《 Original Article 》

Development and use of virtual reality video educational materials in clinical pharmacy education: a questionnaire-based feasibility study

Yoshihito Morimoto[1]*, Ken Yamamoto[1], Iori Hirosawa[1], Dan Kambayashi[1], Shinsuke Tajima[2], Yoko Kobayashi[2], Tadashi Yoshida[2], Kazuhiro Watanabe[1], Masayoshi Hirohara[1]

In recent years, there have been increased studies on the feasibility of virtual reality (VR) in simulation-based education in medical fields. This study aims to develop VR video educational materials for aspects of clinical pharmacy education such as drug dispensing and injection techniques, patient communication, and interviewing case patients in problem-based learning (PBL), and to clarify the materials' feasibility and satisfaction for pharmacy students. We created VR video educational materials by recording with a 360° camera and editing. After introducing these materials to fourth-year clinical pharmacy practicum and PBL, we conducted a questionnaire on their usefulness and satisfaction for fourth-year pharmacy students. Responses were received from 205 of 217 fourth-year pharmacy students (giving a 94.5% response rate). In response to the question "Do you think VR video educational materials are useful for clinical pharmacy education?", 193 students (94.1%) answered "I think they are very helpful" or "I think they are helpful." For the question "Did you experience motion sickness while watching VR video educational materials on a Meta Quest 2?", only 10 students (5.0%) and 31 students (15.3%) responded "I did" and "I did a little," respectively. The free response results included opinions such as "I can imagine actual procedures in VR" and "It is good to have a sense of reality." These evaluations by pharmacy students demonstrate the feasibility of developing and introducing VR video teaching materials for clinical pharmacy education.

Key words; feasibility of virtual reality, simulation education, pharmacy students, clinical pharmacy practicum, motion sickness

Received August 18, 2023; Accepted October 21, 2023

[1] Education and Research Center for Clinical Pharmacy, Showa Pharmaceutical University, 3-3165 Higashi-Tamagawagakuen, Machida, Tokyo 194-8543, Japan
[2] Department of Pharmacy, Kyorin University Hospital, 6-20-2 Shinkawa, Mitaka, Tokyo 181-8611, Japan
*Corresponding author: Yoshihito Morimoto, Ph.D., Education and Research Center for Clinical Pharmacy, Showa Pharmaceutical University, 3-3165 Higashi-Tamagawagakuen, Machida-shi, Tokyo 194-8543, Japan
Phone : +81 4 2721 1436 Fax : +81 4 2721 1539 E-mail : y-morimoto@ac.shoyaku.ac.jp

1. Introduction

Virtual reality (VR) is a technology that uses recorded or artificially generated images and sounds to produce a simulated environment that feels as if it were real. In immersive VR, viewers can watch first-person videos while freely changing their viewpoint, providing a simulated experience. In recent years, VR has been applied to simulation education and its feasibility has been reported[1,2]. VR is currently applied to simulation-based education for surgery and treatments in medical education[3-5]. It is also used as educational material for nursing simulations[6]. A systematic review showed that immersive VR improves learning and cognitive and psychomotor performance[7]. In a study comparing nurses using VR and conventional video for hand hygiene education, the VR group more effectively understood the importance of hand hygiene and better recalled their own practice[8].

In clinical pharmacy education, it is necessary to acquire the knowledge, skills, and attitudes necessary for pharmacists, such as drug dispensing and formulation, patient communication, and clinical judgment. Viewing immersive VR can be expected to lead to subsequent practice, as it allows the viewer to imagine actually performing the practice, rather than observing an instructor's model performance. In addition, simulated experiences allow pharmacists to obtain practical experience in the medical field. However, there are almost no reports on introducing VR educational materials into clinical pharmacy education. Further research is thus needed to understand the potential impact of VR on pharmacy education[9].

This study aimed to create VR video educational materials related to dispensing techniques and patient care in clinical pharmacy education and to clarify those materials' usefulness and satisfaction for pharmacy students in the Faculty of Pharmaceutical Sciences at Showa Pharmaceutical University.

2. Methods

1. Development of immersive VR video educational materials

VR videos were recorded using a 360° camera (Theta Z1, Ricoh) positioned to provide a first-person point of view. We edited the resulting video using video editing software (PowerDirector 19 Ultra, CyberLink), adding explanatory text and audio. This study implemented three VR video viewing methods. First, we uploaded the created VR video teaching materials to YouTube. This was a limited release, which students could view using a smartphone running the YouTube app in VR mode with a VR headset (VRG-GVSB01BK, ELECOM; Figure 1a, b). We also directly transferred video data to a VR headset (Meta Quest 2, Meta; Figure 1c) for viewing by students. The third method was to view VR video educational materials directly on a smartphone, tablet, or PC without using a VR headset.

