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Incorporating virtual reality in nurse education: A qualitative study of nursing students' perspectives

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ABSTRACT

Background: Recent challenges to nurse education have resulted in an increased use of virtual reality which serves as an immersive and effective medium for skill and knowledge acquisition. Virtual reality technology is being included in nurse curricula at undergraduate level. This technology remains a relatively new experience for many nursing students with limited evidence regarding students' perspectives regarding virtual reality.
Objective: To explore nursing students' perspectives of incorporating virtual reality in nurse education.
Design: Qualitative descriptive study using thematic analysis.
Setting: Public university in Ireland.
Participants: Undergraduate nursing students were recruited using purposive and snowball sampling.
Methods: Students (n = 26) participated in face-to-face semi-structured individual interviews and focus groups in January and February 2020. Data were analysed using inductive thematic analysis.
Results: Three themes were constructed from the interviews: captivating, innovative, and empowering nature of virtual reality; contextual transfer; and challenges and threats to actualisation. Participants believed that virtual reality affords a novel, fun, memorable, inclusive, and engaging means of learning. Many believed that virtual reality would complement current teaching and learning approaches, help build learners' confidence, and provide nursing students with a safe space for trial, error, and problem-solving. The use of virtual reality was recommended to practise various nursing skills and learn about human anatomy, physiology, problem-solving, and clinical decision-making. Participants identified the resources incurred by the technology as challenges to implementing virtual reality in nurse education and stressed the need for continuous face-to-face feedback.
Conclusions: Findings suggest that virtual reality technology has the potential to facilitate learning, complement current educational approaches, and provide nurse educators with novel and engaging means of content delivery.

1. Introduction

Nurse educators are constantly being challenged to source accessible and innovative methods of teaching and learning that transition students through each stage of their educational journey (Fealy et al., 2019). Over the last decade, and more recently in the context of the COVID-19 pandemic, challenges to nurse education have resulted in an increased use of innovative technologies such as virtual reality (VR) (Morin, 2020). VR includes "a wide variety of computer-based applications commonly associated with immersive, highly visual, 3D characteristics that allow the participant to look about and navigate within a seemingly real or physical world" (Lopreiato et al., 2016; p. 40). Therefore, VR technology has the potential to change the way in which education is delivered since it operates on the premise that a virtual world, real or imagined, can be created, which allows students not only to visualise the content but also to interact with it (Vlachopoulos and Makri, 2017; Zackoff et al., 2020).

In comparison to traditional teaching and learning approaches, VR technology serves as a more immersive medium for the transfer of theoretical and clinical learning in nurse education (Foronda et al., 2017). The immersive and interactive characteristics of VR can also facilitate the link between theory and practice for nursing students, through repeated exposure to theoretical content and related clinical skills (Jenson and Forsyth, 2012). More recently, in their discussion of

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the challenges to nurse education during the COVID-19 pandemic, Liu et al. (2020) emphasised the role of VR in enhancing skill proficiency and learning outcomes among nursing students, especially when clinical practicums were reduced because of the pandemic.

Emerging studies have uncovered some of the benefits of VR at undergraduate nursing level including the provision of an interactive learning opportunity in a safe non-threatening environment (Zackoff et al., 2020), the increased access and flexibility afforded to the learner (Mendez et al., 2020), the provision of a platform for presentations/lectures (Benham-Hutchins and Lall, 2015), and the opportunity to ask questions (Benham-Hutchins and Lall, 2015). Examples of recent experimental studies where VR proved effective in nurse skill acquisition include teaching chemotherapy administration (Chan et al., 2021), nurse skill competence training (Chao et al., 2021), intravenous catheter insertion (İsmailoğlu et al., 2020), and phlebotomy training (Vidal et al., 2013). Additional benefits beyond skill acquisition were identified in a recent randomised controlled trial which found that VR promoted knowledge retention, clinical reasoning, self-efficacy, and greater satisfaction with the learning experience among nursing students (Padilha et al., 2019). Similarly, a recent systematic review of 14 trials evaluating the effectiveness of VR training in improving undergraduate nursing students' knowledge found that VR training was more effective than conventional training methods in delivering procedural knowledge to nursing students (Ning et al., 2021). In addition to knowledge and clinical skill gains, VR is often perceived by nursing students as a means to promote positive learning experiences with evidence of improved learning outcomes with higher levels of immersion (Farra et al., 2018).

