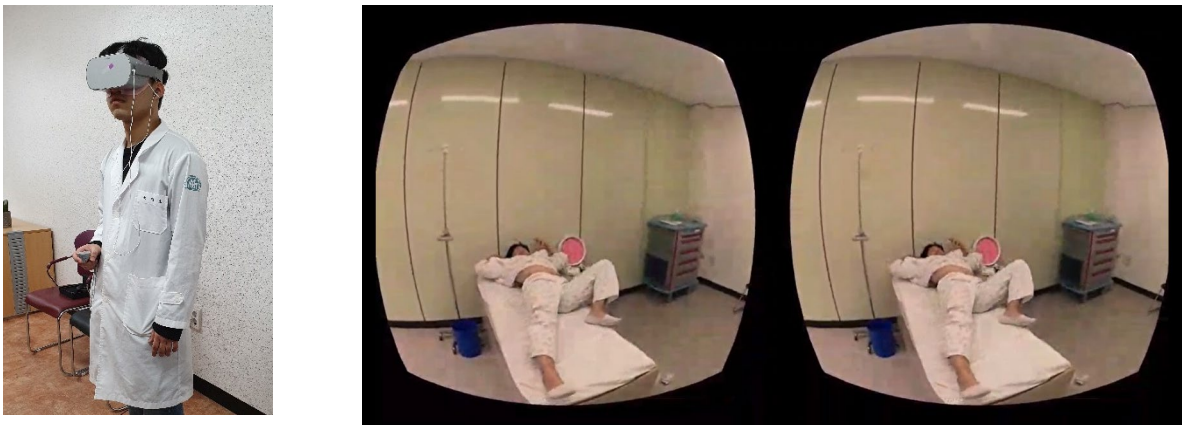

Figure 1. A student wore an HMD (left) and watched a 360-degree video (right)

2.3 Control group

The control group provided indirect experience of patients with schizophrenia using diverse 2D video clips from various sources of multimedia regarding disease-related symptoms. The 360-degree video clips were filmed by researchers based on five scenarios that were developed after thorough consultation of experts with mental health nursing. For the control group, 2D videos were searched and five clips containing similar content to scenarios developed for 360-degree videos were chosen (Table 1).

2.4 Participants and recruitment

One hundred and twenty undergraduate nursing students were recruited from two nursing schools (M and P universities) in Korea. Data accrued from September to December 2019 for the VR simulation group (M university) and May to July 2020 for the control group (P university) (Figure 2). Participation inclusion criteria were: (1) nursing students from a 4-year nursing school; (2) previous experience with clinical placement in psychiatric words; (3) the ability to handle an HMD and operate the simulation program; and (4) understanding the purpose of the present study and agreeing to participate (by signing a consent form). Participants consented to join the VR simulation training program and to evaluate its effectiveness using self-reporting questionnaires. Ethical approval was obtained from the institutional reviewed committee board of Mokpo National University in Korea (IRB No. MNUIRB-20190722-SB-005-02).

In this study, we used a pre- and post-test control group design. The experimental group participated in a 2-week educational program consisting of three sessions: schizophrenia disease study, case study, and VR simulation. The control group sourced 5 video clips regarding schizophrenia patients from various sources, including 1 TV drama, 1 movie, 1 documentary, and 2 educational videos produced by the National Center for Mental Health. Except for video clips, the control group used the same educational materials as the experimental group.

The experimental group was provided the opportunity to use VR simulation. During the 2-week educational program, a total of 3 h (1.5 h per week) were allocated for VR simulation. In each VR simulation session, a group of 7 to 8 students shared 5 HMDs.

