Virtual reality: acquisition of skills in physical examination of nursing students

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ABSTRACT

The Nursing Process (NP) is a fundamental tool for providing quality patient care. It has 5 stages, the first being the assessment, which is considered the most relevant since it supports the NP in the information obtained. In this stage, inspection, palpation, percussion, and auscultation techniques are used in the physical examination as tools in the assessment process. Virtual reality could be a beneficial intervention to train nursing students in acquiring their inspection and auscultation skills in the cardiac, respiratory, and digestive systems. The objective of this study was to evaluate the didactic strategy with the use of virtual reality in the acquisition of physical examination skills in the cardiac, respiratory, and digestive systems in nursing students. Methodology: a quantitative study of the quasi-experimental design of one group with pre and post-intervention evaluation was carried out. Results: the results in the pre-test related to the median was 5.5, varying positively with an increase in the post-test to 6.3, obtaining that the application of a didactic strategy with virtual reality significantly improves/enhances the processes of acquisition of physical exploration skills in nursing students. Discussion: the results obtained in our research demonstrate that the use of a realistic and low-cost simulator for cardiac, respiratory, and digestive exploration improves the acquisition of skills and stimulates learning in the student, in addition to facilitating the deliberate practice of the procedure before performing it on a real patient. The incorporation of virtual reality in the acquisition of physical examination skills in the cardiac, respiratory, and digestive systems is an instrument that can be added to the nursing curriculum as a new didactic strategy.

Keywords: Didactic Strategies, Virtual Reality, Physical Examination Skills, Nursing Students.

1 INTRODUCTION

The Nursing Process (NP) is a fundamental instrument to provide quality care to the patient, family, and community. It is a scientific method that allows the nurse to screen the patient's health status, needs, health problems, and specific solutions to them. (Alfaro, 2014; González; Chávez, 2009; Reyna, 2010). The NP has five steps: assessment, diagnosis, planning, implementation, and evaluation, each one interrelated with the other (González; Chávez, 2009). The assessment is the first part, considering it the most relevant since it supports the NP on the information obtained. Exactness in the assessment leads to the identification of any problems presented by users, constituting a key element in the training of nursing students. In this step inspection, palpation, percussion, and auscultation techniques are performed in the physical examination, as tools in the assessment process.

Inspection is the observation of the patient or a visual examination (Alfaro, 2014). It is a technique that is carried out through sight, to detect abnormal findings in relation to normal ones.

Auscultation is a technique based on hearing with a stethoscope. This procedure consists in listening to sounds produced by the different organs to discover variations and deviations in relation to their characteristics, for example cardiac, respiratory, and digestive auscultation. This technique is especially challenging for those who are trying to learn it because abnormal sounds cannot be differentiated until the person executing the examination has already developed an unmistakable appreciation of the normal variations of sounds produced by the structures of the body (Chiba; Hamamoto, 2018).

For the teaching of the previously described techniques, clinical simulation has been used for years, which allows the student to be immersed in a realistic situation [scenario] created within a physical or virtual space [simulator] that replicates the real environment (Halamek *et al*., 2000). The rapid advance of digital technology and within it, virtual reality (VR), has allowed the incorporation of simulated virtual scenarios in the training of students of health careers since they offer a training environment free of risks to the people assisted.

VR is an advanced interface, generated by applications running on the computer, through which the user interacts in real-time, stimulating the senses with the elements of the three-dimensional environment, which can be through visualization, movement, hearing, and/or touch (Tori; Kimer; Siscoutto, 2006). It provides an active learning experience in the first person, through different degrees of immersion, that is, the real perception of the digital world and the ability to interact with objects and/or perform a series of actions in this digital world (Cao; Cerfolio, 2019; Sherman; Craig, 2003). According to Kyaw *et al*. (2019), VR is highly conducive to clinical training with simulation, being able to improve knowledge and skills in students.

Teachers consider VR as a learning opportunity for students, since there is no real-life risk to the user, during the clinical care performed (Foronda; Hudson; Budhathoki, 2017). If we add to this that the behavior of the students within the VR training system is fully monitorable and auditable for subsequent review and debriefing, we find a system that allows learning, reducing to zero the consequences of failures in training periods, allowing to supervise and improve the training process (Halic *et al*., 2010).

Shorey *et al*. (2020) carried out a systematic review where they included 18 studies that evaluated virtual simulation in nursing students, discovering that there is greater cost-time effectiveness, compared to the use of phantom-type simulators and teaching classes, they were able to conclude that the Virtual simulation depicts the most effective instrument to promote cognitive results. VR used by nursing academics can be beneficial to support the acquisition of skills and knowledge in the short term compared to traditional methods (Fealy *et al*., 2019; Singleton *et al*., 2022; Plorsky *et al*., 2023).