Due to the several positive gains from VR, this technology is being included in nurse curricula at undergraduate level (Farra et al., 2018; Lange et al., 2020). However, despite VR being well established in several nursing programs, this technology remains a relatively new experience for many nursing students. Recent studies which have explored nursing students' experience of VR focused on specific contexts like airway management (Botha et al., 2021) and nursing skill training (Chang and Lai, 2021) rather than exploring, in-depth, the potential use of VR in nursing programs where VR is not yet integrated. Moreover, in their systematic review and meta-analysis, (Ning et al., 2021) concluded that, at present, VR is suitable for supplementing conventional teaching and learning methods rather than being used as a standalone approach, which warrants further exploration. This knowledge is key to integrating and sustaining VR technology in nursing programs which are actively seeking opportunities to embed technology-based education into their curricula. Therefore, the focus of this study is to explore nursing students' perspectives of incorporating VR in nurse education.

2. Methods

2.1. Virtual reality intervention

An interactive VR intervention aimed to ***E***nhance ***M***en's ***A***wareness of ***T***esticular diseases (***E-MAT***) was previously developed and tested (Saab et al., 2018, 2019). E-MAT is delivered using a wireless VR headset, headphones with voiceover, and handheld controllers with haptic/vibrational feedback. E-MAT includes three serious game levels and takes 5 to 6 min to complete. Each level aims to familiarise the user with the normal look and feel of the testes and various testicular symptoms and diseases. E-MAT uses colloquial language and plain English. It was delivered to current study participants to familiarise them with VR.

2.2. Design

A qualitative descriptive design was used which involves "no preselection of variables to study, no manipulation of variables, and no a priori commitment to any one theoretical view of a target phenomenon" (Sandelowski, 2000, p. 337). In this study, qualitative description helped elicit participants' perspectives regarding the use of VR in nurse education in factual terms (Sandelowski, 2000), without adhering to pre-existing theoretical, philosophical, or epistemological perspectives (Lincoln and Guba, 1985).

The Standards for Reporting Qualitative Research checklist was used to report this study in order to enhance research transparency and quality and reduce the risk of incomplete data reporting (O'Brien et al., 2014).

2.3. Reflexivity

A researcher with computer science and interactive media qualifications recruited participants and administered the E-MAT intervention. This individual was not known to participants. Within one week from exposure to E-MAT, interviews were conducted by three researchers with expertise in qualitative research. These researchers were faculty members but were not directly involved in teaching the students.

2.4. Sample and context

Participants eligible for inclusion were third year undergraduate nursing students in a large public university in Ireland who had no previous history of motion sickness which rarely occurs within modern VR experiences (Fernandes and Feiner, 2016). Purposive and snowball sampling strategies were used whereby eligible participants were asked to encourage their colleagues to participate. The study was advertised at the start of a nursing course using a 5 min PowerPoint presentation. Invitation letters with the researchers' contact details were distributed on the day. A second study presentation was delivered two weeks later to enhance participation.

2.5. Ethical considerations

This study was carried out according to the Declaration of Helsinki and received ethical approval from the university's Social Research Ethics Committee. Permission to access students was secured from the Research Access Committee.

2.6. Procedures

Data were collected in January and February 2020. Students interested in participating contacted the researcher to arrange for data collection which took place on campus. Students signed informed consent and completed a sociodemographic questionnaire with questions on their age; gender; employment; course of study; computer use; hours of computer use; hours of internet use; experience with video gaming; and prior VR use.

