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Virtual Reality Simulation's Influence on Nursing Students' Anxiety and Communication Skills With Anxious Patients: A Pilot Study☆☆☆

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KEYWORDS
Full immersion virtual reality simulation;
Anxious patients;
Communication skills;
Nursing students

Abstract

Background: Anxiety is the most prevalent mental health disorder in the United States and globally. Nurses do not feel adequately prepared to care for anxious patients, citing a lack of education in effective communication skills. Ineffective communication can negatively influence the therapeutic nurse-patient relationship and patient outcomes. Simulation methods such as high-fidelity simulation and standardized patients have decreased nursing students' anxiety levels in caring for anxious patients. The use of full immersion virtual reality simulation as an education modality has demonstrated success in nonhealthcare and medical education but is limited in nursing education.

Sample: Thirty-three nursing students from two accredited registered nurse programs.

Methods: A quasi-experimental design implementing an anxious patient scenario in full immersion virtual reality simulation was utilized. Spielberger's short-form State Anxiety Inventory assessed students' anxiety levels, while the simulation's analytics dashboard evaluated their communication skills.

Results: A statistically significant decrease in students' anxiety levels over time was found. Participants' communication scores did not demonstrate significance.

Conclusion: Full immersion VRS demonstrated a decrease in students' anxiety levels. This study was the first to utilize the simulation's analytics dashboard to evaluate communication skills.

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Background

Anxiety disorders are the most prevalent mental health disorder in the United States and globally, with approximately 40 million United States adults experiencing anxiety each year (Anxiety & Depression Association of America, 2022), and 45.82 million anxiety cases across the world (Yang et al., 2021). Unfortunately, many anxiety sufferers go undiagnosed or untreated because of a perceived negative societal stigma, personal embarrassment, or normalization of symptoms (Sari & Yuliastuti, 2018; Wei, McGrath, Hayden, & Kutcher, 2015, 2016). Those who attempt to seek treatment for their anxiety symptoms

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may perceive their encounters with healthcare providers as unsupportive or dismissive; therefore, avoiding care (Brunero, Ramjan, Salamonson, & Nicholls, 2018).

Key Points

- Ineffective communication with anxious patients can negatively influence the therapeutic nurse-patient relationship and patient outcomes.
- Full immersion VRS decreased students' anxiety levels when communicating with anxious patients.
- This study was the first to use an algorithm-based analytics system to assess communication skills, assigning numeric values to performance.

Untreated anxiety symptoms lead to poor outcomes as patients experiencing anxiety may not be able to process and remember newly given information and may exhibit poor coping skills, leading to noncompliance (Meng et al., 2020; Price, 2017; Toronto & Weatherford, 2016).

Nurses are the frontline caregivers of patient care and spend the most time communicating with patients; however, many nurses feel unprepared to successfully care for patients experiencing anxiety (Alexander, Ellis, & Barrett, 2016; Avery, Schreier, & Swanson, 2020). A lack of effective communication experiences in undergraduate nursing education, limited professional development opportunities addressing therapeutic communication techniques, and overall guidance on meeting anxious patients' needs have contributed to nurses' feelings of unpreparedness (Alexander et al., 2016; Avery et al., 2020; Giandinoto & Edward, 2015). Insufficient communication experiences with anxious patients in nursing education have contributed to anxiety in nursing students, which may negatively influence the therapeutic nurse-patient relationship and patient outcomes (Avery et al., 2020; Kameg, Szpak, Cline, & Mcdermott, 2014; Szpak & Kameg, 2013). Moreover, nurses who suffer from anxiety may also negatively impact the nurse-patient relationship due to an inability to communicate effectively and empathize with their patients' experiences, which can lead to misunderstandings, errors, and patient dissatisfaction (Ayuso-Murillo et al., 2020).