Table 1. Educational contents: VR simulation vs video clip simulation

360-degree video in HMD	Length	Video clips for various source	Length
-Risk of violation Scene: Patients with impulsive and aggressive behavior	2 min 30 s	-Risk of violation and visual hallucination Source: National Center for Mental Health	5 min 51 s
-Auditory hallucination Scene: Patients with command hallucination	2 min 10 s	-Medication refusal Source: National Center for Mental Health	5 min 12 s
-Visual hallucination Scene: Patients scared from visual hallucination	2 min	-Delusion and visual hallucination Source: TV soap opera "It's okay, It's love"	3 min 44 s
-Delusion Scene: Patients having delusion of reference	2 min 15 s	-Medication refusal, risk of violation, delusion and visual hallucination Source: movie "Beautiful mind"	5 min 35 s
-Medication refusal Scene: Patients refuse taking medications	2 min 10 s	-Auditory hallucination and delusion Source: documentary film "We are having schizophrenia"	17 min 11 s

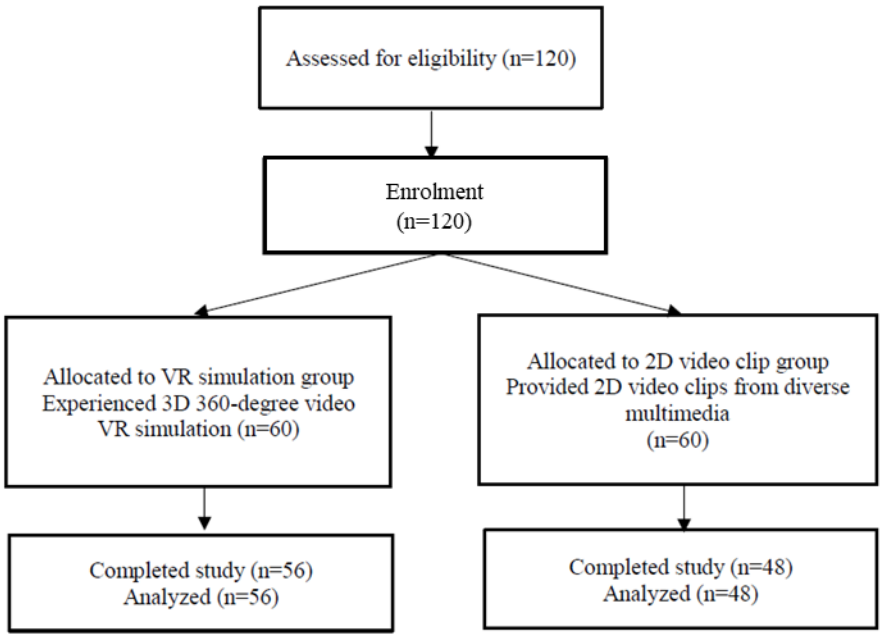

Figure 2. Study flow diagram

2.5 Instrument

2.5.1 Knowledge

Knowledge acquisition was assessed using 18 questions. Multiple choice questions (MCQs) were used to evaluate changes in knowledge that the questionnaire was validated by two faculties in mental health nursing. Figure 3 shows an example of MCQ. Considering the current simulation program's education, the contents were revised from the existing questionnaire developed by Seo (Seo and Kim, 2020). The minimum and maximum scores for each question were 0 and 18, respectively; the higher score indicated a higher level of knowledge.

"A nurse was interviewing a psychiatric patient. During the interview, he showed various physical symptoms such as tilting his head to the side, stopping talking, and intentional listening. What may this patient be experiencing?"

- a body delusion
- nervous confusion
- auditory hallucination
- pseudo parkinsonism

Figure 3. An example of multiple choice question

2.5.2 Problem solving

A 30-item questionnaire (Lee et al., 2008) was used to evaluated the students' problem-solving abilities. The tool consisted of five factors, including clarifying problems, seeking a solution, decision-making, applying solutions, and evaluating and reflecting. Using a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree), the minimum and maximum scores totaled 150. Higher scores indicated better problem-solving ability.

2.5.3 Learning satisfaction

Satisfaction levels of this simulation program were assessed with a 9-item questionnaire using a 5-point Likert scale (1 = strongly disagree; 5 = strongly agree). Developed by Kim and Ha (2020), we customized the questionnaire according to the present study's purpose. Items included: usefulness of learning experience (1 item), content satisfaction (4 items), and perceived program effectiveness (4 items). With a maximum score of 45, a higher score indicated a greater level of learning satisfaction.

2.6 Statistical analysis

SPSS (version 25) was used to statistically analyze the collected data. Frequency, percentage, mean, and standard deviation (SD) were calculated for demographical data. An x^2 and an independent t-test were performed to conduct a homogeneity test between groups. Knowledge acquisition and problem-solving ability of pre- and post-test (or between groups) were analyzed by performing a paired t-test. An independent t-test analyzed the comparison of learning satisfaction between groups.