2. Introducing VR video educational materials to practical training

2.1. Simulation of procedural techniques

For ointment preparation and aseptic preparation practice, we created and introduced VR video educational materials related to ointment preparation and aseptic preparation of staining drugs and eye drops. The materials were designed

to simulate in VR the aseptic preparation of staining drugs and eye drops in medical settings, which requires advanced techniques that cannot be learned in a university laboratory. This was a 160-min practical training session, with 60 students per session. The ointment dispensing materials showed a model performance by an instructor (viewing time, 5 min) (Figure 2a). In the VR video showing aseptic preparation, pharmacists from the pharmacy department of Kyorin University Hospital (Figure 2b) prepared staining drugs and eye drops aseptically on a clean bench. The prepared eye drops were dispensed into containers, reagents for staining drugs were dissolved and dispensed into ampoules, and the ampoules were heated and sealed. To give students the feeling of being in the formulation room of a hospital pharmacy department, we included not only scenes of preparation but also scenes with 360° views from various parts of the formulation room. The instructor gave a lecture on aseptic preparation in the hospital pharmacy preparation room and conducted a simulated experience (viewing time, 7 min). After viewing these VR simulations, the students prepared the ointment in the university's laboratory. Subtitles and audio commentary were added to the VR video to make it easier to understand. To view these materials, the students connected their smartphones to a VR headset and watched in the YouTube app's VR mode (Figure 2c).

For injection technique training, we created and

Figure 1 VR headset images.
(a) VR headset for smartphones. (b) A smartphone attached to a VR headset. (c) The Meta Quest 2 headset.

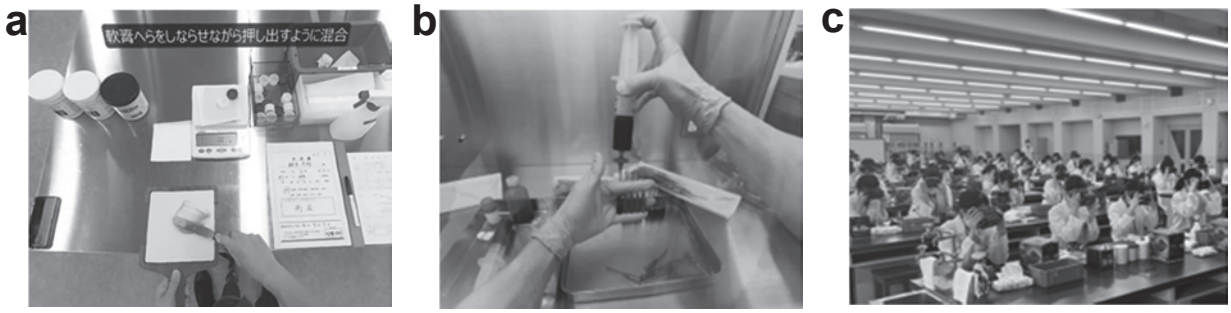

Figure 2 Images of VR video educational materials
(for ointment dispensing and aseptic preparation in the hospital pharmacy preparation room).
(a) Materials for ointment dispensing.
(b) Materials for aseptic preparation in the hospital pharmacy preparation room.
(c) Watching VR video educational materials during practice on a VR headset for smartphones.

introduced VR video educational materials on intramuscular injection techniques (Figure 3a) and how to deal with anaphylaxis after intramuscular injection of a vaccine (Figure 3b). We developed the intramuscular injection technique material by filming the technique being performed by a physician. In the material for managing anaphylaxis after intramuscular injection of a vaccine, we filmed the steps from the pharmacist's confirmation of vital signs to using an EpiPen for a patient experiencing anaphylaxis (Figure 3b). Subtitles and audio commentary were added to the VR video. This was a 60-min practical training session, with 36 students per session. We also showed a 30-min lecture on intramuscular injection and how to respond in the event of anaphylaxis following intramuscular injection of a vaccine. The students conducted a simulated experience using VR (viewing time, 3 min 20 sec) before the students actually practiced with an upper arm simulator and EpiPen kit. Students viewed this material using a Meta Quest 2 VR headset (Figure 3c).

2.2. On-demand VR video educational materials rations of research

We created VR video educational materials on injection preparation and patient communication (initial patient interview and patient medication instruction) by filming an instructor's model performance. The duration of the VR video educational materials is about 4 min each. Subtitles and audio commentary were added to the VR video. We posted the VR videos on YouTube for on-demand viewing, and students could watch them directly on their own devices (smartphones, PCs, tablets) at any time without using a VR headset.