The literature established that simulation using high-fidelity mannequins and SPs reduced nursing students' anxiety when caring for anxious patients (Kameg et al., 2014; Szpak & Kameg, 2013). However, high-fidelity mannequins are expensive and may not be able to portray the necessary level of realism as they cannot display nonverbal communication cues (Haerling, 2018; Kameg et al., 2014; Szpak & Kameg, 2013). Programs using SPs may face barriers such as cost, availability, and consistency concerns when functioning within large-scale simulations (Sarikoc, Ozcan, & Elcin, 2017).

Full immersion virtual reality simulation (VRS) uses a headset and hand controls to completely immerse the learner in a virtual environment, igniting emotional responses and reactions as if the virtual simulation were a real-life scenario (Muckler, 2017). Research has demonstrated the effectiveness of full immersion VRS in nonhealthcare disciplines such as computer and gaming science, engineering, chemical sciences, construction, pharmaceuticals, military training, and the oil and gas industry (Ahmed, 2019; Kassem et al., 2017; Lele, 2013; Norrby et al., 2015). Evidence of full immersion VRS in medical education for surgical training, advanced trauma life support skills, and leadership and communication skills are also prevalent (Izard, Juanes Mendez, & Palomera, 2017; Locketz et al., 2017; McGrath et al., 2018; Real et al., 2017; Sugand, Akhtar, Khatri, Cobb, & Gupte, 2015). Although an emerging concept in nursing education, research on full immersion VRS in nursing education is limited. However, the available literature has found that participants viewed full immersion VRS as an authentic and immersive experience, earning positive feedback (Butt, Kardong-Edgren, & Ellertson, 2018; Samosorn, Gilbert, Bauman, Khine, & McGonigle, 2020; Shin, Rim, Kim, Park, & Shon, 2019; Smith et al., 2018; Ulrich, Farra, Smith, & Hodgson, 2014; Vottero, 2014). To date, no studies have investigated full immersion VRS's influence on nursing students' anxiety levels and communication skills when caring for anxious patients.

Theoretical Framework

The NLN Jeffries simulation theory, originating from the literature supporting simulation-based learning, served as the theoretical framework (Jeffries, 2016). Collaboration among INACSL, NLN, and other key simulation stakeholders has driven its development and refinement (Jeffries, 2016). This study meets Jeffries' six core elements: context, background, design (content, complexity, and fidelity level), simulation experience, educational strategies, and outcomes (participant, patient, and system outcomes). The full immersion VRS anxious patient scenario is designed for instruction and learning, setting the simulation's context while its student learning objectives and goals set the background. Moreover, the scenario provides appropriate content related to the communication and care of anxious patients, its complexity is designed for nursing students, and its full immersion VRS delivery produces a high-fidelity level. The simulation's context, background, and design influence the overall simulation experience. The interactions between the participant and the avatar followed by a performance analytics summary contribute to the simulation's educational strategies. Lastly, this study focused on participant outcomes with the goal of contributing to nursing education system out-

comes on graduate nurse communication skills and anxiety levels.

Sample

Participants

A convenience sample of undergraduate registered nursing students was recruited from two accredited registered nursing education programs from a college in North-central Pennsylvania. Only those currently enrolled in the nursing programs were asked to volunteer for the study. There were no exclusion criteria for the eligible participants.

Method

Guided by the NLN Jeffries Simulation theory, this pilot study implemented a quasi-experimental design to determine if full immersion VRS influenced nursing students' anxiety levels and communication skills when caring for anxious patients. Before implementation, this study earned approval from the Human Subjects Institutional Review Board (IRB).

Simulation Scenario

The anxious patient scenario by Oxford Medical Simulation (OMS) was utilized for this study as they provide a large variety of peer-reviewed, full immersion scenarios that engage participants, assess performance, and allow for repeated practice (Oxford Medical Simulation, 2022). The scenario's objectives included determining the root cause of the patient's acute anxiety, demonstrating appropriate nursing interventions regarding patient care, and employing therapeutic communication techniques to calm the patient. Each participant completed the same anxious patient scenario twice with 21-37 days between simulation sessions I and II. Participants were given a three-week window of time to complete each session to accommodate their busy schedules.

