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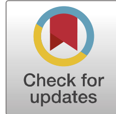

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Building Self-Efficacy in Dementia Care Through Immersive Education: A Mixed-Methods Randomized Control Trial

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KEYWORDS
Virtual reality;
Nursing students;
Self-efficacy;
Dementia;
Mixed methods

Abstract
Background: Improving self-efficacy for nursing students to manage aggressive behaviours in clients with dementia supports better outcomes for clients. No studies have been conducted on the use of immersive virtual reality as a potential tool.
Method: A mixed-methods, randomized control trial explanatory design compared perceived self-efficacy for practical nursing students who used the CareGiVRTM virtual reality application with those who did not, using the Inventory of Geriatric Nursing Self-Efficacy (IGNSE) along with qualitative focus groups.
Results: Forty-six students (49%) participated in the quantitative component. Fifteen students elected to participate in the follow-up qualitative focus groups. Findings indicate participants who used the CareGiVRTM application reported statistically significant higher levels of perceived self-efficacy post-intervention and when compared with those in the control group following their clinical rotation. Four themes were identified: getting real-world experience, a safe place to practice, meeting the client where they are at, and a tool not a replacement.
Conclusion: Immersive virtual reality can be an effective tool to increase perceived self-efficacy for managing aggressive behaviours in clients with dementia in practical nursing students.

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Introduction

The need for dementia education within nursing curricula has been well established (Alushi, Hammond, & Wood, 2015; Cariñanos-Ayala, Arrue, & Zarandona, 2022). However, Eccleston et al. (2015) identified nursing students lack knowledge around progression, symptoms, and management of dementia. This lack of knowledge suggests as students graduate, they may not have the necessary preparation to care for the increasing number of people with dementia (Eccleston et al., 2015). In their study, Kimzey, Mastel-Smith, and Seale (2019) discuss how experiential learning in a simulated environment prior to entering the clinical setting may improve knowledge and attitudes of students providing dementia care to older adults. One form of experiential learning which has become more utilized in nursing education is virtual reality (VR). However, the potential for this technology to increase self-efficacy for nursing students to manage aggressive behaviors in clients with dementia remains a gap in existing literature. Therefore, the purpose of this mixed-methods research project was to explore the effect of the CareGiVR VR platform on student perceptions of self-efficacy in managing aggressive behaviors in clients with dementia.

Background

VR has only recently been applied to the nursing context. Previous studies using VR in a variety of settings with nursing students identified the value of the technology for improving knowledge gain (Adhikari et al., 2021; Chen et al., 2020; Jütten et al., 2017; Kidd, Knisley, & Morgan, 2012; Kimzey et al., 2019; O'Connor, Arizmendi, & Kaszniak, 2014; Saab et al., 2022; Samosorn, Gilbert, Bauman, Khine, & McGonigle, 2020; Wijma et al., 2018), promoting engagement (Adhikari et al., 2021; Botha, de Wet, & Botma, 2021 Butt, Kardong-Edgren, & Ellertson, 2018; Chao et al., 2021; Lange et al., 2020; Saab et al., 2022), skill acquisition (Chang & Lai, 2021; Kardong-Edgren, Farra, Alinier, & Young, 2019), building self-confidence (Adhikari et al., 2021; Chao et al., 2021; Farra, Smith, & Ulrich, 2018; Siah, Xu, Teh, & Kow, 2022) and role-playing (Ma, Huang, & Yao, 2021; Saab et al., 2022). Studies have also explored student perceptions on how students felt the technology could contribute to their overall learning (Farra et al., 2018; Thompson, Thompson, & McConnell, 2020). None of the mentioned studies specifically addressed self-efficacy in a practical nursing student population. There remains a lack of understanding as to how immersive VR can influence student perceptions of self-efficacy in managing aggressive behaviors in clients with dementia.