2.3. Problem-based learning

As a problem-based learning (PBL) exercise, we created and introduced a VR video of an interview with a simulated patient in a hospital room. This was a male patient with lung cancer receiving pemetrexed + cisplatin combination therapy in the hospital. On the morning of the third day after administration, the patient could not eat due to nausea. The variety of potential factors causing nausea (opioids, constipation, anticipatory nausea, etc.) provided an opportunity for clinical reasoning about its cause. We thus videotaped a conversation where a faculty member, acting as a ward

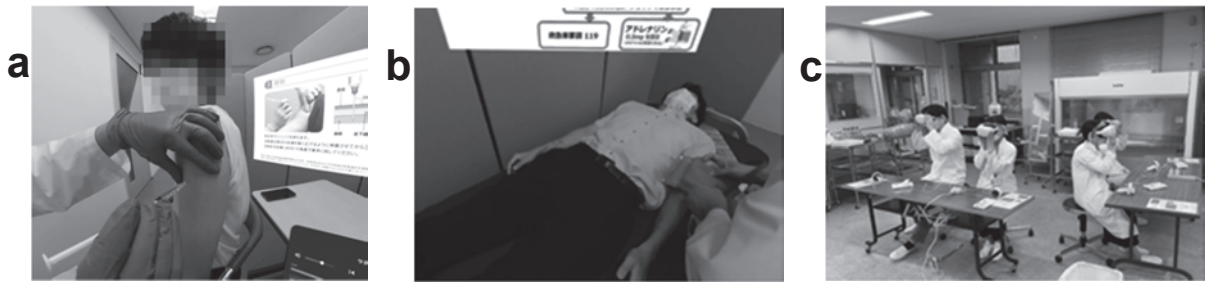

Figure 3 VR video educational materials for intramuscular injection techniques and management of anaphylaxis after intramuscular injection.

(a) Materials for intramuscular injection technique.
(b) Materials for management of anaphylaxis after intramuscular injection.
(c) Watching the developed materials on a Meta Quest 2 during practice.

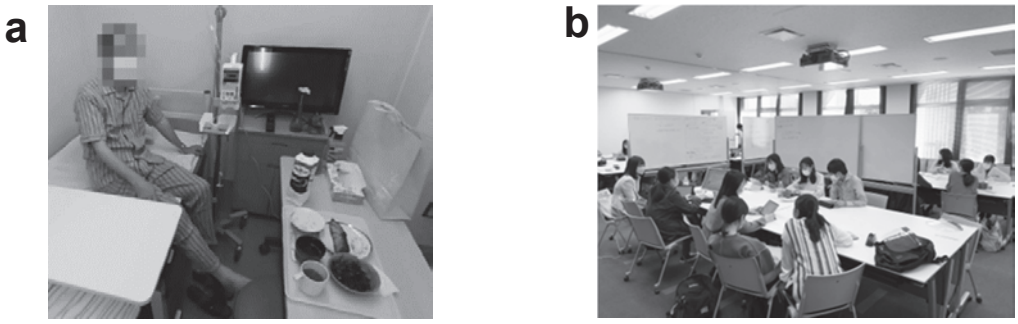

Figure 4 Introduction of VR video educational materials to PBL.
(a) Materials for interviewing a case patient in a hospital room for PBL. (b) Group discussion in PBL.

pharmacist, interviewed the patient in a model hospital room (Figure 4a). Viewing was on-demand, posted on YouTube and viewed directly from student devices (smartphones, PCs, or tablets) without using headsets. Students could watch the video as often as needed during the case study. The duration of the VR video educational material is 2 min.

The exercise included a 30-min case introduction, followed by 130-min discussions among groups of approximately eight students (Figure 4b). One week later, after an 80-min group discussion, there was a general presentation in the SOAP format followed by a 60-min post-lecture by faculty members. The post-lecture explained how to proceed to clinical reasoning and intervention as a pharmacist.

3. Questionnaire

We conducted a questionnaire on the usefulness and satisfaction of the created VR video educational materials for 217 fourth-year pharmacy students. Using the educational support system manaba ver. 2.971 (Asahi Net, Inc.), the questionnaire was posted online, the students were invited to participate, and their responses were collected. Each question was answered on a 5-point scale, with a final free-response question. Table 1 shows the questionnaire items. This survey was conducted after review by the ethics review committee at Showa Pharmaceutical University (2022-3).

3. Results

1. Number of valid responses

We received responses from 205 of 217 fourth-year pharmacy students, for a 94.5% response rate.