Demographics Survey

After providing informed consent and drawing a random number to assure anonymity, the participants completed an electronic demographics survey and Spielberger's short form State Anxiety Inventory (SAI). The demographic data survey included age, ethnicity, nursing education program, nursing education level, participants' experience communicating with anxious patients, and their experience with full immersion VRS. The experience questions were rated on a four-point Likert scale ranging from no experience (one point) to most experienced (four points).

Spielberger's Short-Form State Anxiety Inventory

Spielberger's short form SAI, a shortened subscale of Spielberger's 40-item State-Trait Anxiety Inventory for Adults™, is a ten-item inventory consisting of five anxiety-present and five anxiety-absent items (Spielberger, 2015). The anxiety-absent items are sensitive to low stressors, while the anxiety-present items are sensitive to high stressors. The short form SAI measures anxiety on a four-point scale ranging from 1 (i.e., not at all) to 4 (i.e., very much so) for the anxiety present items, and 4 (i.e., not at all) to 1 (i.e., very much so) for the anxiety absent items. Scores range from a minimum of ten, or no anxiety, to a maximum of 40, or high anxiety (Spielberger, 2015).

The mean anxiety score norms from the short form SAI for working adults are described as follows: 18.61 (± 5.95) for ages 18-22, 18.66 (±6.17) for ages 23-32, and 17.53 (±5.65) for those 33 years and older (Spielberger, 2015). This data was used to compare the study participants' anxiety scores. The copyright policy for Spielberger's SAI prohibits item reproduction in published work, only allowing item numbers. Therefore, to maintain the integrity of the SAI, only four sample items that the publishing company chose were permitted for display (Appendix A). This anxiety assessment was chosen because it has been commonly used to measure anxiety in college students and evaluate anxiety treatment outcomes (Spielberger, 2015). In addition, Spielberger's short-form SAI has an extensive history of reliability coefficients greater than 0.90 (Spielberger, 2015).

All participants were instructed to complete the short form SAI under the context of being assigned to care for a patient experiencing anxiety. Participants' anxiety levels were assessed one week before simulation session I, immediately after session I, and immediately following session II, providing three points of anxiety data over time.

Oxford Medical Simulation Communication Performance Analytics Dashboard

The performance analytics dashboard uses algorithms to evaluate the participants' communication skills, issuing a percentage score ranging from 0% to 100% (Oxford Medical Simulation, 2022). The analytics dashboard has been supported by many medical schools and nursing education programs and demonstrated effectiveness in medical, military, and nursing research (Oxford Medical Simulation, 2022). Currently, there is no reliability and validity data to support the OMS communication performance dashboard. Appendix B provides an example of the scores displayed within the analytics dashboard which include

the individual's average score; percentages on skill performance including technical skills, communication, teamwork, and timing; improvement between attempts, and peer comparison.

Anxious Patient Scenario Session I

After a brief orientation to the simulation equipment, each participant logged into the OMS software system using their random identification number and independently completed the anxious patient scenario. The researcher remained present to troubleshoot any technical issues but did not provide any assistance in completing the scenario. The expected time to complete the full immersion VRS anxious patient scenario was 15-20 minutes. Upon completion of the scenario, each participant reviewed their communication score provided by the simulation's analytics dashboard, completed the short form SAI posttest under the same conditions as the SAI pretest, and scheduled their second simulation session a minimum of three weeks from session I.

Anxious Patient Scenario Session II

During simulation session II, each participant logged into the OMS software and independently completed the same anxious patient scenario. In addition, they reviewed their second communication score and completed the short form SAI posttest II under the same context provided for the SAI pretest and posttest I.

Results

Description of the Sample

The demographic data presented in Table 1 represented the study sample by age, ethnicity, nursing program type, nursing education level, experience in communicating with anxious patients, and lastly, their experience with full immersion VRS. Although there was representation within all the age categories, the most common age range was 18-25 years. The undergraduate nursing student population at the college lacked diversity which was apparent in the sample as most participants were white, with only a few from the Hispanic or black population. The sample depicted an almost even split between the associate and bachelor's degree registered nurse programs; however, there were far more participants in the latter half of their nursing education than those in the fundamentals and med-surg 1 level. The number of students in the upper-level med-surg categories (Med-surg 2 and Med-surg 3) correlated with participants' experience communicating with an anxious patient. Five participants expressed moderate to high experience with full immersion VRS, whereas the remainder of the sample had minimal to no experience with this technology.