After familiarising themselves with VR through their exposure to E-MAT, participants were interviewed face-to-face either individually or within a focus group. Analysing and presenting data from focus groups and individual interviews, often referred to as qualitative interview method triangulation, helps enhance data richness, depth of inquiry, and trustworthiness (Lambert and Loiselle, 2008). This was suitable for students who did not feel comfortable discussing their views in front of their peers.

Individual interviews and focus groups lasting on average 40 and 60 min respectively were audio-recorded and guided by a bespoke semi-structured guide exploring: participants' thoughts around using VR in nurse education; perceived advantages and disadvantages of using VR in nurse education; and blue sky thinking about the future of VR in nurse education. Open-ended probing was used to explore participants' responses in greater depth.

2.7. Data analysis

Data were collected and analysed concurrently until no new themes

emerged (Guest et al., 2006). Individual interviews and focus groups were transcribed verbatim. Data were analysed using Braun and Clarke's (2006) six-phase thematic analysis. First, transcripts were read and re-read, and the researchers' thoughts were written down. Relevant participant verbatims were then extracted and summarised into codes. Similar codes were gathered, collapsed, and transferred to a coding sheet. Sub-themes linking the different codes were generated and cross-checked against participant verbatims. A thematic map was then created to illustrate and clarify the relationship between the codes and sub-themes. Finally, sub-themes were refined to generate themes.

Data analysis were conducted by the first author and cross-checked by the second and last author to minimise errors and improve research credibility and confirmability (Cope, 2014). Inaccuracies were discussed and sub-themes and themes were refined. Data from the socio-demographic questionnaire were analysed using descriptive statistics.

3. Results

3.1. Participant characteristics

Data saturation were deemed achieved by the sixth interview. A seventh interview was conducted to confirm data saturation. In total, two individual interviews and five focus groups were conducted with 26 participants. Participants' ages ranged between 20 and 42 years. Of those, only two were male. Most participants (n = 16) were studying full-time and working part-time. All participants reported having computer access and spending on average 4.2 h using the internet daily. None of the participants reported engaging in any type of video gaming and the majority (n = 18) have never used VR (Table 1).

Findings from individual interviews (I) and focus groups (FG) are presented under three overarching themes: captivating, innovative, and empowering nature of VR; contextual transfer; and challenges and threats to actualisation (Table 2).

3.1.1. Theme1: captivating, innovative, and empowering nature of virtual reality

Participants believed that "*VR keeps learning interesting and adds a little bit of fun*" (FG1). They also perceived that the novelty of VR makes it more memorable and "*grabs the attention*" (I2), particularly when compared to traditional learning strategies:

> "…*Everyone sees posters and videos on the Internet or TV and they just move on. But in VR, you will tell someone else 'oh, I did this, this is what I learned,' and you will pass it on.*"
>
> (FG5)

Several participants believed that "*doing*" rather than "*seeing*" or "*hearing*" (FG2) using VR grabs the attention and makes the experience more memorable:

> "*I was paying attention to everything and I was really interested. I didn't find myself zoning out, because you couldn't. You saw something you had to do it…you're definitely going to remember what was said.*"
>
> (FG3)

VR was perceived to promote equity among students by delivering the same information through the same means, particularly when exposure to certain clinical experiences is limited:

> "*On placement, I might never see a grade four pressure sore, but then someone else might see one. This might be putting me at a disadvantage, whereas if I was able to see that on VR, it kind of puts everyone on the same playing field.*"
>
> (FG2)

VR was also perceived to "*cater for various types of learners*" (FG1) and provide individualised "*one-to-one education and very individualised*" (FG4) teaching and learning experiences.