2. Usefulness of VR video educational materials

Figure 5a shows the responses to a question about the usefulness of VR video educational materials. In response to Q1 (“Do you think VR video educational materials are useful for clinical pharmacy education?”), 193 students (94.1%) reported finding the materials useful or very useful. In response to Q2 (“Did you experience a sense of realism when watching VR video educational materials with a VR headset?”), more than 80% of the students reported feeling a sense of presence. In response to question Q3 (“Do you think that publishing on YouTube to allow watching and reviewing at home is useful?”), 69.3% of students strongly agreed and 24.9% of students somewhat agreed. Similarly, more than 90% of students agreed with question Q4 (“Do you think it is useful to watch a simulated experience using VR video educational materials before actually practicing?”).

Table 1 Questionnaire items

Questions 1-9 were answered on a 5-point scale. 1. I think so very much 2. I think so 3. Neither 4. I don't think so 5. I dont think so at all	
Q1	Do you think VR video educational materials are useful for clinical pharmacy education?
Q2	Did you experience a sense of realism when watching VR video educational materials with a VR headset?
Q3	Do you think that publishing on YouTube to allow watching and reviewing at home is useful?
Q4	Do you think it is useful to watch a simulated experience using VR video educational materials just before actually practicing?
Q5	Was it easy to connect your smartphone to the VR headset?
Q6	Do you think the ointment dispensing VR video educational materials are useful?
Q7	Do you think in-hospital formulation VR video educational materials are useful?
Q8	Do you think the intramuscular vaccination VR video educational materials are useful?
Q9	Do you think the VR video educational materials for treating anaphylaxis after intramuscular injection are useful?
Questions 10-12 were only answered by those who have watched on-demand VR video educational materials and answered on a 5-point scale. 1. I think so very much 2. I think so 3. Neither 4. I don't think so 5. I don't think so at all	
Q10	If you watched the injection dispensing VR video educational materials: Do you think the materials were useful?
Q11	If you watched the first patient interview VR video educational materials: Do you think the materials were useful?
Q12	If you watched the medication guidance VR video educational materials: Do you think the materials were useful?
Questions 13-15 on PBL were answered on a 5-point scale. 1. I think so very much 2. I think so 3. Neither 4. I don't think so 5. I don't think so at all	
Q13	Were the VR video educational materials presenting the simulated patient meaningful for the case study?
Q14	Did the VR video educational materials presenting the simulated patient lead to an image of the patient's situation?
Q15	Do you think that VR video educational materials presenting patients are useful for developing a pharmacist's clinical reasoning (thinking process to clarify what is happening to the patient)?
Questions 16-18 on motion sickness in VR video educational materials were answered with the three options. 1. Yes 2. Only a little 3. No	
Q16	Did you feel motion sickness when watching VR video educational materials using the VR headset with an attached smartphone?
Q17	Did you get motion sickness when watching VR video educational materials on the Meta Quest 2?
Q18	Did you experience motion sickness when watching VR video educational materials directly on your smartphone (without using a VR headset)?
Questions 19-20 on VR video educational materials were answered with the options below.	
Q19	Which device do you think is the best for watching VR video educational materials? 1. Dedicated VR headset (Meta Quest 2) 2. Smartphone attached to a VR headset 3. Direct viewing on a smartphone 4. Direct viewing on a tablet 5. Direct viewing on a PC
Q20	Have you ever experienced VR before? 1. I own a VR headset and am accustomed to using VR 2. I do not have a VR headset, but I have experience with VR and am accustomed to it 3. I have experience with VR, but I am not used to it 4. This was my first time experiencing VR 5. Unsure
Q21	Please let us know if you have any comments or final impressions. (Free response)