Table 1 – Demographic Profile of Study Participants (N = 33).

Characteristic	Dimension	Frequency	Percentage
Age	18-25 years	18	54.5%
	26-35 years	7	21.2%
	36-45 years	6	18.2%
	46+ years	2	6.1%
Ethnicity	White	28	84.8%
	Hispanic or Latino	2	6.1%
	Black or African American	3	9.1%
Nursing program	Associate degree RN	17	51.5%
	Bachelor degree RN	16	48.5%
Nursing education level	Fundamentals	7	21.2%
	Med-surg 1	4	12.1%
	Med-surg 2	10	30.3%
	Med-surg 3	12	36.4%
Experience communicating with an anxious patient	No experience	3	9.1%
	Minimal (1-2)	8	24.2%
	Moderate (3-5)	10	30.3%
	Experienced (5+)	12	36.4%
Experience with full immersion virtual reality simulation	No experience	23	69.7%
	Minimal (1-2)	5	15.2%
	Moderate (3-5)	4	12.1%
	Experienced (5+)	1	3.0%

Table 2 – Timeframe Between Session I and Session II.

Characteristic	Dimension	Frequency	Percentage
Days between VRS 1 and VRS 2	21 days	17	51.5%
	23 days	1	3%
	25 days	3	9.1%
	26 days	3	9.1%
	28 days	6	18.2%
	31 days	1	3%
	35 days	1	3%
	37 days	1	3%

Full Immersion Virtual Reality Simulation Session I and II

All 33 participants that volunteered for the study completed it in its entirety, earning a presimulation anxiety score, two postsimulation anxiety scores, and two communication scores. The mean timeframe between the completion of simulation sessions I and II was 24.36 days, with a minimum of 21 days and a maximum of 37 days (Table 2). Participants were not permitted to complete their second session less than 21 days or greater than 37 days after their first session to limit the possibility of confounding variables. Three participants completed session II on days 31, 35, and 37 because of quarantine requirements related to COVID-19.

Participants completed VRS session I (Figure 1) within a median time of 17 minutes 25 seconds (1,045 seconds), whereas the shortest time spent in VRS I was 9 minutes (540 seconds) and the longest was 25 minutes (1,500 seconds). VRS session II (Figure 1) was completed within a median time of 13 minutes 1 second (781 seconds); the shortest time at 7 minutes 41 seconds (461 seconds) and the longest at 24 minutes 16 seconds (1,456 seconds). The anticipated time to complete the VRS anxious patient scenario was 15-20 minutes, as depicted by the red lines in Figure 1. The median time for VRS session I was in the anticipated time range, while the median time for VRS II was below that range. Completing VRS II in less time than VRS I was expected because it was the same anxious patient scenario. Based on their first

