

How Can Virtual Reality Glasses and Virtual Learning Material be Useful for Final Stage Nursing Students?

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Purpose: to describe nursing students' experiences of learning with help of virtual learning materials and virtual simulations. The aim was to produce knowledge that can be used to develop virtual simulation teaching and counseling further and to support students' self-debriefing. Methods: This is a mixed method study conducted with 13 final-stage nursing students at a University of Applied Sciences in Finland. Following virtual simulations performed during an acute nursing course, the students completed a questionnaire with qualitative and quantitative items on their experiences and on the usefulness of the simulations. The findings are primarily based on an inductive content analysis of the students' responses to qualitative items. The quantitative data, analyzed by means of SPSS, was used to support the qualitative analysis. Results: Most participants found virtual simulation learning and the use of virtual reality glasses a welcome change and a meaningful and safe way to promote their theoretical and practical competencies. They appreciated the possibility to choose the topic and the time and place of study. The simulations had been useful in practicing assessment and decision-making skills. Problem-solving, simulation of rare incidents, game-like elements and step-by-step feedback were proposed. A few students disliked the artificial setting and some reported headache and nausea. Conclusion: Virtual simulations and virtual reality glasses can be effectively used to teach final-stage nursing students as part of a blended learning approach. Careful planning of the learning contents and a suitable level of challenge in the simulations increase student motivation.

Keywords: *experience, nursing student, acute nursing, virtual simulation, virtual reality, VR glasses*

Introduction

The use of simulation pedagogy has expanded rapidly in healthcare education over the past two decades. Built on the experiences from military, aviation and space industries, simulations have been used to enhance both technical and non-technical competencies (Flentje et al. 2018.) Simulations strive to imitate authentic nursing situations and contexts, providing students an opportunity to learn important practices and to promote their decision-making and critical thinking skills (Salminen-Tuomaala et al. 2020). Teachers can decide to concentrate on simulating specific nursing situations or extend the simulation to cover a wider range of clinical reality (Salminen-Tuomaala et al. 2018). The method is safe and it engages students in the learning process. The sessions start with preparation, which

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includes going through the study objectives, scenarios, roles and practical instructions. After the scenario, debriefing is held to allow students and teachers reflect and evaluate their own and each others' contributions (Ranta 2013).

Simulated learning has been found to provide a response to the demands for better patient safety (Motola et al. 2013) and students' opportunities to experience, evaluate and reflect on critical situations before entering a clinical setting (Sanford 2010). In addition to the development of technical competencies through repetition in a safe setting (Salminen-Tuomaala and Koskela 2022), simulation training has been claimed to incorporate the affective or emotional components of learning (Salminen-Tuomaala et al. 2020). Simulations have been used to practice such complex competencies as clinical reasoning, decision-making (Bogossian et al. 2015, Liaw et al. 2015, Oddvang et al. 2021), situational awareness and emotional intelligence (Salminen-Tuomaala 2020, Salminen-Tuomaala et al. 2020, Salminen-Tuomaala 2021). Situational awareness is important both in acute nursing situations, in which helping critically ill patients requires rapid decision-making and correct action, and in sensitive situations, which call for comfort and emotional support (White et al. 2021).

In recent years, simulation-based education has been increasingly complemented by elements of virtual reality (VR), a combination of hardware and software that can be used to block out the real world and create a sensory illusion of being immersed in another environment (Pottle 2019). In the Healthcare Simulation Dictionary (Lioce et al. 2020), virtual simulation is defined as follows:

The recreation of reality depicted on a computer screen (McGovern 1994).

A simulation involving real people operating simulated systems. Virtual simulations may include surgical simulators that are used for on-screen procedural training and are usually integrated with haptic device(s) (McGovern 1994, Robles-De La Torre 2011).

A type of simulation that injects humans in a central role by exercising motor control skills (for example, flying an airplane), decision skills (committing fire control resources to action), or communication skills (as members of an air traffic control team) (Hancock et al. 2008).