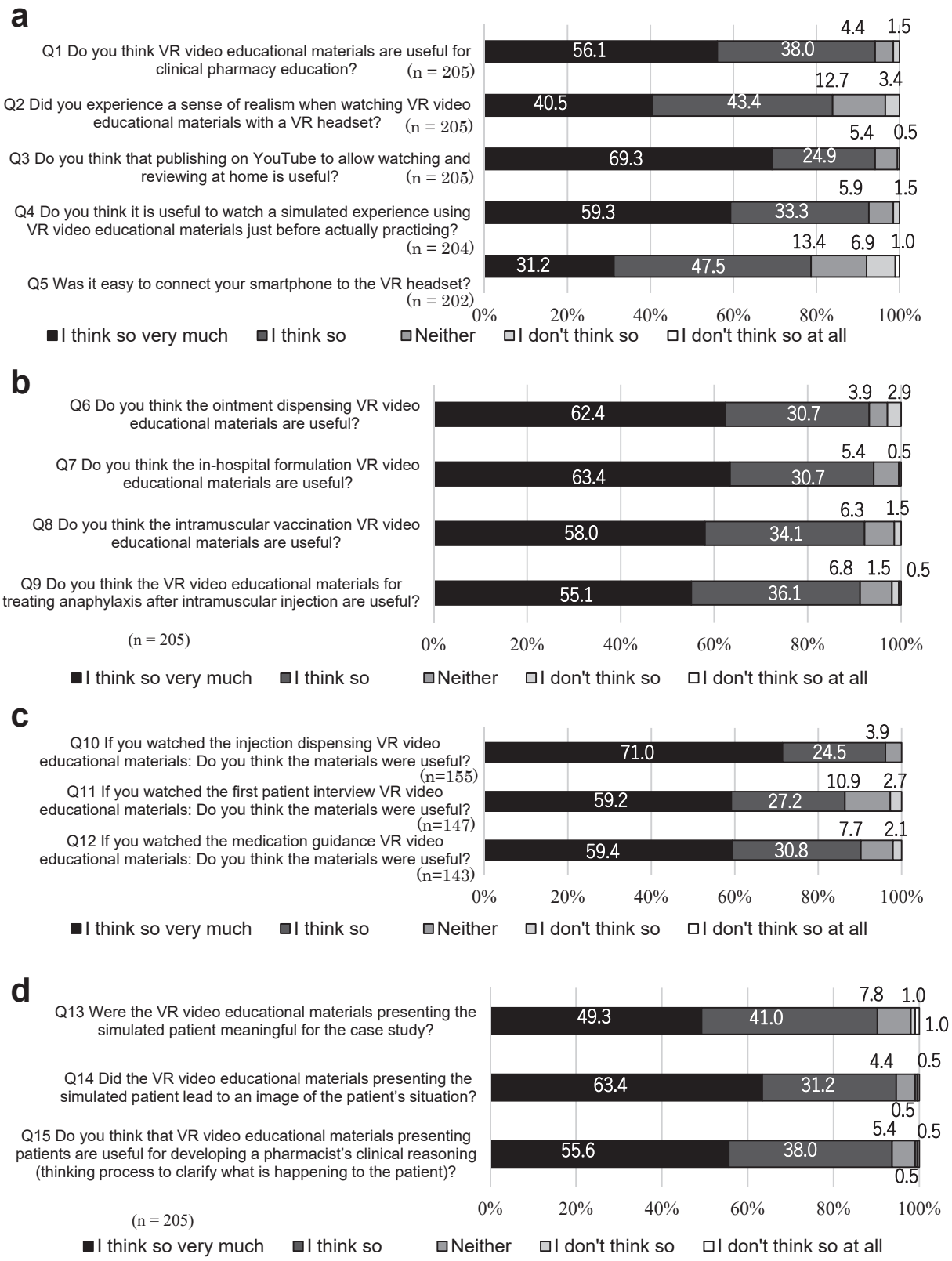

Figure 5 Questionnaire results on usefulness of the developed VR video educational materials.

(a) Usefulness of the materials (Q4, n = 204; Q5, n = 202; others, n = 205).
(b) Usefulness of each material (n = 205).
(c) On-demand materials (Q10, Q11, Q12: n = 155 (75.6%), 147 (71.7%), 143 (69.8%), respectively).
(d) PBL VR video educational materials (n = 205).

Smartphones must be accurately attached to a VR headset, and a tutorial explained in detail how to do so. We expected many students to find this difficult, but responses to Q5 ("Was it easy to connect your smartphone to the VR headset?") showed that 31.2% found doing so very easy, and 47.5% found doing so somewhat easy. Figure 5b shows the responses to questions about the usefulness of each VR video educational material. Questions 6 to 9 asked about the usefulness of each VR video (Q6: ointment dispensing; Q7: aseptic preparation in the hospital pharmacy preparation room; Q8: intramuscular vaccination; Q9: treating anaphylaxis after intramuscular injection), and more than 90% of students answered that they agreed or strongly agreed with all the questions. More students responded that aseptic preparation in the hospital pharmacy preparation room at Kyorin University Hospital (Q7) was useful compared with the other three question items (Q6, Q8, Q9), although by a small margin.