3. RESULTS

3.1 General characteristics and homogeneity tests

The mean age of participants in experimental group and control group was 23.54±1.21 and 25.92±6.04, respectively. About 42.9% of participants in the experimental group and 62.5% in the control group reported being satisfied with their previous clinical placement experience. With a maximum score of three, the competency score for communication was 2.18±0.58 and 2.15±0.51, respectively. A homogeneity test between groups was conducted, and the results showed a statistically significant difference between the VR simulation and video-clip groups in one variable of age (Table 2).

Table 2. General characteristics and homogeneity tests (n=104)

Variables	Experimental group (n=56) n (%) or M±SD	Control group (n=48) n (%) or M±SD	x^2/ *t*	*p*
Gender				
Male	12(22.6%)	7(14.6%)	0.81	0.368
Female	41(77.4%)	41(85.4%)		
Age	23.54±1.21	25.92±6.04	-2.57	0.013
Academic competence	2.04±0.57	1.96±0.62	0.66	0.508
Communication competence	2.18±0.58	2.15±0.51	0.31	0.760
Satisfaction on clinical placement				
Poor	1(1.7%)	0(0%)	4.53	0.104
Fair	31(55.4%)	18(37.5%)		
Good	24(42.9%)	30(62.5%)		

3.2 Knowledge acquisition

The video-clip groups showed a statistically significant improvement in knowledge where the participants' mean scores increased from 12.40±1.47 to 13.00±1.24. The experimental group's mean scores also increased from 13.61±1.84 to 14.04±1.76; however, the paired *t*-test results were not statistically significant (Table 2).

3.3 Problem solving ability

After a 2-week simulation intervention, the problem-solving scores increased in both groups, and the score changes for each subscale were greater in the experimental group. The 360-degree video VR simulation group showed a statistically significant improvement in decision-making ($p<0.05$), solution applying ($p<0.05$), and evaluation reflection ($p<0.05$). In the 2D video clip group, on the other hand, there was no variable with statistically significant improvement after the 2-week intervention ($p<0.05$) (Table 3).

3.4 Comparison of learning satisfaction

The learning satisfaction scores between groups were compared (Table 4). The overall scores for learning satisfaction were 39.80±5.76 in the experimental group and 28.54±15.79 in the control group. The results showed the learning satisfaction of 360-degree video VR simulation group participants was statistically significantly higher than that of the 2D video-clip control group overall ($p<0.001$) as well as for each examined item ($p<0.001$). The experimental group showed the highest score on the item "This program is new and effective, while the control group had the highest score on the item "My ability to communicate with schizophrenia patients and other colleagues improved". The intervention group had the lowest score on "My ability to communicate with schizophrenia patients and other colleagues improved". The control group revealed the least satisfaction with the items "It was a useful learning experience" and "The program used well organized learning materials".

Table 3. Comparison of knowledge and problem-solving ability between the experimental and control groups (n=104)

Variables	Group	Pre-test M±SD	Post-test M±SD	*t*	*p*
Knowledge	Experimental group	13.61±1.84	14.04±1.76	-1.69	0.096
	Control group	12.40±1.47	13.00±1.24	-2.82	0.007
Problem solving ability					
Clarification	Experimental group	23.54±2.52	24.52±3.58	-1.98	0.052
	Control group	24.92±2.73	25.73±3.07	-1.99	0.052
Searching for solution	Experimental group	23.43±2.88	24.34±3.58	-1.95	0.056
	Control group	24.67±3.68	25.50±3.27	-1.79	0.079
Decision making	Experimental group	19.18±3.02	20.05±2.81	-2.17	0.035
	Control group	20.48±3.24	21.27±3.11	-1.87	0.068
Solution applying	Experimental group	27.04±3.50	28.46±4.19	-2.74	0.008
	Control group	28.58±3.65	29.27±4.71	-1.30	0.199
Evaluation reflection	Experimental group	22.66±3.44	24.21±3.69	-3.14	0.003
	Control group	23.92±3.60	24.85±3.66	-1.70	0.095

Table 4. Comparison of learning satisfaction between the experimental and control groups