VR, augmented reality and gaming have increasingly become a target of experimentation and study in teaching both technical and non-technical skills. Virtual simulations have been used to enhance lecture or web-based courses and to foster intradisciplinary and interdisciplinary education (e.g., Wankel and Blessinger 2012, Salminen-Tuomaala et al. 2020, Foronda and Bauman 2014). As simulations in general, virtual simulations allow mistakes to be made (Poulton et al. 2009) and high-risk situations to be replicated (Kidd et al. 2012). They have been very useful during the COVID-19 pandemic, when there have been limited clinical placements available (Wei 2021).

In all simulation-based education processes, instructor and peer feedback, reflection and debriefing are essential elements. Debriefing can be defined as discussion conducted to explore and analyze the performance with the aim of gaining insights that can improve clinical practice (Cheng et al. 2014). Shared discussion can open up new perspectives for the participants and observers of the

simulated process (MacLean et al. 2019) and facilitate reflection, a skill that will be necessary in the students' future work (Roca et al. 2020).

It is possible to practice post simulation debriefing, in-simulation debriefing, and video-assisted instructor debriefing. Simulated situations can be captured on video, to be used for reflection (Levett-Jones and Lapkin 2014, Paige et al. 2014). The idea of self-debriefing has also been introduced, for example to complement individual virtual simulations. Self-debriefing can be facilitated by structured models (Kuiper et al. 2008, MacKenna et al. 2021).

A systematic literature review of 80 studies spanning 1996 to 2018 (Foronda et al. 2020) revealed that most research (n = 69.86%) supported virtual simulation as an effective pedagogy for nursing students. In addition to improving cognitive learning outcomes, virtual simulation had an effect on the affective domain of learning (attitudes, values and student engagement). The learning benefits were found to increase with the time spent and amount of use. The review stressed the importance of looking for best practices and for a common understanding of terminology for virtual simulations (Foronda et al. 2020). Among other evidence of the effectiveness of the method are increased empathy towards people with mental health illness (Wan and Lam 2019) through virtual simulation and improved assessment skills through virtual gaming simulation (Verkuyl et al. 2017).

The use of narrative-based virtual patients has been recommended as a technique having potential for wide application in healthcare education (Guise et al. 2012, Wei 2021). These case-based computer games involve several alternative pathway options. This means that the user needs to make care and treatment decisions, which will affect the progress of the simulation. Adverse choices will cause the scenario to end or allow a second choice based on feedback (Cook et al. 2013). This technique should be based on a careful choice of learning objectives and on realistically designed narratives and authentic scenarios (Guise et al. 2012).

Finally, it should be noted that learning through technology may be influenced by preferences, such as visual or kinesthetic learning. As far as possible, students should be recognized as individuals and offered learning situations that take this diversity into consideration (Bradshaw and Hultquist 2021).

Research Purpose and Aim

The study purpose was to describe final-stage nursing students' experiences of learning with help of virtual learning materials and virtual simulations. The aim was to produce knowledge that can be used to develop virtual simulation teaching and counseling further and to support students' self-debriefing.

The research question was:

How helpful are virtual simulations as a learning experience?

Research Methods

Research Design

This mixed method study was conducted with 13 final-state nursing students at a University of Applied Sciences in Finland. The findings are primarily based on an inductive content analysis of material collected through an online survey. The quantitative data collected in the survey was used to support the qualitative analysis, although it is not suitable for generalization due to the limited number of participants.

Participants and Data Collection

The 13 participants (response rate 68.4%) were a group of final-stage nursing students at a University of Applied Sciences in Finland. Their age range was 22-30 years (mean 26, median 27 years), and most of them (85%) were women.

The participants had plenty of experience of simulation-based learning. During their nursing education, they had undertaken several courses taught through workshop and full scale simulations. They had also been introduced to small-scale virtual simulations through the Teams application during the Covid-19 pandemic. In May 2021, they had for the first time an opportunity to try out virtual reality (VR) glasses and virtual learning materials in a classroom situation.