3. Use of VR video educational materials on-demand and in PBL

Figure 5c shows the results of questions about on-demand VR video educational materials. Only students who used on-demand materials answered Q10 to Q12. The response rates were 155 (75.6%) for Q10, 147 (71.7%) for Q11, and 143 (69.8%) for Q12. We released materials related to injection dispensing, initial patient interviews, and medication counseling. Students considered the injection dispensing materials as the most useful, with 71.0% of students reporting them as very useful. Figure 5d shows responses to the question about the use of the materials in PBL. Regarding question Q13, 41.0% of students answered that they agreed and 49.3% answered that they strongly agreed. As for Q14 regarding whether they could imagine a PBL case patient, 31.2% agreed and 63.4% strongly agreed. In response to question Q15, which asked whether the VR material is useful as a teaching material for learning clinical reasoning, 38.0% agreed and 55.6% strongly agreed. Students found those materials very useful for the case study and reported that they facilitate visualization of the patient's situation. Students also evaluated these materials as useful for learning the clinical reasoning of pharmacists.

4. Motion sickness

Thirteen students (6.5%) reported experiencing motion sickness while using a VR headset with a connected smartphone and 40 (19.9%) experienced motion sickness to some extent (Figure 6). Motion sickness was somewhat diminished when using the Meta Quest 2 VR headset, with 10 (5.0%) and 31 (15.3%) students giving the same responses. The responses to Q18 suggest that viewing VR video educational materials directly on a smartphone without using a VR headset resulted in the least motion sickness.

5. VR video display device and VR experience

Regarding the device used to view VR videos, 80 students (39.0%) preferred the Meta Quest 2 (Figure 7a), followed by 75 students (36.6%) preferring direct viewing on smartphones. When asked about their previous experience with VR, more than half of the students (53.7%) answered that this was their first time (Figure 7b). Only 9 students (4.4%) reported owning a VR headset and being used to using one.

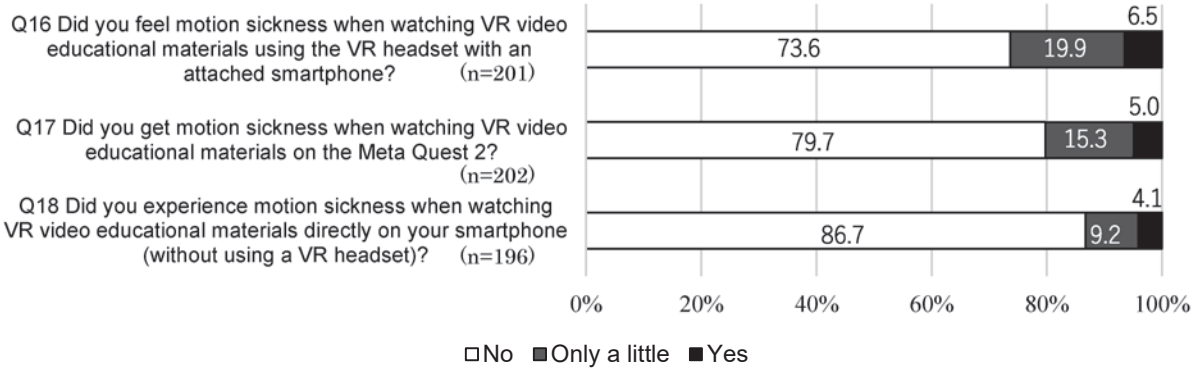

Figure 6 Questionnaire results on motion sickness.
Q16, Q17, Q18: n = 201, 202, 196, respectively.

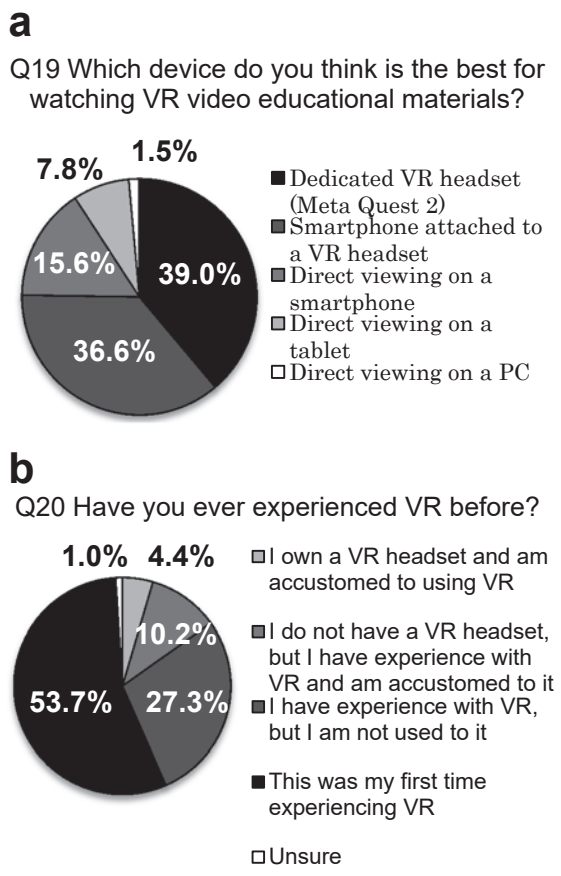

Figure 7 Questionnaire results on viewing device for VR video educational materials and VR experience.