Participants discussed how VR can help increase students' confidence by providing them with a safe environment which allows for trial and error, an experience not afforded with real patients:

> "*When I'm in clinical practice, I can get quite shaky, especially if it's the first time I'm doing something. That's where VR would come in. It would give me that space to practise literally hands-on without actually being on clinical placement.*"
>
> (FG3)

VR was often compared to "*putting on a mask and adopting a different persona*" (FG2), which was perceived to help build students' confidence and learn from their mistakes:

> "*In VR, it's just yourself with the goggles. Nobody is going to observe you. You can feel free to make errors and increase your confidence. You can fail, you can do things wrong, you can learn from the mistakes.*" (I1)

Participants reported that VR can be used to consolidate pre-acquired information and skills or complement pre-existing teaching and learning approaches. They recommended using VR before lectures, between lectures and practical sessions, or after lectures to test their knowledge:

> "*Every lecture could have a VR element. You could, you wouldn't say VR-ise the curricula, but you could definitely integrate a lot of what we're learning already into VR.*"
>
> (FG2)

Others perceived that VR could serve as a refresher on previously acquired knowledge and skills. This was believed to help students prepare for their clinical placements:

> "*In practicals, we do the skills once and we don't always get the opportunity to do them that much in clinical practice. You forget the skill a little bit when the time comes around for you to be doing it in clinical practice. Booster lessons with VR on certain skills would be very beneficial.*"

Table 1
Socio-demographic characteristics of study participants (n = 26).

Characteristic	n (%)
Age (years)	
Range	20–42
Mean (standard deviation)	23.6 (6.1)
Gender	
Female	24 (92.3)
Male	2 (7.7)
Employment	
Student only	9 (34.6)
Student and working part-time	16 (61.5)
Student and working full-time	1 (3.8)
Course of study	
General nursing	21 (80.8)
Children's and general integrated nursing	5 (19.2)
Computer use	
Yes	26 (100)
Computer use per day (h)	
Range	1–6
Mean(standard deviation)	2.5 (1.3)
Internet use per day (h)	
Range	2–12
Mean (standard deviation)	4.2 (2.1)
Video gaming	
No	26 (100)
Virtual reality use	
Never	18 (69.2)
Once	4 (15.4)
Several times	4 (15.4)

Table 2
Themes, sub-themes, and sample codes identified from the study.

Themes	Sub-themes	Sample codes
Captivating, innovative, and empowering nature of VR	Novel, memorable, and engaging means for learning	• Novelty of technology makes it memorable • Memorable since it is more engaging, fun, and one-on-one • VR increases attention due to interactivity — no zoning out • Memory of information by "doing" rather than "reading/hearing"
	Promoting equity and individualised teaching and learning	• Puts everyone on the same "playing field" • Caters for different types of learners • Makes sure students start and finish together • One-on-one education
	Increasing confidence by providing a safe space for trial and error	• You can fail, you can do things wrong, you can learn from that • Privacy: only you can see what you are doing • VR increases confidence: shaky in clinical placements • Similar to someone wearing a mask — a different persona
	Consolidating and complementing existing teaching and learning approaches	• VR helps consolidate learning • VR to give background knowledge prior to lecture/practice VR • VR "in the middle" between lab practice and patient care • Use VR after lectures to quiz yourself
Contextual transfer	Learning human anatomy and physiology	• VR use in anatomy for dissection: suitable for visual learners • Easier to learn about names of arteries and veins • Opportunity to see different type/depths of pressure sores • Physiological processes like digestion
	Developing practical and clinical decision-making skills	• Removing sutures becomes more real • Easier to visualise injection sites • Catheterisation: saves the person discomfort • Emergency cases: how to react
	Emphasising the patient experience and enhancing empathy	• The feelings of a patient in a trolley before going into surgery • Create an appreciation of difficulties: hearing/sight impairment • Reminder to experienced nurses of the need to be empathetic • Feel what the patient is going through
Challenges and threats to actualisation	Resources incurred by the technology	• Barrier: cost of equipment • Not suitable for several people simultaneously due to expense • VR takes time if there are 250 students in class • Human resources required to convert current material to VR
	Threats to compassion and human connections	• The computer cannot possess the compassion of a person • Not being able to ask a question as a barrier • VR should not replace the core values of nursing • VR is not suitable when an emotional connection is required • VR at home "*not for me*": need to see and interact with people
	Potential side effects and safety concerns	• Motion sickness/vertigo risk can limit use of VR • Sight problems as barriers to VR • Safety concerns: standing up and moving around during VR • Safety concern: senses shut off
	Potential lack of interest and unfamiliarity with VR	• Students who are not into technology will not use VR • Not sure if personally interested: VR out of comfort zone • VR is easier for people in their 20s than 80-year-olds • Like working remotely: other distractions
	Addressing challenges and threats to actualisation	• Enough VR headset needed so that students do not fall behind • Have a few VR headsets for booking: libraries and IT labs • Infection control: clean VR headsets between uses • Suitable for smaller tutorial and practical groups • Presence of a facilitator to address questions and brief students