During an acute nursing course in May 2021, all students completed at least one simulation alone, choosing one or several of the following topics: Cardiopulmonary resuscitation; assessment and examination of an acutely ill patient; care of an unconscious patient; and management of an acute situation in the patient's home context. Most students (7), performed the assessment and examination of an acutely ill patient, designed to practice the use of the ABCDE protocol. Four students chose the care of an unconscious patient, and two practiced cardiopulmonary resuscitation. The classroom situation was led by two teachers. Following the simulation, the students were instructed to conduct self-debriefing to determine their successes, challenges and development needs. Students' experiences of self-debriefing and the development of their professional identity were discussed later in a teacher-led seminar, arranged through a communications platform.

A few days after the virtual simulation, in May 2021, the students were contacted by e-mail and informed about the study. They received a link to a survey and reporting tool, which enables the collection of both qualitative and quantitative data (Webropol Services).¹ The questionnaire consisted of two background questions (age and gender); four qualitative items and 15 quantitative items.

The qualitative items were as follows, (1) What kind of virtual simulations did you perform during the acute nursing course?, (2) Describe your experiences of virtual simulations during the acute nursing course, (3) Describe your experiences of using VR glasses, and (4) Describe your experiences of acting in the virtual learning environment.

¹<https://webropol.com/>. [Accessed August 15-October 31 2021].

In the quantitative part of the questionnaire, students were requested to rate their learning experiences in various areas of acute care using a Likert scale (for example, 1= very much improvement; 2 = rather much; 3 = neither much nor little; 4 = rather little; and 5 = very little improvement.)

Data Analysis

Inductive content analysis was used to analyze the qualitative data. First, the work involved reading and re-reading the transcribed material and picking out semantic units that represented an answer to the research question. These phrases, saved into Word files, were then reproduced in a reduced form. Reduced expressions with similar contents were gathered under categories, which were grouped into four higher-level categories. To ensure the consistency of the coding process, the researcher returned to the original data several times during the analysis (Polit and Beck 2018). Table 1 illustrates how the inductive content analysis proceeded.

Table 1. *Virtual Simulation as a Motivating and Safe Learning Experience*

Sub-category	Generic category	Main category
Virtual simulation as a welcome change to previous learning methods	Experiences of virtual material and simulations as a learning method	Virtual simulation as a motivating and safe learning experience
Virtual simulation as a safe way to promote technical skills in acute care		
Virtual simulation as a good possibility to train the ABCDE protocol		
Virtual simulation as a meaningful way to test one's problem-solving skills		
Virtual simulation as a suitable way to develop situational awareness in acute situations		
Virtual simulation as a good way to develop decision making skills		
Virtual learning material had been concrete and open for various solutions		
Using VR glasses was easy and fast to learn	Experiences of VR glasses	
Using VR glasses experienced as an exciting situation		
Using VR glasses as an immersive experience		
Using VR glasses experienced as a visit to another reality	Experiences of the virtual learning environment	
Virtual environment as a safe learning environment		
Virtual environment contained a suitable amount of technological challenges		
Easy environment to navigate	Wishes for virtual simulation courses	
More game-like elements		
Step-by-step feedback before moving on to the next step of the process		
More virtual simulation scenarios of situations in emergency departments and in intensive care units		

The quantitative material was analysed using SPSS for Windows 27. The results section starts with quantitative data (percentages, frequencies and means).

Research Ethics and Trustworthiness

The permission to conduct research was received from the Research and Innovation Director of a University of Applied Sciences. National guidelines (TENK 2013) on good scientific practice were observed carefully. The target group members were first informed about the study purpose and practices in a classroom situation and secondly by means of e-mail. It was stressed in the cover letter that participation was voluntary, withdrawal possible at any point, and anonymity secured at all stages of the research process. Accessing the link and completion of the survey was regarded as consent to participate.