(a) Devices used for playing the materials (n = 205).
(b) VR experience (n = 205).

Table 2 Representative responses to Q21

Positive opinions about VR
VR allows me to envision the situation.
It was useful to be able to visualize the scene when I wanted to.
It was useful to be able to check the hand movement
It was useful for checking procedures
It was nice to visualize doing it myself
It was useful to be able to practice alone
VR makes me feel like I'm actually there
Preparing for practical training with VR is effective
The video materials are very good
It is easier to understand than a textbook
It was good to be able to visualize the place I wanted to see
The injection preparation simulation was very useful
The Quest 2 is a good VR device
Negative opinions about VR
Conventional video is better than VR
I don't want to use a VR headset because I get motion sickness easily
It is difficult to use a VR device with my glasses
Setting up goggles is a hassle
The subtitles are intrusive

6. Free response

There were 42 responses to Q21 (“Please let us know if you have any comments or final impressions”), representative examples of which are presented in Table 2. Although some students expressed opinions such as “VR allows me to envision the situation” (7 responses), “It was useful to be able to visualize the scene when I wanted to” (6 responses), and “It was useful to be able to check the hand movement” (3 responses), there were also comments such as “Conventional video (fixed 2D video) is better than VR” (5 responses).

4. Discussion

This study tried to develop and introduce VR video educational materials in clinical pharmacy education and practicum, and students gave positive evaluations regarding the feasibility of such materials. However, we also found that VR caused some students to experience motion sickness, so there is a need to create teaching materials that mitigate that effect.

The effects of immersive VR in medical education have been reported using various research designs, such as randomized controlled trials (RCTs) and pre–post studies[2]. However, these studies have focused on medical, nursing, and dental students, and there are few studies involving pharmacy students. While our study evaluated only the feasibility for use with pharmacy students, we developed and introduced VR video teaching materials for dispensing techniques, intramuscular injections related to skills, and PBL, and the results suggested high feasibility. VR enables practice that would normally be impossible in a university laboratory. The VR video teaching material showing aseptic preparation of staining drugs and eye drops at Kyorin University Hospital provided an experience that felt like participating in the medical field, which we believe will increase learning satisfaction. In addition, the pharmacist shown in the materials was a highly skilled veteran of preparing staining drugs and eye drops. It is very meaningful for pharmacy students to experience a simulation of techniques used by pharmacists in clinical practice.

For practical training of procedures, the instructor must observe model practices. Students far from the instructor will see the instructor’s actions from a distance. By contrast, VR allows students to view the instructor’s technique from a first-person perspective and review it as often as desired. Also, emerging infectious diseases such as the COVID-19 pandemic have made VR video teaching materials a useful tool even in situations requiring social distancing or limited practice hours. The results of the free responses indicated that students were satisfied with the ability to check the hand movements.

Pharmacists in Japan are currently not allowed to give intramuscular injections, so they can be practiced using a simulator only. However, it is important that they accumulate skills through pharmaceutical education and workshops because they may be allowed to perform intramuscular injections in the future[10]. By using VR video educational materials showing a doctor performing injections, we can provide a simulated experience of the process. In addition to performing intramuscular injections, they must also be able to deal with any adverse reactions[10]. The results of a meta-analysis revealed that immersive VR contributes to improving skills in various medical

procedures[1]. VR video teaching materials have enabled a simulated experience of how to deal with anaphylaxis when it occurs. We thus newly combined VR video educational materials with practice performing intramuscular injections on an upper-arm simulator.

PBL is an educational method that encourages students to discover learning questions in case scenarios and promotes student-led learning through group discussions. The usefulness of combining PBL and video has been reported[11]. In this study, we incorporated VR materials into PBL that show the face of and discussions with a simulated patient in a hospital room. The questionnaire responses from many pharmacy students suggest that they considered the VR materials useful for learning clinical reasoning. It has been reported that the use of VR in clinical training improves critical thinking, clinical reasoning, clinical judgment, and clinical decision-making in nursing students[12]. Learning clinical reasoning is an important part of pharmacy school education, and VR can be utilized as a teaching material for this purpose[13].