Virtual Reality

VR has been defined in several ways. This creates confusion and lack of clarity around a common understanding of what VR is. One contributing factor to this lack of clarity is the use of the terms simulation, augmented reality, and VR interchangeably. Two variables are often considered when defining VR: immersion and presence. Immersion represents the ways in which the user can interact within the virtual space through various sensory stimuli (Kardong-Edgren et al., 2019). Presence refers to the extent to which the user experiences the simulated environment (Kardong-Edgren et al., 2019). Broad definitions of VR are inclusive of equipment such as mobile devices, computer monitors, and head-mounted devices. For the purpose of this study, VR has been defined as an immersive simulated experience where the user can interact within the three-dimensional, virtual environment, through multisensory modalities, using a head-mounted device and haptic technology (Lioce et al., 2020).

Self-Efficacy

Self-efficacy is the belief one has in their own abilities, specifically the ability to meet the challenges ahead and complete a task successfully (Bandura, 1993). Increased self-efficacy has been linked to the reduction of caregiver and student stress (Tang & Chan, 2016). Self-efficacy improves resiliency in students leading to improved patient-caregiver interactions, enhanced continuity of care, and economic benefits for the health authority (Cuartero & Tur, 2021).

CareGiVR Application

The purpose of creating the CareGiVR VR application is to provide a realistic training platform for students and caregivers to learn how to de-escalate an aggressive dementia client to a more baseline and controllable mood through the safe use of VR. This dementia scenario presented in VR was designed according to the Healthcare Simulation Standards of Best Practice™ by an interdisciplinary team of content experts including registered nurses, practical nurses, and therapeutic recreation therapists (Rossler, Molloy, Pastva, Brown, & Xavier, 2021). An *International Nursing Association of Clinical Simulation and Learning*—Certified Healthcare Simulation Educator provided expert guidance and consultation on the development and implementation of the simulation. The final application leverages performance capture technology to provide convincing interactions with virtual beings who exhibit signs of anxiety and aggressive behavior. Students can practice responses in a variety of scenarios, receive immediate performance feedback and repeat as necessary for ongoing iterative learning.

Methodology

This study utilized a mixed-methods, randomized control trial explanatory design to answer the following research questions:

1. Does perceived self-efficacy improve for practical nursing students who use the CareGiVR application compared to those who do not, in relation to managing aggressive behaviors in clients with dementia?
2. Are there significant differences between practical nursing students perceived self-efficacy with managing aggressive behaviors in clients with dementia before and after using the CareGiVR application?
3. How did practical nursing students perceive using the CareGiVR application influenced their self-efficacy with managing aggressive behaviors in clients with dementia?

Theoretical Framework

Project design and qualitative thematic analysis were guided by the user-centered design analytic framework proposed by Risling and Risling (2020). The recommended process in the framework is outlined in six steps: (1) Problem identification, (2) Technology solution hypothesis/research question, (3) Data collection and analysis, (4) Intervention Design, (5) Intervention solution building or development, (6) Testing the effectiveness (Risling & Risling, 2020). The qualitative phase of this explanatory study was guided by an interpretive description approach as described by Thorne (2016).

Study Procedures

Sampling and Recruitment

After institutional ethics review board approval (Beh-REB ID:2601) was received, a purposive convenience sample of first year practical nursing (diploma) students enrolled at a mid-western Canadian college was recruited for this study ($n = 93$). Students must have been enrolled in the clinical practice course which takes place in their second semester. Student participation in the study was voluntary, confidential from their instructor, and it was made known the decision to participate would not affect their grades or course evaluation. An a priori power analysis to test the difference between two independent group means using a two-tailed test showed a total sample of 32 participants was required to achieve a power of .80. To test the difference within two dependent group means using a two-tailed test, a total sample of 15 participants was required to achieve a power of .80.