Four quality criteria; credibility, confirmability, transferability and reflexivity, were used to promote the trustworthiness of the study (Polit and Beck 2018). Following good scientific practice (TENK 2013) and providing direct quotations increase the credibility of this study. The findings reflect the participants' voices and experiences. The credibility of the study is also enhanced by the researcher's long experience of teaching acute nursing and developing simulation-based learning. Confirmability refers to objectivity - having independent people agree about the accuracy, relevance or meaning of the data (Lincoln and Cuba 1985). The research process, participants and study context were carefully described to make it easier for readers of this study to assess both the confirmability and transferability of the findings. The quantitative data in this study is not suitable for generalization due to the limited number of participants. The findings on the qualitative data, however, appear to be transferable nationally, possibly also internationally.

Reflecting on her role (the criterion of reflexivity), the researcher was conscious that her long experience and conducting the study alone may have increased the risk of bringing pre-conceived assumptions and subjective interpretations into the study, thus decreasing confirmability. This may be a limitation. To counteract this limitation, the researcher returned to the original data repeatedly (Polit and Beck 2018).

Results*Quantitative Data*

The majority of the nursing students (69 %, n=9) had never used VR glasses before. The remaining students had used the glasses a few times (n=2) or several times (n=2).

All students rated the virtual simulations as a good method to learn acute nursing (very good, 61.5%; rather good 38.5%) and almost everybody regarded the virtual setting as a good learning environment (very good, 53.8%; rather good, 38.5%). The students had found it easy to navigate the virtual environment (fully agree, 38.5%; rather agree, 53.8%). They agreed that the virtual environment had felt 'authentic' (fully agree, 46.1%; rather agree, 38.5%), with authentic-feeling procedures (fully agree, 38.5%; rather agree 46.1%), and it had been relatively

easy for them to live into the role of the nurse in the simulated situation (fully agree, 23.1%; rather agree, 53.8%).

In addition, the preparatory instructions preceding the simulation had been clear according to all students (100%), and learning about the objectives for the simulations had been a good experience (very good, 38.5; rather good 53.8%).

Table 2 shows students' responses to the benefits of virtual simulation in learning important areas of acute care. In general, the students found that their competencies had increased very much or rather much; nearly 85% of them agreed that following the simulation, they felt more confident about working as nurses in acute care settings. More than half of the students, 61.5%, also found that the simulation had affected their theoretical competence positively.

Table 2. *Usefulness of Virtual Simulations for Learning Acute Nursing*

Student's rating	very much improvement	Rather much	Neither much nor little	Rather little	Very little	Mean	Median
The virtual simulation improved my competence in assessing breathing	7.7%	69.2%	7.7%	15.4%	0%	2.3	2.0
The virtual simulation improved my competence in assessing circulation	7.7%	61.5%	15.4%	15.4%	0%	2.4	2.0
The virtual simulation improved my competence in assessing the level of consciousness	15.4%	69.2%	0%	15.4%	0%	2.2	2.0
The virtual simulation improved my competence in patient examination	15.4%	46.1%	30.8%	7.7%	0%	2.3	2.0
The virtual simulation improved my theoretical competence	15.4%	46.1%	38.5%	0%	0%	2.2	2.0
The virtual simulation increased my confidence to work as a nurse in acute nursing settings	23.1%	61.5%	15.4%	0%	0%	1.9	2.0

In this group of students, the virtual simulations seemed especially useful in learning to assess the level of consciousness (ca 85% very or rather much improvement). The students also felt better prepared to assess the patient's breathing (ca 77% very or rather much improvement) and circulation (ca 70% very or rather much improvement). Last, 61.5% of the students reported that the virtual simulations had improved their patient examination skills very much or rather much.

Qualitative Data

In this section of the results, the nursing students' experiences of virtual simulations are described through four categories: *Experiences of virtual material and simulations as a learning method*; *Experiences of VR glasses*; *Experiences of the virtual learning environment*; and *Wishes for virtual simulation courses*. The quotations have been translated from Finnish into English by the author.