(FG4)

3.1.2. Theme2: contextual transfer

Using VR to visualise the human body (e.g. cardiovascular system) and learn about different physiological processes (e.g. digestion) were discussed in all the interviews:

"*VR will be really nice in anatomy lectures. Have a hologram and everybody can put the VR goggles on while the lecturer is delivering the*

lecture, you can go and dissect or touch the organs…you can with gloves [VR controllers] *feel the heart or the shape of the liver.*"

(I1)

VR was perceived to "*enhance kinetic learning and skills acquire during practical labs*" (FG2). All participants stated that various nursing skills can be acquired using VR including aseptic techniques; wound dressing; pressure sore care; intravenous cannulation; vital sign measurement; suturing; administering injections; catheterisation; physical assessment; medications administration; stoma care; and nasogastric tube insertion. VR was also perceived to enhance decision-making skills, particularly while responding to patient deterioration and in "*emergency settings like a cardiac arrest*" (I2):

"*If you were able to go into it* [VR] and *interact with a patient and if there was a random mode and their vitals change and you need to recognise them. So, you're kept on your toes.*"

(FG5)

Participants believed that VR can be used for nursing students to "*put themselves in patients' shoes*" (I1). Examples were given on how VR can help visualise how "*patients with dementia feel while being fed, or how a patient lying on a trolley feels*" (I1):

"*You see nurses who have been working on a ward for 15 plus years and they're a bit more curt with people. It might be nice for them to go back to VR and be reminded of what patients are going through…grow their empathy back a small bit…if it was something where people just had their peripheral vision...or even trying to make a cup of tea when you have Parkinson's or arthritis…you just have to go through it and see how tough it is for patients.*"

(FG1)

3.1.3. Theme3: challenges and threats to actualisation

Concerns regarding the resources incurred by VR related to the "*cost of purchasing and maintaining VR headsets*" (I2), whereby "*getting five or 10 of them* [VR headset] *isn't that easy*" (FG5) as well as not having "*enough resources to convert text and PowerPoint into VR*" (FG2). These challenges were perceived to lead to inequities:

"*If there wasn't enough VR sets for everyone to do it at the same time, students would fall behind because they mightn't do it, say they could do it four days after another person has done it. So, the first people would have four days of learning while the other person would be just sitting and waiting.*"

(FG4)

While some participants recommended using VR to promote empathy, others believed that VR can be "*antisocial and isolating*" (FG4) and would impact negatively on human interactions and "*core nursing values, caring and compassion*" (FG1):

"*Nursing for me is one-to-one. I need to interact with people, I need to see people's faces, their eyes, their expressions. Even if you want to check the temperature or a person's skin integrity, you have to touch their skin or body…It's* [VR] *not for me.*"

(I1)

Potential lack of in-person feedback was perceived as another threat posed by VR:

"*You might want to ask a question in a lecture if you don't understand completely what is in the slides. But I think with VR, you wouldn't have the opportunity to ask a question.*"

(FG4)

Sight problems, vertigo, dizziness, motion sickness, and risk for injury were perceived to limit the use of VR:

"*You warn of motion sickness and some people would be more prone to that, so it* [VR] *excludes anybody who has a light stomach. And then are you excluding them from extra learning because they have motion sickness?… I think the big thing also is safety…if we did do something, like panicked…you might hurt yourself by reacting since senses are shut off somewhat…cleanliness also, if there's multiple students using it…*"

(FG5)

Some participants believed that being inherently uninterested in VR would cause students to become distracted and disengaged:

"*When you're in college…everyone around you is writing notes and the lecturer is looking at you, whereas when you're at home, you'd have it* [VR headset] *on, you could be falling asleep and nobody would know…some people are more enthusiastic and more willing to use it, whereas others would have a negative attitude towards it.*"

(I2)

Age was identified as another challenge to using VR, whereby "*younger generations are so open to experimenting with new technologies*" (I1) whereas older students might not be interested in new technologies.