Factor	Experimental group M±SD	Control group M±SD	*t*(*p*)
1. It was a useful learning experience.	4.39±0.71	3.10±1.85	
2. My knowledge and nursing skills improved after this educational program.	4.38±0.75	3.25±1.76	
3. Educational goals of this program were well achieved.	4.38±0.73	3.13±1.72	
4. The program consisted of learning materials that were necessary for nursing care of schizophrenia patients.	4.48±0.79	3.17±1.86	
5. The program used well organized learning materials.	4.43±0.81	3.10±1.86	
6. The program was new and effective.	4.64±0.70	3.13±1.81	
7. My ability to communicate with schizophrenia patients and other colleagues improved.	4.27±0.80	3.27±1.70	
8. My ability to make nursing diagnosis for schizophrenia patients improved.	4.34±0.70	3.21±1.71	
9. The feedback obtained during the program was helpful.	4.50±0.74	3.19±1.89	
Total	39.80±5.76	28.54±15.79	4.682(<0.001)

4. DISCUSSION

This VR simulation was developed to provide a high-realism experience of caring for patients with schizophrenia. The simulation was composed of 360-degree video using HMD along with related tasks to improve theoretical knowledge and problem-solving abilities. In current nursing education, students are unable to experience therapeutic interaction within an observation-based clinical placement. In addition, conventional 2D video clips are limited in providing a real-like experience with a sense of presence. Given the advanced VR technology, nursing education could establish optimal learning environments, providing real-like virtual clinical experiences.

Regarding knowledge acquisition, there was no statistically significant improvement among the intervention group participants. On the other hand, students in the VR simulation group showed a statistically significant difference in learning satisfaction by reporting a greater level of satisfaction than those in the 2D video-clip control group. Understanding that learning satisfaction was associated with learning motivation and engagement (Walker et al., 2016) suggested the current VR simulation had a high potential to affect students' knowledge acquisition. Long-term use of VR technology with a diverse range of educational programs would ensure knowledge acquisition and promote student interest in nursing-care theory. Reflecting on the results of learning satisfaction, the perceived effectiveness of VR simulation on communication skills seemed less satisfactory. Thus, nursing facilities should develop additional educational strategies as therapeutic communication is key to quality care in mental-health nursing.

Two items regarding content satisfaction scored relatively higher than item 6, "This program is new and interesting," which showed the highest score (4.7 out of 5). This result indicated the positive responses of nursing students to new learning methods. This finding aligned with previous studies proving the effectiveness of innovative approaches for nursing education (Kim et al., 2019). Simulation education showed that integrated VR technology is preferable and expected to assist in obtaining high learning outcomes among nursing students (Foronda et al., 2016). Given the rapidly changing medical

environment, incorporating advanced technology would ensure nursing education optimization.

Interestingly, effects on problem-solving ability differed between groups. Students using 2D video clips showed no statistically significant improvement in problem-solving ability. Those receiving VR simulation education, however, showed a statistically significant improvement in decision making, solution applying, and evaluation reflection. One possible explanation for these results is the different levels of perceived presence in the clinical setting that students experienced during the two educational programs. Students within the VR simulation had real-like experiences and could focus on taking actions for interventions in the clinical situation they were experiencing. The findings could provide evidence of VR simulation enabling students to take action on the existing problems of virtual patients.

The control group students who received education using 2D video, on the other hand, were exposed to relatively diverse symptoms from diverse cases, which led students to engage in a theoretical study on schizophrenia. As a matter of fact, there was a statistically significant increase in knowledge improvement among the control group participants. The effectiveness of multimedia applications toward teaching is well established (Berk, 2009) so that the precise description of a situation can play a role in materials for case study (Kendal and Diug, 2017; Ta Park et al., 2019).

This study also proved the effectiveness of 2D video in knowledge acquisition and to a certain extent in problem solving. Video clips have been used in previous studies, largely for practicing mental status exams that depicted symptoms of mental illness (Martin et al., 2020; Selim and Dawood, 2015). The method successfully improved learning, showing that well-structured 2D video could provide opportunities for practical and meaningful experience. Although 2D video is less likely to deliver realism, the video content has great potential to support faculties to enhance effective teaching.