Quantitative Instrument

To measure changes in self-efficacy, the Inventory of Geriatric Nursing Self-Efficacy (IGNSE) (Appendix A) was administered to all students to collect data. The IGNSE is a nine item Likert scale (Mackenzie & Peragine, 2003). This scale consists of nine items assessing self-perceptions of the degree of confidence one has in dealing with challenges experienced working on a dementia unit (Mackenzie & Peragine, 2003). For each item participants are asked to rate their confidence to remain calm, resolve the problem, and achieve a positive outcome (Mackenzie & Peragine, 2003).

Quantitative Phase

Students received theoretical instruction during a practical nursing theory course, with a focus on chronic illness and geriatric care and completed 144 hours of supervised clinical instruction as part of their curriculum where they interacted with a population of clients experiencing dementia. In total, there were three points of data collection (completion of the IGNSE) for the interventional group and two points of data collection for the control group. Table 1 summarizes the following data collection procedures.

Data Collection Procedure

After providing informed consent, each study participant completed the IGNSE via the Survey Monkey online sur-

Table 1 – Summary of Mean IGNSE Scores in Control and Intervention Groups

Weeks	1-6	7-8			9-12	End of Semester	
Control group	Theory and coursework	IGNSE baseline 43.4			Clinical practice experiences	(Q1) Control group IGNSE following clinical practice experience 43.8 $p = .840$	(Q1) Between groups comparison of IGNSE scores following clinical practice experiences $p = .003$
Intervention group		IGNSE baseline 34.1	CareGiVR intervention	(Q2) IGNSE following intervention 49* $p < .01$		(Q1) Intervention group IGNSE following clinical practice experience 53.3 $p < .01$	

* Analysis included two students who did not complete the post-clinical survey.

vey platform to collect baseline data. Using the Microsoft Office Excel random number function, subjects were assigned to the control or intervention group. Because of time and scheduling constraints, this was done as an ongoing process in batches of six to ten students. At the end of recruitment, both the intervention and control groups had 20 students.

Intervention Group

Students who were part of the intervention cohort scheduled an individual appointment in the VR lab located within the educational institution then participated in the CareGiVR simulation, which was the intervention. During the appointment the researcher met the students and provided an orientation to the Oculus Quest 1 VR headset, Oculus Touch controller equipment operation, and an overview of the scenario. The use of the CareGiVR application did not require the participant to enter any login credential or enter any personal information into the application or computer. No personal data was collected or stored when the participant completed the CareGiVR scenario using the Oculus Quest 1 headset.

Once the application was launched, a visual tutorial of how to move within the virtual space, pick up objects, and interact with the client took place. After the tutorial the participants worked through the "Vivian" dementia case scenario. During this time the researcher was present ensuring safety of the participant from cords and walls, and observed for signs of disorientation or distress. The researcher was able to watch the same view as the participant through a computer monitor and observe their clinical decisions within the scenario. Following the conclusion of the scenario, a user report of every participant was automatically generated by the software detailing the participant's activity log, including the decision, time, repetition, and total progress through the scenario. This record provided a secondary source of quantitative data which the researcher analyzed and contributed to data triangulation. Immediately after the scenario the participant was taken into an adjacent room to complete the IGNSE a second time without the researcher present. The student provided email from the initial survey was re-entered to be able to pair responses. Participants were also advised they would receive the survey a third time, and a focus group invitation after their clinical course was completed.

Control Group

Participants assigned to the control group were advised they would be receiving a second invitation to complete the IGNSE once their clinical course was completed for a total of two survey completions. Once data collection closed, anyone who wished to participate in the "Vivian" scenario was given an opportunity via an email invitation. No students from the control group were elected to participate.

Analysis

A paired samples t-test was conducted to see if the practical nursing students' self-rated scores changed before and after the VR simulation, and after their 144 hours of clinical practice in the long-term care environment. An independent samples t-test was conducted to see if there was a significant difference in perceived self-efficacy between students in the intervention and control groups after their clinical experience. All data analysis were performed using Statistical Package for the Social Sciences (SPSS) version 28. The researcher reviewed the user logs for identification of patterns and trends to further understand the participants' experiences.