It's necessary to develop and implement simulation software using object modeling tools and VR applications, allowing the student to apply physical examination techniques (inspection and auscultation) during the respiratory cardiovascular, and gastrointestinal assessment, facing situations that resemble the reality of clinical experience, in a protected environment created by computer (Pérez *et al*., 2022).

The objective of this work is to evaluate the didactic strategy with the use of virtual reality in the acquisition of physical examination skills in the cardiac, respiratory, and gastrointestinal systems in nursing students.

2 METHODOLOGY

The study corresponds to a quantitative approach, a quasi-experimental design of a group, before and after (Zurita *et al*., 2018). The sampling was intentionally non-probabilistic, with 47 participants of the second year of the nursing career from August to December of the year 2021.

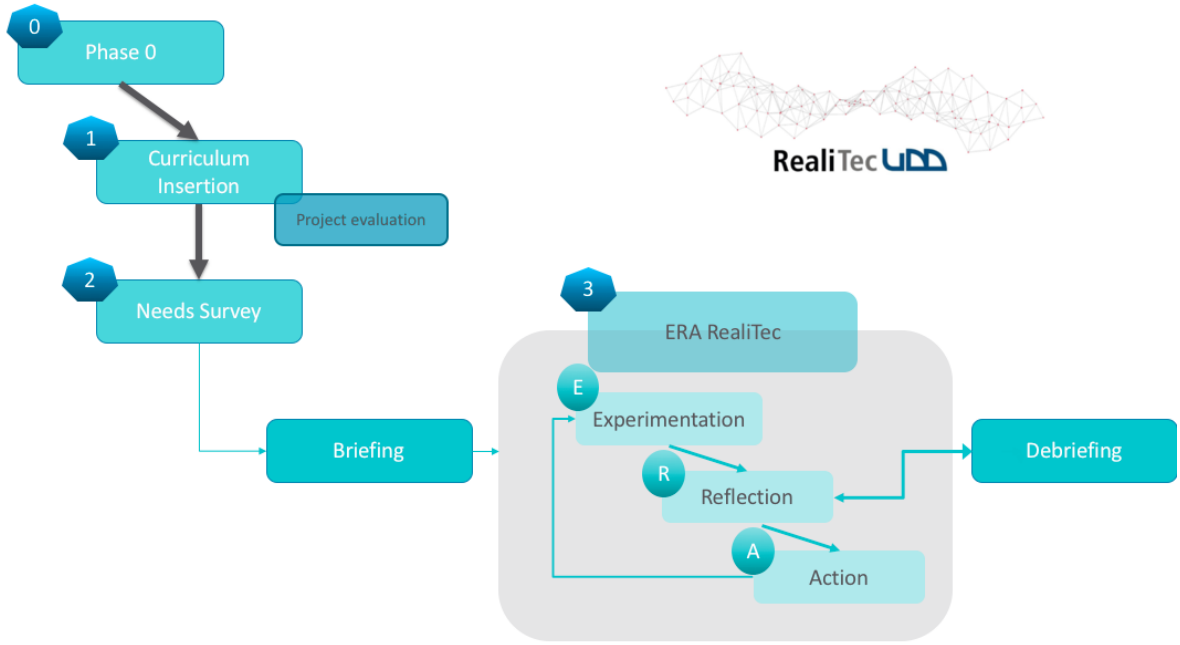
The intervention carried out was structured based on the ERA (experimentation-reflection-action) experiential pedagogical protocol of the RealiTec UDD unit (Figure 1), which consists of 3 well-differentiated stages: Experimentation, Reflection, and Action (Pérez *et al*., 2022).

Experimentation: The students learned and applied the auscultation technique through a VR simulator using the three-dimensional model of a male patient. With the possibility of showing or hiding the different organs of the virtual patient and within the environment, the student would be able to assess the inspection and auscultation of the cardiac, respiratory, and gastrointestinal systems, in addition to moving and approaching the stethoscope in foci and anatomical quadrants. Each student had to inspect and auscultate the virtual patient at least 5 times to activate the test option.

Reflection: Once the students practiced each of the sounds, access to the practice tests was automatically enabled, providing instantaneous feedback associated with the response provided by the students. In this way, the students had an instance to analyze the decisions they made.

Action: Enabled final exams through the control panel located inside a website. Thus, the students were able to answer the exam that contained questions similar to those previously practiced.

Figure 1. Experiential pedagogical protocol of the RealiTec UDD unit.