This study showed significantly lower levels of students' learning satisfaction among students in the 2D video-clips group, compared to those in the 360-degree VR simulation group. It implied students' desire for ground-breaking learning materials rather than conventional education. In addition, 2D video clips had clear restrictions in producing feelings of presence, so that students perceived themselves as observers, not care providers. Recently, the need for learning experiences that convey high realism with the increased complexity of clinical settings has been increasing (Choi et al., 2016). This increasing need is a reason for the high demand for mental-health nursing simulation with SP, which is recognized as an effective method in providing authentic and realistic student experiences (Øgård-Repål et al., 2018; Yong-Shian et al., 2016). The potential for 360-degree video to replace current SP-based simulation is high, and reputative self-practice with HMDs would more likely improve students' confidence in nursing mentally ill patients.

There were several limitations of this study. One limitation is that the homogeneity between the experimental and control groups was not achieved in some variables. In addition, the attrition rate was much higher in the 2D video group, which could affect the study results. Participants were recruited using convenience sampling from only two universities in Korea; therefore, a certain degree of caution is required to generalize our findings. A self-reported questionnaire was used, which could affect the validity of the study's outcomes. Second, because this study involved pre- and post-test methodology, testing effects may have influenced the follow-up test results (participants scored better on the second test in terms of examining knowledge acquisition). Lastly, the relatively small sample size for this contrast test did not provide sufficient explanation. Recently, there has been general doubt regarding *p*-values; thus, people attempting to interpret the findings of this study should be used with caution.

5. CONCLUSION

This study found preliminary evidence of several potential effects of VR simulations on mental-health nursing education to improve knowledge acquisition and problem-solving abilities and achieve high levels of learning satisfaction among undergraduate nursing students. Although 2D video could effectively deliver information for knowledge construction, the level of learning satisfaction was lower due to its deficiency in reenacting clinical experiences. The VR simulation with 360-degree video produced better real-like experiences, and the newly introduced technology attracted students to actively participate in learning activities. Given the demonstrated benefits to learning outcomes, it is believed that VR simulation induced motivational learning behavior with a great sense of presence in providing real-like experiences. This study could also contribute to the educational field by suggesting VR simulation could bridge the gap between theoretical education and clinical practice with its high potential for providing practical learning with rehearsal opportunities prior to providing care for actual patients. Further studies with a robust design, such as randomized controlled trials, are warranted, especially for low volume and high-risk events, and VR simulation would provide the best learning opportunities for nursing education.

ACKNOWLEDGMENT

This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (MSIT) (No. NRF-2019R1G1A1006737).

REFERENCES

Alexander, L., Sheen, J., Rinehart, N., Hay, M., and Boyd, L. (2018). Mental health simulation with student nurses: a qualitative review. *Clinical Simulation in Nursing*, 14, 8-14.

Berk, R. A. (2009). Multimedia teaching with video clips: TV, movies, YouTube, and mtvU in the college classroom. *International Journal of Technology in Teaching and Learning*, 5(1), 1-21.

Bingham, H., and O'Brien, A. J. (2018). Educational intervention to decrease stigmatizing attitudes of undergraduate nurses towards people with mental illness. *International Journal of Mental Health Nursing*, 27(1), 311-319.

Brown, P. (2022). Mental health care and social policy. In *The De Facto US Mental Health Services System: A Public Health Perspective*. (Regier, D. A., Goldberg, I. D., and Taube, C. A., eds.), pp. 105-126. London: Routledge.

Casso, G., Schoettker, P., Savoldelli, G. L., Azzola, A., and Cassina, T. (2019). Development and initial evaluation of a novel, ultraportable, virtual reality bronchoscopy simulator: The computer airway simulation system. *Anesthesia* and *Analgesia*, 129(5), 1258-1264.

Chang, S., Ong, H. L., Seow, E., Chua, B. Y., Abdin, E., Samari, E., Teh, W. L., Chong, S. A., and Subramaniam, M. (2017). Stigma towards mental illness among medical and nursing students in Singapore: A cross-sectional study. *BMJ Open*, 7(12), e018099.

Choi, H., Hwang, B., Kim, S., Ko, H., Kim, S., and Kim, C. (2016). Clinical education in psychiatric mental health nursing: Overcoming current challenges. *Nurse Education Today*, 39, 109-115.