Participants proposed several approaches to address the challenges surrounding VR use. Some perceived that VR "*might work better in a master's degree because in undergraduate degrees, there's hundreds of students*" (I2). When used in undergraduate education, participants proposed using VR in small tutorial groups rather than during lectures and recommended a system which allows them to "*rent out VR for 10 minutes*" (FG3):

"*Have one or two* [VR headsets] *in the library to come down and practise…if they were installed in the IT lab or into one of the private rooms off the library, it would be a really good facility and resource for people.*"

(FG5)

The need for continuous feedback was iterated on several occasions to prepare students to use VR, assist them during VR, and/or debrief them following VR:

"*Like the way the VR we did for this study* [E-MAT] *was talking to us, if you did something wrong, it would stop you and tell you that you've done something wrong and explain it to you and then you could go and do it again.*"

(FG4)

4. Discussion

Findings highlight the captivating, innovative, and empowering nature of VR and the various contexts where VR can be used as well as the challenges to using VR and ways to overcome them. Several positive features of VR were highlighted. In keeping with emerging research (Benham-Hutchins and Lall, 2015; Smith and Hamilton, 2015; Thompson et al., 2020), current study participants identified the engaging and novel nature of VR, which in their view increased their motivation and made learning more interesting. Similar findings were evident in a recent systematic review which found that VR provided a rich, interactive, and engaging educational context that supported experiential learning-by-doing (Fealy et al., 2019). VR can enhance the link between theory and practice for students, through repeated exposure to content and related clinical skills (Jenson and Forsyth, 2012). Similarly, current study participants reported that VR would potentially support knowledge retention and skill acquisition.

Consistent with recent research (Thompson et al., 2020), this study highlighted that VR could facilitate the consolidation of pre-acquired information and skills. Notable recommendations included using VR before lectures, between lectures and practical sessions, or after lectures to test knowledge. Others perceived that VR could serve as a refresher on previously acquired knowledge. Participants also considered VR as an important means to promote equity among students by delivering the same information through the same medium, especially when exposure to certain clinical experiences is limited and intermittent. In keeping with earlier research (Benham-Hutchins and Lall, 2015), current study participants believed that VR could help increase students' confidence by providing them with a safe environment, which allows for trial and error, an opportunity not afforded with real patients.

The present study also highlighted that VR could accommodate diverse learning styles and provide individualised teaching and learning experiences. Underpinned by the Felder-Silverman Model (Felder and Spurlin, 2005), Mangold et al. (2018) advocated for educational approaches in various formats to meet the needs of individual nurses in an ever-changing healthcare environment. The results indicated that 'sensing' and 'visual' were the preferred learning styles among nurses regardless of gender, age, or experience.

Consistent with emerging research (Benham-Hutchins and Lall, 2015; Smith and Hamilton, 2015), current study participants indicated that VR sessions could be used to complement the learning that occurs in the skills lab and during lectures. However, in accordance with Benham-Hutchins and Lall's (2015) findings, students believed that while VR would augment clinical skills training, it would not necessarily replace actual clinical practice. Nonetheless, our participants endorsed the use of VR simulation as a supplemental tool for teaching a range of psychomotor skills. It is the view of Benham-Hutchins and Lall (2015) that the potential benefits of VR for clinical skill acquisition and critical incident simulation allows students more practice time compared to traditional simulation methods.