Results

A total of 46 students (49%) responded to the invitation to participate. Two surveys were not completed and therefore removed prior to randomization. Two students from the intervention group did not make appointments to participate in the scenario and therefore their responses were excluded. An additional two intervention group

students and six control group students did not complete the post-clinical survey and their data was excluded from question one.

Question 1: Does perceived self-efficacy improve for practical nursing students who use the CareGiVR application compared to those who do not, in relation to managing aggressive behaviors in clients with dementia?

Question 2: Are there significant differences between practical nursing students perceived self-efficacy with managing aggressive behaviors in clients with dementia before and after using the CareGiVR application?

Table 1 summarizes the findings from research questions 1 and 2.

Normality testing demonstrated the control and intervention group clinical mean scores for the IGNSE to be normally distributed. Levine's Test for Equality of Variances was not significant ($p = .137$) therefore, equality of variances is assumed. Mean intervention group IGNSE scores following the CareGiVR intervention were significantly higher (49; $p < .01$) than the baseline IGNSE (34.1). Following their clinical practice experience, the intervention group had significant variation in their IGNSE score (53.3) compared to the control group (43.8) ($p = .003$). In the control group, there was no significant difference between the pre-clinical (baseline) IGNSE and the IGNSE following clinical practice experience (43.8; $p = .840$) however, there was a significant difference within the intervention group (53.3; $p < .01$). Therefore, the null hypothesis of no differences for practical nursing students perceived self-efficacy with managing aggressive behaviors in clients with dementia who use the CareGiVR application compared to those who do not, in relation to managing aggressive behaviors in clients with dementia is rejected.

Qualitative Phase

Procedure

Informed by the quantitative findings, CareGiVR user reports, and researcher field notes, a structured focus group interview guide (Appendix B) was developed by the principal investigator and reviewed and refined by several members of the research team until consensus was reached. Three focus groups were held on zoom with an average group size of four to six and 15 participants total, excluding the researcher; they lasted approximately 45 minutes each.

Data Analysis

Data analysis began following the first focus group in a constant comparative format and continued until all focus groups were completed. The researcher became immersed in the data by reading transcripts, listening to recorded audio, and reflecting on observations and field notes. Data analysis were conducted by the first author and discussed with the second author to minimize errors and improve research credibility and confirmability.

Results

Based on the study data four themes were identified: getting real-world experience, a safe place to practice, meeting the client where they are at, and a tool not a replacement.

Getting Real-world Experience

When asked to reflect on the experience of using the CareGiVR application, study participants from the intervention group noted the application was a way to gain potentially real-world experience through the use of VR. This finding meant the students were able to experience a potential scenario they may encounter within the clinical setting and experiment with a variety of interventions. One participant, SN3, noted how the scenario presented was similar to an event which occurred within the clinical setting:

"*It's funny when [client] became upset with me I thought back about Vivian and it was like 'ok I know what to do I have seen this before' so ya, it made me feel like I could handle this you know? It made me feel like I could do what I did with Vivian because I had tried it with her and it worked. I didn't have to immediately call for help."* [SN3]

A participant recalled their time within the VR application and noted the realism of the scenario helped contribute to feeling as though the scenario was actually occurring rather than taking place in a lab. SN6 explained:

"*When you put the headset on, I dunno it's like I forgot where I was. I think that's what made me get so into it. Like I really cared about her and what was going on. When she was getting upset at me I could feel myself getting more and more frustrated. It's like I forgot I was in the simulation and I really was in a long-term care room trying to get this client ready. Even the drawings and the lamp, like it was so realistic."* [SN6]

A Safe Place to Practice

Participants reinforced the advantage of the CareGiVR platform allowing for practice without risk of injury to self or client. Students noted although the avatar 'Vivian' would often display non-verbal body language suggesting she may strike out or kick, the students were aware there was no risk of physical harm. As SN12 explained:

"*At one point she didn't like the hairbrush I gave her and she like almost threw it at me and shouted. I jumped because I wasn't expecting it but like that could happen you know? So like, you need to be prepared and I knew I couldn't get hurt. So I kept going and trying the scenario and I eventually was able to brush her hair. I don't know what I would have done if that was real clinical and she actually threw it at me, I probably would have needed help*

but in the scenario I knew she couldn't hurt me and she's not real so like she wasn't going to get hurt either, so I could keep practicing." [SN12]

The theme of practicing in a safe place also emerged within the context of assessment and self-perception. Students appeared to associate their own psychological safety with the scenario being non-evaluative and individual. SN4 described their experience:

"*There wasn't any risk you know? It's not like this was a lab exam that my instructor was going to fail me and I'd get kicked out if I did something wrong, or embarrass me in front of everyone in the class, since no one else was here and you already said this was for learning and you wouldn't tell if we did something bad."* [SN4]

Meeting the Client Where They Are At

Students acknowledged during the CareGiVR scenario there were times they experienced feelings of frustration and annoyance because the client would not comply with the intervention. SN2 recalled a situation where she had to use a facecloth to help wash Vivian's face:

"*Like I could feel myself getting tense and annoyed and I had to be like 'ok stay calm this isn't anyone's fault she has dementia' but it was hard you know? I wanted her to just let me do it but I knew I had to try something else since it wasn't working. But that's the thing like it isn't their fault and it isn't yours either when something doesn't work you can't overthink it you just need to meet them where they are at and do the best you can."* [SN2]

The literature review on the use of immersive VR with students noted the capacity for this technology to assist in building empathy with students (Ma et al., 2021; Saab et al., 2022). Although the students in this study did not explicitly use the term empathy in the description of "meeting the client where they are at supports" this idea. SN10 acknowledged the concept of empathy as a determining factor for their own self-efficacy.

"*I didn't really think about it at the time but after I was like, man it must be really tough to not be able to do stuff anymore, like for her especially since she used to do everything. So you can kind of see why she would get so frustrated with us always bugging her, especially if she's confused. Like that was my big thing for clinical, I think is just like that we really don't know when they will have good days or bad days but I know that I can still do a good job and try to help them as much as I can because they aren't doing it on purpose."* [SN10]

Tool Not a Replacement

Students were asked to envision how CareGiVR and VR could be used within the program as way to build self-efficacy in dementia education. Students were enthusiastic about the prospect of this technology being integrated into the curriculum. However, students also expressed that while they felt the technology would be useful it could not fully replace the clinical setting as a learning tool. SN4 expressed:

"*I think it has its place for sure, like I could see us using it to practice in the lab before clinical but I still think we need real experiences. Especially for the hands-on stuff like you still are holding controllers with the VR and you have a limited amount of options and things you can do. Plus there was only one head set so I don't really know how that would work unless you had more."* [SN4]

One student offered specific insight as to how they would suggest the CareGiVR platform be utilized within the program as a way to build self-efficacy in dementia education.

"*So if I were you I'd do it as like an extra because for one thing it wouldn't really work to have us all there at once like we are when we are together at clinical. I could see it being maybe an optional thing for students who are really nervous about clinical or in the lab to go and use it but there are still parts that aren't real – like the teleport part you can't do in clinical and you only have a few options to pick from with this, in clinical anything can happen and you need to know what to do, so like this helps but it's not going to totally prepare us*." [SN5]