Choi, J., Thompson, C. E., Choi, J., Waddill, C. B., and Choi, S. (2022). Effectiveness of immersive virtual reality in nursing education: Systematic review. *Nurse Educator*, 47(3), E57-E61.

Choi, S. H., and Byun, E. K. (2020). The lived experiences of psychiatric nursing practice among nursing students. *The Journal of the Convergence on Culture Technology*, 6(4), 21-30.

Delahunt-Smoleniec, N., and Smith-Merry, J. (2020). A qualitative analysis of the portrayal of young people and psychosis in Australian news reports. *Journalism Practice*, 14(7), 847-862.

Dix, S., Morphet, J., Jones, T., Kiprillis, N., O'Halloran, M., Piper, K., and Innes, K. (2021). Perceptions of final year nursing students transer of clinical judgement skills from simulation to clinical practice: A qualitative study. *Nurse Education in Practice*, 56, 103218.

Fay-Hillier, T. M., Regan, R. V., and Gordon, M. G. (2012). Communication and patient safety in simulation for mental health nursing education. *Mental Health Nursing*, 33(11), 718-726.

Foronda, C. L., Shubeck, K., Swoboda, S. M., Hudson, K. W., Budhathoki, C., Sullivan, N., and Hu, X. (2016). Impact of virtual simulation to teach concepts of disaster triage. *Clinical Simulation in Nursing*, 12(4), 137-144.

Goh, Y. S., Selvarajan, S., Chng, M. L., Tan, C. S., and Yobas, P. (2016). Using standardized patients in enhancing undergraduate students' learning experience in mental health nursing. *Nurse Education Today*, 45, 167-172.

Huang, Y. C., Backman, S. J., Backman, K. F., McGuire, F. A., and Moore, D. (2019). An investigation of motivation and experience in virtual learning environments: A self-determination theory. *Education and Information Technologies*, 24, 591-611.

Hur, H. K., and Roh, Y. S. (2013). Effects of a simulation based clinical reasoning practice program on clinical competence in nursing students. *Korean Journal of Adult Nursing*, 25(5), 574-584.

Kendal, E., and Diug, B. (2017). An empirical study of student engagement with professional and ethical issues in medical television dramas. In *Teaching Medicine and Medical Ethics Using Popular Culture* (Kendal, E., and Diug, B., eds.), pp. 99-114. London: Palgrave Macmillan.

Kim, H. Y., Ma, H., and Lee, M. (2021). Effects of simulation-based practice and clinical practice for critical thinking disposition and nursing process confidence. *Journal of Digital Convergence*, 19(6), 399-408.

Kim, M., and Ha, J. (2020). Simulation-based education program on postpartum hemorrhage for nursing students. *Korean Journal of Women Health Nursing*, 26(1), 19-27.

Kim, S. K., Eom, M. R., and Park, M. H. (2019). Effects of nursing education using virtual reality: A systematic review. *The Journal of the Korea Contents Association*, 19(2), 661-670.

Kim, S. O., and Kim, H. S. (2014). Effects of psychiatric nursing practicum using simulated patients on self-directed learning readiness, learning self-efficacy, satisfaction of learning. *The Journal of the Korea Contents Association*, 14(2), 396-408.

Kolb, A. Y., and Kolb, D. A. (2009). Experiential learning theory: A dynamic, holistic approach to management learning, education and development. In *The SAGE and Book of Management Learning, Education and Development* (Armstrong, S. J., and Fukami, C. V., eds.), pp. 42-68. London: SAGE Publications.

Krokos, E., Plaisant, C., and Varshney, A. (2019). Virtual memory palaces: Immersion aids recall. *Virtual Reality*, 23, 1-15.

Lee, E. H., and Ryu, S. Y. (2021). Analysis of the virtual simulation practice and high fidelity simulation practice training experience of nursing students: A mixed-methods study. *The Journal of Korean Academic Society of Nursing Education*, 27(3), 227-239.

Lee, S. Y. (2019). Morl distress and ethical values of nursing students. *The Journal of the Convergence on Culture Technology*, 5(3), 119-124.

Lee, Y. S., Kim, J., Lim, J. Y., and Kim, G. M. (2021). Effect of psychiatric nursing practice online education using case-based VR. *Journal of Korean Academy of Psychiatric and Mental Health Nursing*, 30(4), 369-378.