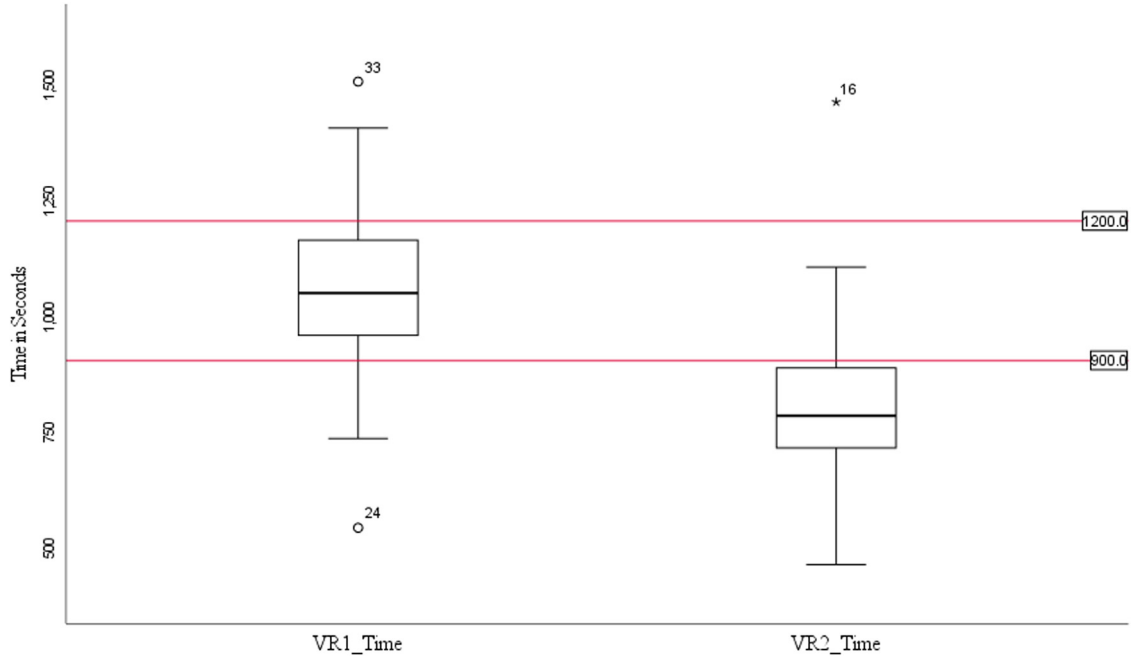


Figure 1 Session I and Session II time.

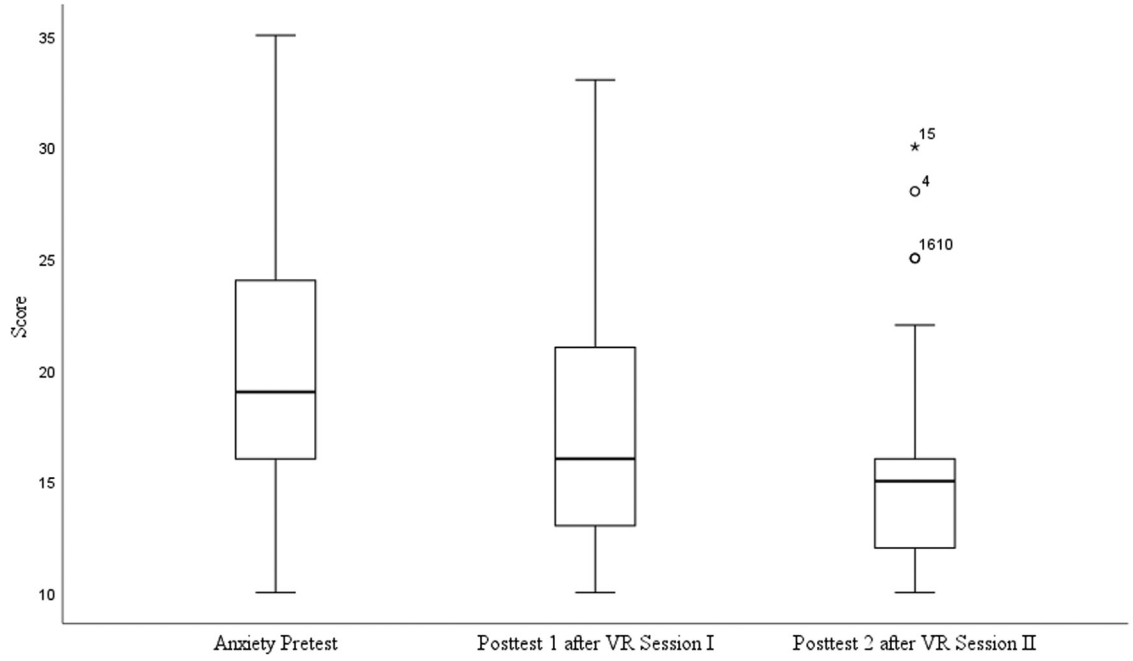


Figure 2 Box plot identifying outliers: anxiety levels.

experience, participants knew what to expect and reacted quicker.