Discussion

This study is the first of its kind exploring the use of VR for improving self-efficacy in managing aggressive behaviors in clients with dementia with a practical nursing student population. Within the population of practical nursing students, it is apparent their self-efficacy improved following using the CareGiVR application, and their perceived self-efficacy was higher than their peers who did not use the CareGiVR application, following their clinical practice experiences. Therefore, this study affirms VR can be an effective strategy for building self-efficacy to manage aggressive behaviors in clients with dementia. As demonstrated in this research, perceived self-efficacy for managing aggressive behaviors in clients with dementia can increase when students utilize the CareGiVR application compared with those who do not. When students have a higher self-efficacy they may perform better in the clinical setting, exhibit higher levels of independence, and be less likely to leave the program (Alosaimi, 2021; Gregory et al., 2022). Four themes were identified during the qualitative analysis within this study: getting real-world experience, a safe place to practice, meeting the client where they are at, and a tool not a replacement.

Similar to previous studies (Botha et al., 2021; Farra et al., 2018) students felt the scenario provided an element of realism not offered in the traditional laboratory setting. The scenario evoked the same emotions one may feel during clinical practice if a client is being aggressive and non-compliant, including frustration and annoyance.

The result of experiencing these emotions allowed the students to reflect on their own behaviors and body language during the scenario, and recognize the importance of self-regulation and understanding the disease process. By meeting the client where they were at cognitively, and recognizing the actions taken by the avatar were part of the disease process, rather than a personal attack, the students felt better equipped to anticipate how they would respond in a real-word setting, which reinforces the conclusions from Ma et al. (2021) and Saab et al. (2022) that VR can be effective for building empathy. Additionally, students highlighted the importance of being able to practice in a safe setting, where although the avatar was displaying a variety of facial and physical movements, suggesting they may exhibit an aggressive response, the students were aware there was no risk of injury to themselves or a client. The practical nursing students highlight the importance of integrating the CareGiVR application to enhance experiences, not replace clinical hours.

Previous research and the results of this study demonstrate VR can be a viable teaching tool within nursing education (Adhikari et al., 2021; Chao et al., 2021; Farra et al., 2018; Siah et al., 2022; Thompson et al., 2020). However, none of the previous research included the use of immersive VR to improve practical nursing students' self-efficacy to manage aggressive behaviors in clients with dementia. Therefore, this study helps to fill a gap within the existing body of nursing knowledge and create future opportunities for ongoing research in this area. Furthermore, this study represented the student population whose perspective may not always be considered when making pedagogical decisions for nursing program curriculum development.

Strengths and Limitations

During this timeframe of the study students were also completing their laboratory examinations and practical skills testing prior to entering the practice setting. Therefore, the recruitment may have been impacted by students prioritizing their assessments. Implementation of the intervention did not result in any delays or malfunctions with the technology. In one instance, the system had to be restarted prior to the participant commencing the scenario. The clinical practice experience is part of the nursing curriculum and although all students had the opportunity to interact with a variety of clients with dementia, each experience of the student was not identical. The amount of interaction and exposure to aggressive behaviors prior to completing their post-clinical IGNSE may have varied depending on the site and shift attended.

The sample population from this study included practical nursing students from only one post-secondary institution. Therefore, generalization of these findings to the broader nursing student populations should be done with caution. The COVID-19 pandemic was a major limitation of this study. There may have been hesitancy among the student population to participate, knowing this would warrant additional time in the presence of another person. All guidelines were followed to clean and social distance.

Conclusion

The findings from the study provide insight into students' perceptions of the CareGiVR VR program and may provide guidance to nursing educators for effective integration of VR as a teaching tool. Within the existing literature it was suggested students responded more positively to the VR when they had adequate orientation and familiarly with the technology (Saab et al., 2022; Siah et al., 2022). Therefore, when planning to integrate the CareGiVR application into their curriculum, nursing educators should be mindful to intentionally schedule orientations for showing students how to use the use the controllers and interact with the features of the application, while allowing time for questions and clarification. Within this study the dependent variable was self-efficacy. Future studies could measure other traits such as resilience, determination, empathy, and competence.

Conflict of Interest

The authors declare no conflict of interest.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.ecns.2024.101557.

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