A recurring theme related to using VR to supplement the teaching of complex anatomical structures and physiological processes. In keeping with earlier research, which focused on the use of 3D models to teach anatomy to medical students (Pujol et al., 2016), being afforded the opportunity to visualise anatomical models, structures, and processes was seen to be particularly valuable to nursing students in the current study. Students perceived VR to enhance decision-making skills, particularly when responding to patient deterioration and emergency settings such as cardiac arrest. Consistent with these findings, Felszeghy et al.'s (2019) quasi-experimental study suggested that the games element of their course enhanced students' problem-solving skills.

From the perspective of the affective domain, participants saw the potential use of VR to foster empathy and help nurses visualise situations from the perspective of patients. Ouzouni and Nakakis (2012) concluded from their exploratory qualitative study that the concept of empathy is multi-dimensional and involves emotional and cognitive responses from the nurse. Thus, using VR in teaching has the potential to enhance nurses' ability to sense another person's feelings, become aware of their significance, and react accordingly.

Participants voiced concerns regarding the resources incurred by VR, such as the cost of purchasing and maintaining VR headsets and having adequate resources to convert text and PowerPoint into VR. In the view of some participants, these challenges could lead to inequities. While some participants recommended using VR to promote empathy, others believed that VR could be antisocial and isolating and could negatively affect human interactions. Indeed, Dean et al. (2020) argued that the use of VR to teach nurses procedures is beneficial, but not if it replaces opportunities to learn from experienced educators on how to convey caring to patients.

A finding unique to this study related to the view that a lack of interest in VR would result in some students to become distracted and disengaged. Subsequently, participants highlighted the need for feedback while using VR. Some believed that problems such as motion sickness would limit the use of VR. However, Huygelier et al. (2019) in a self-reported questionnaire identified that motion sickness was minimal and had no association with exposure to immersive VR. Of note, motion sickness is associated with extreme VR gaming which involves 'shooting' and 'falling down' rather than using VR for educational purposes (Fernandes and Feiner, 2016).

Participants proposed several approaches to deal with the challenges surrounding VR use. They recommended using VR in small rather than large classes. Some perceived that VR would work better for postgraduate students, possibly due to the smaller numbers of students. When adopted in undergraduate education, participants proposed using VR in small tutorial groups rather than during lectures and recommended having a system in place, which would allow them to hire/use VR at their own leisure in a designated area such as the library and computer lab. The need for continuous feedback was iterated by participants on several occasions to prepare students to use VR, to assist them during VR, or debrief them following VR.

4.1. Limitations

Limitations relate to the small sample size and the descriptive methodology used. It must be acknowledged that the current study was exploratory in nature attempting to explore nursing students' perspectives of incorporating VR in nurse education. Thus, transferability to other students may be limited. Notwithstanding these limitations, this study offers valuable insights into students' perspective of the application of VR to undergraduate nurse education at theoretical and clinical levels.

5. Conclusion

In conclusion, participants recommended embedding VR in nursing curricula. VR was perceived to help students acquire several psychomotor, decision-making, and problem-solving skills and to promote equity among students, especially when exposure to certain clinical experiences is limited. Participants, however, cautioned against replacing pre-existing teaching and learning approaches with VR. Instead, they recommended using VR as an additional/supplemental resource to consolidate learning.

Educators ought to consider the value of using VR across diverse nursing curricula and help address potential threats to actualisation. Educators who are committed to adopting VR as a teaching and learning tool must address issues such as technology costs as well as space and training in VR use. The VR educational experience could be adapted and delivered on a standard desktop to reduce inequity for individuals who experience motions sickness.

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CRediT authorship contribution statement

Mohamad M. Saab: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Validation, Writing – original draft, Writing – review & editing. **Josephine Hegarty:** Conceptualization, Data curation, Formal analysis, Validation, Writing – review & editing. **David Murphy:** Conceptualization, Data curation, Resources, Writing – review & editing. **Margaret Landers:** Conceptualization, Data curation, Formal analysis, Validation, Writing – original draft, Writing – review & editing.

Declaration of competing interest

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