Experiences of Virtual Material and Simulations as a Learning Method

The students mainly described positive experiences of the virtual learning method and virtual material. Even though they had been introduced to new technology and had been expected to learn a new technique, they had found the method meaningful and useful for improving both theoretical and practical competencies.

To quote one of the students,

“As an experience, it was meaningful and interesting. It reminded me of how to use the ABCDE protocol, and the motion during the practice certainly helped remembering and learning. The learning atmosphere was positive, encouraging and fun.”

According to the students, the learning materials had been concrete and open for various solutions. The students appreciated the possibility to gain more confidence through repeating the simulations. They described how the virtual material had challenged them to become aware of the existing contradictory information and motivated them for independent decision-making. They had been encouraged to reassess situations and make decisions. They said, for example,

“It makes you think about your own decisions.”

“Especially systematic monitoring of vital functions. It could also be done so that you had to first decide what should be assessed next, and then you would be told if it was correct or not, before moving on to the next stage, maybe that way you would think even more about the actual care.”

The students appreciated the possibility to choose which topics they wanted to practice. They found that the teachers had provided them an opportunity to train in whichever area they had experienced their most pressing learning or development needs. The simulations on the care of unconscious patients and on care carried out in the home context were considered to be suitable for final-stage students, whereas resuscitation simulations were regarded as fit for beginners.

Experiences of VR Glasses

The students' experiences of using VR glasses varied, depending on their background. Some students had been nervous about how to learn to use the glasses and navigate the virtual environment. Their challenges had mostly been related to the use of motion controllers. Other students, however, had felt no hesitation in starting the simulations, because they had played computer games since their childhood. After the simulations, none of the students rated the technique as difficult to learn. They commented, for example,

“You can learn to use the VR glasses fast.”

“You got the idea really fast, and it was easy to navigate the environment.”

“At first it was a bit tricky, of course, trying to pick things from the environment or to understand when it was enough to point or press with your finger, but you could learn pretty fast.”

Moreover, the use of VR glasses in a virtual learning environment was considered to be a welcome change from lectures. The experience was described as immersive, as a visit to another reality, and as more authentic than learning with help of a manikin. To quote the students,

“The outlook was authentic, the noises in the environment made it feel more authentic. The patient seemed authentic.”

“It was a nice change from ordinary simulations. It was helpful to see other students perform. It could have been even more challenging, I already have some VR experience and know how to navigate there.”

Experiences of the Virtual Learning Environment

The students' experiences of the virtual learning environment and virtual reality were mostly positive; the learning was described as safe and interesting. According to most students, the learning environment contained a suitable amount of technological challenges. The students wrote, for example,

“Easy, safe, because there is no harm to the patient. A fun way to learn.”

“You could learn fast how to navigate the environment and it was meaningful to watch others perform.”

Secondly, the students appreciated the fact that now that they knew how to use the equipment, they could choose to participate from home, or practice alone whenever it suited them best. This was considered an asset during the prevailing COVID-19 pandemic.

A few students, however, found the environment 'artificial' and described their experience as 'sham'. For these students, the sensations produced by simulation or the artificially created environment had not felt as authentic as simulations conducted with real persons in the classroom situation. Moreover, some students had suffered from headache and slight nausea following the simulation.

Wishes for Virtual Simulation Courses

In their responses, the students made a number of proposals for future virtual simulation courses. More 'game-like' elements were suggested, and a few students wished for more sensory cues, challenging client questions and doctor's orders. Step-by-step feedback was proposed before moving on to the next stage of the process. According to the students, simulations could be used to practice a variety of situations in virtual emergency departments and clinics and in intensive care units. Several students wished for virtual training in resuscitation, care of trauma patients and various intensive care situations. In the students' own words,

“First aid and emergency care situations.”

“Resuscitation, examinations, how to act in various situations.”

“Especially situations, where decision-making and problem-solving are required from nurses.”