Lee, W. S., Park, S. H., and Choi, E. Y. (2008). Development of a Korean problem solving process inventory for adults. *Journal of Korean Academy of Fundamentals of Nursing*, 15(4), 548-557.

Liaw, S. Y., Chen, F. G., Klainin, P., Brammer, J., O'Brien, A., and Samarasekera, D. D. (2010). Developing clinical competency in crisis event management: An integrated simulation problem-based learning activity. *Advances in Health Sciences Education*, 15, 403-413.

Lim, H. J., Moxham, L., Patterson, C., Perlman, D., Lopez, V., and Goh, Y. S. (2020). Students' mental health clinical placements, clinical confidence and stigma surrounding mental illness: A correlational study. *Nurse Education Today*, 84, 104219.

Martin, A., Krause, R., Jacobs, A., Chilton, J., and Amsalem, D. (2020). The mental status exam through video clips of simulated psychiatric patients: An online educational resource. *Academic Psychiatry*, 44, 179-183.

McCaughey, C. S., and Traynor, M. K. (2010). The role of simulation in nurse education. *Nurse Education Today*, 30(8), 827-832.

Øgård-Repål, A., De Presno, Å. K., and Fossum, M. (2018). Simulation with standardized patients to prepare undergraduate nursing students for mental health clinical practice: An integrative literature review. *Nurse Education Today*, 66, 149-157.

Rahman, R., Wood, M. E., Qian, L., Price, C. L., Johnson, A. A., and Osgood, G. M. (2020). Head-mounted display use in surgery: A systematic review. *Surgical Innovation*, 27(1), 88-100.

Ritchie, H., and Roser, M. (2018). *Mental health*. Our World in Data. [Online URL: https://ourworldindata.org/mental-health] accessed on August 15, 2020.

Rourke, S. (2020). How does virtual reality simulation compare to simulated practice in the acquisition of clinical psychomotor skills for pre-registration student nurses? A systematic review. *International Journal of Nursing Studies*, 102, 103466.

Ryan, R. M., and Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, 55(1), 68-78.

Selim, A. A., and Dawood, E. (2015). Objective structured video examination in psychiatric and mental health nursing: A learning and assessment method. *Journal of Nursing Education*, 54(2), 87-95.

Seo, D. H., and Kim, S. J. (2020). The effect and development of a simulation learning module based on schizophrenic patients care of nursing students. *Journal of Korean Academy of Psychiatric and Mental Health Nursing*, 29(2), 106-118.

Shafi, R., Shuai, W., and Younus, M. U. (2020). 360-degree video streaming: A survey of the state of the art. *Symmetry*, 12(9), 1491.

Simanjuntak, M. P., Hutahaean, J., Marpaung, N., and Ramadhani, D. (2021). Effectiveness of problem-based learning combined with computer simulation on students' problem-solving and creative thinking skills. *International Journal of Instruction*, 14(3), 519-534.

Stephen, T., King, K., Taylor, M., Jackson, M., and Hilario, C. (2022). A virtual, simulated code white for undergraduate nursing students. *Canadian Journal of Nursing Research*, 54(3), 320-330.

Ta Park, V. M., Olaisen, R. H., Vuong, Q., Rosas, L. G., and Cho, M. K. (2019). Using Korean dramas as a precision mental health education tool for Asian Americans: A pilot study. *International Journal of Environmental Research and Public Health*, 16(12), 2151.

Vettehen, P. H., Wiltink, D., Huiskamp, M., Schaap, G., and Ketelaar, P. (2019). Taking the full view: How viewers respond to 360-degree video news. *Computers in Human Behavior*, 91, 24-32.

Walker, S., Rossi, D., Anastasi, J., Gray-Ganter, G., and Tennent, R. (2016). Indicators of undergraduate nursing students' satisfaction with their learning journey: An integrative review. *Nurse Education Today*, 43, 40-48.

Yoo, S., Kim, S., and Lee, Y. (2020). Learning by doing: Evaluation of an educational VR application for the care of schizophrenic patients. In *Proceedings of the Extended Abstracts of the 2020 CHI Conference on Human Factors in Computing Systems*, pp. 1-6. Hawai, USA.