This study used three methods for using devices to view VR video educational materials. First, the method of attaching the smartphone in a special VR headset is inexpensive. However, the specifications of some students' smartphones may result in low video resolutions, which more easily cause motion sickness. Second, the Meta Quest 2 VR headset has a high resolution but is expensive. However, since the viewing time of the materials used in our study was only about 10 min, each small group could experience use of the Meta Quest 2, allowing all students to experience it as one of the devices used. Third, many current VR devices are characterized by their excessive weight, high local pressure, thermal discomfort, visual fatigue, and motion sickness, which make some people reluctant to wear headsets for extended periods[14]. Since watching VR for a long time can cause motion sickness and visual fatigue, it would be better to create short educational materials and let many students experience them during practical training.

Regarding study limitations, we conducted only a questionnaire on the materials' usefulness and student satisfaction. Particularly, we did not examine the extent to which the created materials contributed to improving students' skills and knowledge. In the future, it will be necessary to evaluate the learning effects of VR teaching materials and their effect on skill acquisition.

VR video educational materials for clinical pharmacy education can be very useful and our participating pharmacy students were satisfied with their use. It is necessary to consider how to combine these materials with practical training and exercises, and how to take advantage of their benefits.

Conflict of Interest

The authors declare that they have no conflicts of interest.

Acknowledgment

This work was supported by a Grant-in-Aid for Education Reform at Showa Pharmaceutical University (No. R4-1). It was also conducted as a project of the Ministry of Education, Culture, Sports, Science and Technology, "Training Medical Personnel Who Can Respond to New Medical Care in the Era of COVID-19."

References

.

1) Kim HY, Kim EY, Effects of medical education program using virtual reality: a systematic review and meta-analysis, *Int J Environ Res Public Health*, **20**, 3895 (2023).
2) Dhar E, Upadhyay U, Huang Y, Uddin M, Manias G, Kyriazis D, Wajid U, AlShawaf H, Abdul SS, A scoping review to assess the effects of virtual reality in medical education and clinical care, *Digit Health*, **26**, 9 (2023).
3) Fahl JT, Duvivier R, Reinke L, Pierie JEN, Schönrock-Adema J, Towards best practice in developing motor skills: a systematic review on spacing in VR simulator-based psychomotor training for surgical novices, *BMC Med Educ*, **23**, 154 (2023).
4) Ntakakis G, Plomariti C, Frantzidis C, Antoniou PE, Bamidis PD, Tsoulfas G, Exploring the use of virtual reality in surgical education, *World J Transplant*, **13**, 36-43 (2023).
5) Kacmaz KS, Kaçmaz C, Bibliometric anal ysis of research in pediatrics related to vir tual and augmented reality: a systematic r eview, Curr Pediatr Rev, doi:10.2174/1573 396319666230214103103 (2023).
6) Plotzky C, Lindwedel U, Sorber M, Loessl B, König P, Kunze C, Kugler C, Meng M, Virtual reality simulations in nurse education: a systematic mapping review, *Nurse Educ Today*, **101**, 104868 (2021).
7) Choi J, Thompson CE, Choi J, Waddill CB, Choi S, Effectiveness of immersive virtual reality in nursing education: systematic review, *Nurse Educ*, **47**, E57-61 (2022).
8) Takeshita Y, Yamakawa M, Utsumi M, Evaluation of availability of training aid using virtual reality for hand hygiene, *J Jpn Acad Nurs Sci*, **41**, 234-240 (2021).
9) Coyne L, Merritt TA, Parmentier BL, Sharpton RA, Takemoto JK, The past, present, and future of virtual reality in pharmacy education, *Am J Pharm Educ*, **83**, 7456 (2019).
10) Watanabe K, The role of pharmacists in the light of the vaccination against Covid-19, *Bull Showa Pharm Univ*, **56**, 49-58 (2022).
11) Kou S, Isahaya K, Mochizuki A, Ino M, Akashi Y, Nobuoka S, Development and introduction of practical problem-based learning using ICT in undergraduate medical education, *J St Marianna Univ*, **48**, 197-210 (2021).
12) Jans C, Bogossian F, Andersen P, Levett-Jones T, Examining the impact of virtual reality on clinical decision making - An integrative review, *Nurse Educ Today*, **125**, 105767 (2023).
13) Ashizawa T, Primary care requirements for pharmacists -Clinical reasoning education at schools of pharmaceutical sciences-, *Yakugaku Zasshi*, **136**, 939-944 (2016).
14) Chen Y, Wu Z, A review on ergonomics evaluations of virtual reality, *Work*, **74**, 831-841 (2023).