“Traffic accidents, pulmonary edema assessment, pneumothorax etc., care of cardiac patients, e.g., NSTEMI, preparing a sterile table for procedures...It would be nice to

practice these for several times in a VR environment! Especially traffic injured patients, that makes me nervous at work, because they are relatively rare.”

Discussion

Most participants in this study found virtual simulation learning and the use of VR glasses a welcome change and a meaningful and safe way to promote their theoretical and practical competencies. They appreciated the possibility to choose the topic and the time and place of study, and the opportunity to repeat the simulation, if necessary. A few students, however, disliked the “artificial” setting and/or reported headache and nausea. Unwanted symptoms seem to be relatively common and are thought to be caused by sensory mismatch (Weech et al. 2018).

Earlier studies support the finding that the possibility to practice for critical situations safely make simulations an effective way of learning and can improve students’ confidence (Sanford 2010, Saab et al. 2021). The simulations seemed to have had both cognitive and affective learning outcomes, as in earlier studies on simulation-based learning (Foronda et al. 2020). The students found that the simulations had been useful in practicing assessment and decision-making skills and in learning to critically evaluate one’s competencies through self-debriefing. Problem-solving scenarios, simulation of rare incidents, ‘game-like’ elements and step-by-step feedback were proposed. In an earlier study, VR, appreciated as an additional/supplemental resource to traditional teaching, was found to help learn psychomotor, decision-making, and problem-solving skills and to promote equity among students (Saab et al. 2021). Research has also shown that that simulations can increase participants’ confidence in assessing and managing trauma patients (Kelley et al. 2021).

Looking at the findings, one must bear in mind that the novelty of any new learning system is likely to wear off sooner or later (Han-Huei Tsay et al. 2019). The use of a blended learning approach, or combining a wide range of more traditional teaching strategies with virtual teaching can help maintain the interest of students (Grønlien et al. 2021). Blended learning with hypermedia resources and project-based learning has also been found to increase participants’ learning outcomes and interaction in learning management systems (Sáiz-Manzanares et al. 2020). As suggested in literature (Guise et al. 2012, Wei 2021) and by some participants in this study, narrative-based virtual patients and games with alternative pathway options could render the scenarios more authentic and motivating. Another factor that affects student motivation according to this study is careful planning of the learning contents. It is essential that the virtual simulations contain a suitable level of challenge, introduced when the time is right, and accompanied by clear instructions. If students work in their own time, teacher-led feedback sessions can to be arranged through a communications platform, or independent structured self-debriefing can be carried out according to themes provided by the teacher.

Future research on the topic could involve a comparative study with larger samples, possibly with performance testing, to determine the effectiveness of

virtual simulations compared to classroom simulations. Teachers' experiences of virtual simulations and VR glasses might also be worth looking into.

Limitations

The study had a small sample that only contained final-stage students undertaking a course in acute nursing in a single university. The quantitative data collected in the survey was only used to support the qualitative analysis and is not suitable for generalization due to the limited number of participants. Similar studies with larger samples, possibly in international collaboration, are recommended. The analysis was conducted by a single researcher, whose experience of simulation pedagogy may have affected the interpretations of the findings. Despite this, the researcher believes that the study presents relevant, authentic experiences of nursing students experimenting on VR glasses and virtual material.

Conclusion

Virtual simulations and VR glasses can be effectively used to teach final-stage nursing students as part of a blended learning approach. However, students should be recognized as individuals and offered learning situations that take their diversity into consideration. Careful planning of the learning contents and a suitable level of challenge increase student motivation. Virtual simulations allow independent learning and repetitions in a safe, near-authentic environment and they can improve students' confidence. The simulations are useful for practicing assessment and decision-making skills and in learning to critically evaluate one's competencies.

Implications

Virtual simulations can be used as part of a blended learning approach in both initial nurse education and in continuing education programs for nursing professionals. Simulations seem especially useful when preparing for situations, which require rapid assessment, situational awareness, problem solving and decision-making skills. Repeated training can help address challenging situations and facilitate the learning of schemes and protocols for acute nursing.

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