Participants' Anxiety Levels

The participants' mean pretest anxiety levels aligned with the anxiety norms outlined by Spielberger's SAI among adults. The intent was to complete a one-way repeated measures ANOVA to determine whether there were statistically significant differences in participants' anxiety scores. However, the data failed some assumptions of the ANOVA, so the Friedman one-way analysis of variance by ranks test was completed. The pretest and posttest I data contained no outliers; however, the box plots identified three outliers and one extreme point within the posttest II data (Figure 2).

The Friedman test found that participants' anxiety scores were statistically significantly different at the three different time points, x^2 (2) = 21.193, $p < .001$. Therefore, the null hypothesis was rejected. Post hoc analysis revealed statistically significant differences in the anxiety pretest (Mdn = 19) and posttest II (Mdn = 15) ($p < .000$). It is noteworthy that the necessary sample size for the Friedman test for 80% power was 36 participants, and this sample size contained 33 participants. Although significance was met, not meeting the required sample size reduced the statistical power.

Participants' Communication Scores

A one-tailed paired t-test analyzed the participants' communication scores. Figure 3 demonstrates normal distribution among the difference between session I and session II communication scores while Table 3 depicts the mean communication scores from simulation session II (M = 56.64, SD = 12.03) were greater than the mean session I communication scores (M = 55.67, SD = 12.54); however, the mean increase did not meet statistical significance ($p = .320$). Therefore, the null hypothesis was not rejected.

Limitations

This study was limited in several ways. The sample size was small, its participants lacked ethnic diversity, and there was no control group as part of the study design. Furthermore, this was a single-site study which limits generalizability. In addition, the sample size contained a mix of age and education levels which may lead to a vast range of participants' initial anxiety levels, communication skills, and experiences caring for anxious patients. Also, an anxiety score was not captured prior to session II, so the participants' anxiety levels prior to session I cannot be compared to their anxiety levels before starting session II. Moreover, the time lapse between sessions I and II could have allowed students to gain experiences in caring for anxious patients from their clinical rotations, impacting their anxiety levels and communication skills. Given the new use of an analytics dashboard assessing communication skills, there is currently no data to support its reliability and validity, nor was the algorithm used to evaluate communication skills able to be previewed. Therefore, it cannot be determined exactly how the technology rates and scores performances