Source: Prepared by the authors

Before the period of clinical practices, where the student must face direct care with a user, a pre-test evaluation was carried out. The virtual exam consisted of 30 questions in which the student had to identify sounds and their anatomical location in the cardiac, respiratory, and gastrointestinal systems. Each question had a score of 1 point and the final grade was calculated on a scale of 1 to 7 points. The post-test exam was after the educational intervention and was structured in the same way. This post-test was taken in the action phase of the ERA Realitec protocol.

The questions were formulated according to the learning outcomes of the subject and the content validation was through expert judgment as recommended (Wild *et al.*, 2005).

The following hypotheses were considered in the study:

a) H0: The application of the didactic strategy with virtual reality does not improve the processes of acquisition of physical examination skills;

b) H1: The application of the didactic strategy with virtual reality significantly improves the acquisition of physical examination skills in Nursing students.

The data analysis was carried out through descriptive and analytical statistics, and the central tendency statistics of the pre and post-test were obtained. Likewise, the Shapiro-Wilk test was used to evaluate the assumption of normality. To check the validity of the hypothesis, the Wilcoxon test was used for samples that are related. The data was tabulated in a Microsoft Excel® 2020 spreadsheet and then processed using the Python 3.8 programming language.

Finally, the ethical aspects of the research were considered, following the guidelines of the Ethics Committee of the Faculty of Medicine. The confidentiality and anonymity of the collected data were ensured.

3 RESULTS AND DISCUSSIONS

The selected sample was made up of a total of 47 second-year nursing students.

93.6% (n=44) of the subjects were female. Regarding their age, the mean is 19 years old, with a standard deviation of 1.26 years.

Board 1. Entrance students to software

	Descriptive statistics					
	n	Minimum	Maximum	Means	Standard deviation	Median
Revenue to VR Software	47	3	23	12.6	5.15	12

Source: Prepared by the authors

It can be seen when analyzing the statistical results in board 2, that the results in the pre-test related to the median were 5.5, varying positively in the post-test to 6.3, with a maximum of 7.0. For this, the Wilcoxon test was applied and it was determined that there is statistical significance (p = 0.000), for which the null hypothesis was dismissed and it was confirmed that the application of the didactic strategy with virtual reality significantly improves the acquisition processes of physical examination skills in Nursing students.

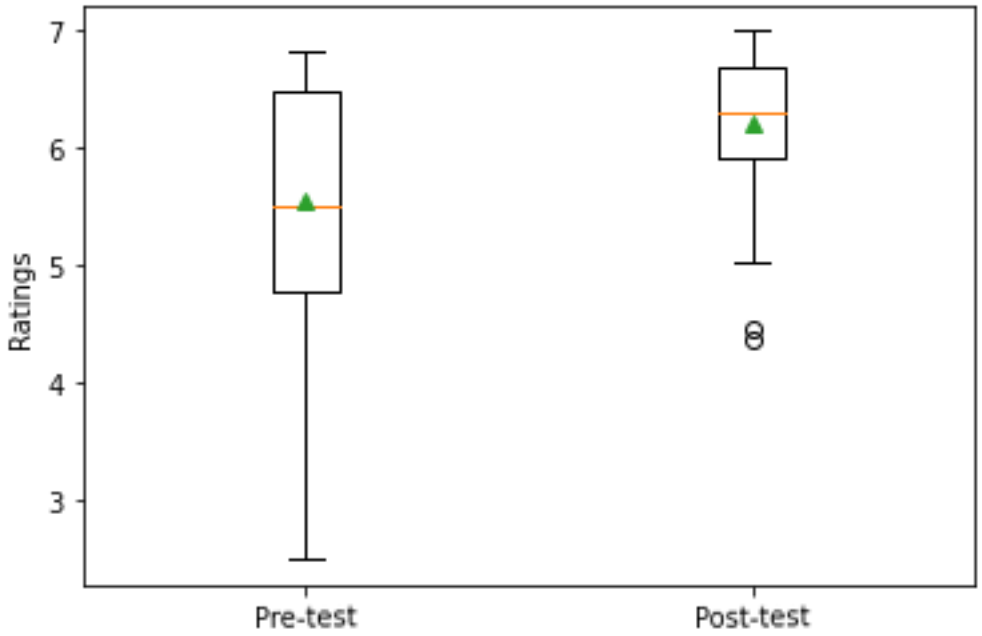
Board 2. Statistical analysis for the general hypothesis

	Descriptive statistics						p value*
	n	Minimum	Maximum	Means	Standard deviation	Median	
Pre-test	47	2.5	6.8	5.5	0.98	5.5	0.00
Post-test	47	4.3	7.0	6.2	0.61	6.3	
*Wilcoxon test, p<0.05							

Source: Prepared by the authors

Figure 2 shows that there is a statistically significant difference between the first measurement of the pre-test and post-test of the scores obtained in the physical assessment techniques exam.