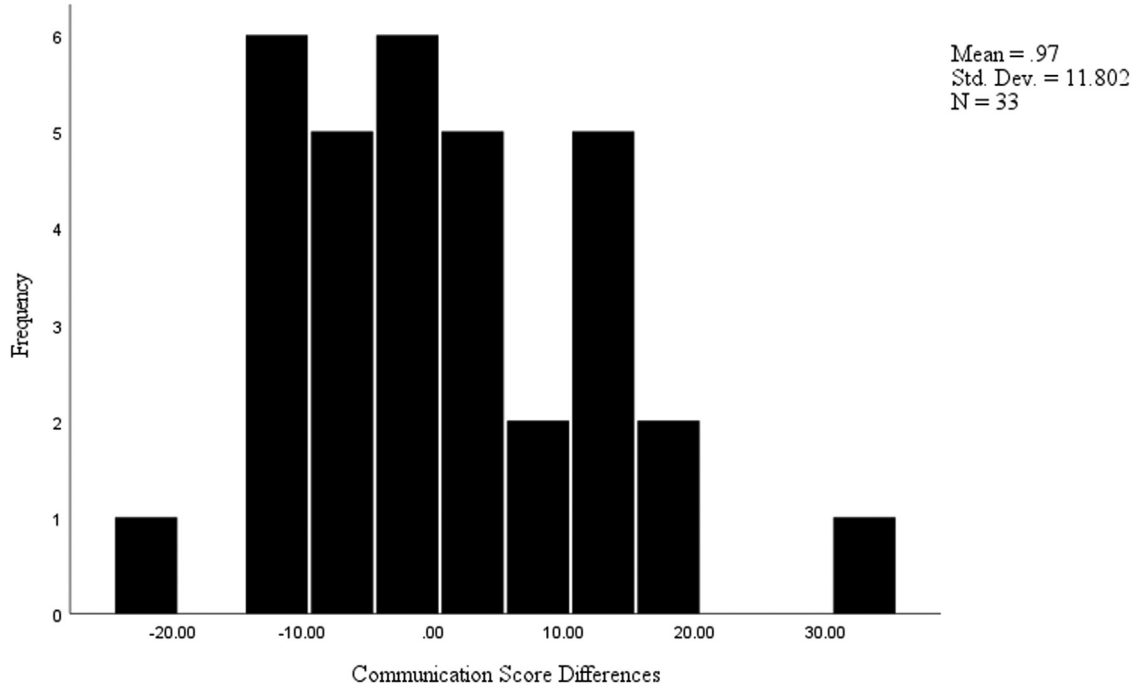


Figure 3 Histogram: differences in communication scores.

Table 3 – Paired Samples Statistics.

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Comm2_Score	56.64	33	12.033	2.095
	Comm1_Score	55.67	33	12.544	2.184

and the specific behaviors being assessed to generate a score.

Discussion

This study aimed to apply the most up-to-date simulation technology to nursing education, focusing on undergraduate nursing students' anxiety levels and communication skills when communicating with anxious patients. The study found that nursing students' anxiety levels decreased over time while using full-immersion VRS. The decrease in anxiety levels aligned with Kameg et al. (2014), who used SPs and assessed students' anxiety levels with the original state-trait anxiety inventory in a pretest-posttest format. Szpak and Kameg (2013) also found similar results with high-fidelity simulation, indicating a significant reduction in students' anxiety levels through a pretest-posttest design using Spielberger's state-trait anxiety inventory. Comparatively, this study found that full immersion VRS may also be an integral tool to reduce students' anxiety levels and evaluate their performance.

The participants' communication scores improved slightly from session I to session II, but statistical significance was not obtained. Notably, the participants' mean communication scores were low for both sessions which may accurately represent nursing students' lack of communication skills, emphasizing the need for more communication-based experiences in nursing education. Another cause for the low scores could be related to the VRS systems' analytics dashboard itself and its sensitivity to students' communication choices.

Although a significant increase in communication scores was not found, this study was the first to utilize an algorithm-based analytics system to assess communication skills. The analytics system provided a way to quantify students' communication skills which could be measured and compared among individuals or as a group. Frequently, communication skills have been evaluated through direct faculty observation, which may introduce subjectivity. Additionally, communication skills have been measured

through a pretest-posttest design which only assesses a student's knowledge related to communication rather than performance. To date, an objective measure of communication skills has not been perfected or consistently applied to nursing education.

In addition, the link between nurse anxiety and a negative impact on the nurse-patient relationship warrants further exploration. A quality, therapeutic nurse-patient relationship is imperative as nurses have the most continued contact with patients compared to other healthcare professionals (Ayuso-Murillo et al., 2020; Wan, Jiang, Zeng, & Wu, 2019). Therefore, research is needed to identify effective methods that support nurses with anxiety disorders, allowing them to provide quality patient care.

Conclusion

Anxiety disorders are highly prevalent worldwide, and due to nurses' unpreparedness in communicating with anxious patients, has led to a strain in the nurse-patient relationship. Nursing education programs may not be providing the necessary communication training for their students, contributing to anxiety among nursing students when having to care for an anxious patient. Full immersion VRS has become an important learning tool in nonhealthcare fields as well as medical education, but its influence in nursing education is limited. Research using high-fidelity simulation and SPs has reduced nursing students' anxiety when communicating with anxious patients, and this study found comparable results using full-immersion VRS. In addition, this study was the first to utilize an algorithm-based analytics system to assess communication skills, assigning numeric values to performance. Further exploration into full immersion VRS as a learning tool and evaluation method in nursing education will contribute to the future of the nursing profession.