Figure 2. Distribution of grades in pre and post-test during the intervention with virtual reality



Source: Prepared by the authors

The use of a virtual simulator is a new instrument for the acquisition of skills in physical assessment. As pointed out by Sanchez *et al*. (2021) the results obtained in our research showed that the use of a realistic and low-cost simulator for cardiac examination improves the acquisition of skills in this competence. In addition, stimulates student learning and facilitates the deliberate practice of the procedure before performing it on a real patient.

Additionally, as a result of our intervention, we confirmed VR as a helpful instrument for the clinical assessment of different body systems, as Tochino *et al.* (2020) mentioned training in auscultation with a virtual simulator, helps health science students differentiate abnormal lung sounds in patients.

The present study was oriented to evaluate the didactic strategy with the use of virtual reality in the acquisition of physical examination skills in the cardiac, respiratory, and gastrointestinal systems in nursing students. The results found in this analysis are consistent with the scientific investigations carried out by Singleton *et al.* (2022), in which the use of VR by nursing students for the management of hypoglycemia management, the non-immersive virtual reality group scored significantly higher in knowledge acquisition compared to the control group. In addition, this simulator can be used by students who are in their training cycle, as Chiba and Hamamoto (2018) points out, it suggests that the simulator is effective for a novice. These results concur with our findings.

Furthermore, the use of VR significantly increased the results found in the post-implementation evaluations, similar to what is indicated by Plotzki *et al.* (2023) in their virtual simulator for the acquisition of procedural nursing skills, the pre and post-tests showed a significant increase in knowledge ($p < 0.001$). The correlation between the presence and behavioral intention was highly positive.

According to the outcomes obtained in our analysis, the incorporation of VR in the acquisition of skills in the physical examination is a tool that can be added to the curriculum. Gold *et. al* (2021) in their randomized clinical trial, point out that virtual reality is effective as a teaching method in the development of intravenous catheter application skills and fluid administration. It is recommended to increase its use in nursing education.

Similarly, in their systematic review of the use of VR in nursing education, Fealy *et al.* (2019) found that this technology served as a rich, interactive and attractive educational strategy that supported experimental practical learning in the acquisition of skills in the nursing process.

The use of virtual reality allows Nursing students to face positive experiences, emphasizing the novelty, simplicity and interactivity of technology (*Saab et al.*, 2022). These factors can influence so much that the students adopt the technology and perceive it as useful. Ease is one of the key factors for technologies to be appropriate for educational communities.

The use of virtual reality can improve the confidence of nursing students in the improvement of their skills. VR offers a risk-free training environment for the people being cared for, teachers consider VR as a learning opportunity for students, since there is no real vital risk during care, so that they learn without affecting the person and avoid that failure when they are performing their tasks in clinical activities, preparing them for clinical activities at the patient's bedside. If to this we add that the student's behavior within the VR training system can be monitored and audited for subsequent review and debriefing, we have a system that allows learning, reducing to zero the consequences of failures in training periods, allowing to improve the training process (Halic *et al*., 2010).

Shorey *et al.* (2020) points out through their study that the use of this innovation better-prepared students for their end-of-semester clinical positions. This concedes to the mentioned benefits of virtual patients in the incorporation of communication skills with future users.

As different authors point out (Tacgin, 2020; Wu *et al*. 2020), after the implementation of the innovation, the VR strategy must be developed with the participation of members of the multidisciplinary team: experts, instructional designers, software developers, 3D designers, teachers and, students, integrating a high-quality team.

First, our study was limited by sample size, recognizing the importance of increasing the number of participants in a new study. Second, due to the design of the study, it cannot be established with certainty whether the observed changes are due to other factors in the environment or by the study participants.

4 CONCLUSION

Nurses have a key role during the physical examination, which requires clinical skills that can be achieved through the use of virtual reality. In conclusion, this study suggests the existence of statistically significant results in the use of virtual reality teaching strategy in the acquisition of physical examination skills in the cardiac, respiratory and digestive systems in nursing students.

This study shows the need to strengthening the use of the use of virtual reality as one of the didactic strategies used in the training of new generations of nurses. The findings of this research may help guide further research on this topic, as virtual reality technology has the potential to facilitate learning, complement current educational approaches, and provide nursing educators and students with novel and engaging media of content delivery, thereby supporting the advancement of nursing education.

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