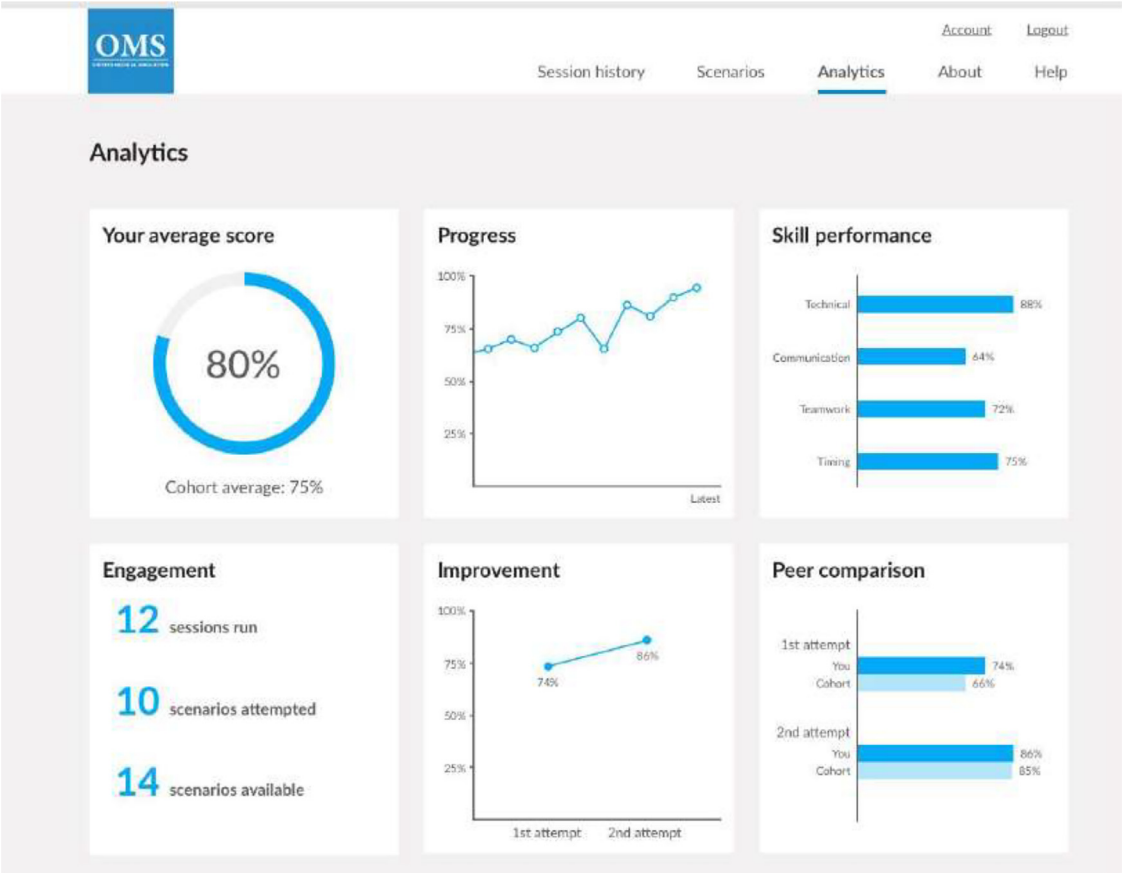
Appendix A: Sample State Anxiety Inventory

Directions: A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how you ***generally*** feel.

Use the following scale:
ALMOST NEVER – SOMETIMES – OFTEN – ALMOST ALWAYS

Sample items:	ALMOST NEVER	SOMETIMES	OFTEN	ALMOST ALWAYS
I feel at ease	4	3	1	1
I feel upset	1	2	3	4
I lack self-confidence	1	2	3	4
I am a steady person	4	3	2	1

Appendix B: OMS Analytics Dashboard



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