



**Arab American University
Faculty of Graduate Studies**

**The Effect of Virtual Reality Program for Post Cardiac Surgery
Care Patients on Knowledge and Practice among Nurse Students in
Arab American University-Palestine**

By
Hothyfa Mohammed Abd Al-Azeez Zhoor

Supervisor
Dr. Sajed Ghawadra

Co-Supervisor
Dr. Ahmad Ewais

**This thesis was submitted in partial fulfilment of the requirements
for the Master's degree in Critical Care of Nursing
July / 2024**

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Thesis Approval

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Hothyfa Mohammed Abd Al-Azeez Zhoor

This thesis was defended successfully on 4 / 7 / 2024 and approved by:

Committee members

Signature

1. Dr. Sajed Ghwadra: Supervisor
2. Dr. Ahmad Ewais: Co-supervisor
3. Dr. Mohammed Jallad: Internal Examiner
4. Dr. Mohammed Hayek: External Examiner



Handwritten signatures of the committee members, corresponding to the list on the left. The signatures are written on horizontal lines. The first signature is for Dr. Sajed Ghwadra, the second for Dr. Ahmad Ewais, the third for Dr. Mohammed Jallad, and the fourth for Dr. Mohammed Hayek.

Declaration

"I dedicate this work to the Almighty Allah for preserving my life", to my loving parents and family (my wife and children) who have always been a source of motivation and inspiration for me. To all who support me in my life who give me the power, love, and confidence to go on ...
Finally, I dedicate this work to myself to achieve my dreams,

The Name of The Student: Hothyfa M.A Zhoor

ID: 202112481

Signature: Hothyfa Zhoor

Date: 13/10/2024

Acknowledgments

We would like to express here, our warm thanks to my supervisor Dr. Sajed Ghawadra, for the observation, guidance, and insightful comments throughout the implementation of this study.

A lot of thanks to Arab American University and Faculty of Health Profession and grateful appreciation to my Co-supervisor Dr. Ahmad Ewais and the coordinator of the Faculty of the Master Critical Care program Dr. Imad Abu khader .

A lot of thanks for support and assistance, to my father, mother, wife, children, brothers, grandfather, grandmother, uncles, and friends.

A lot of thanks to the manager of Immesense company Bader Asalwa.

We also sincerely thank all teachers, professors of the College of Nursing at Arab American University members, and those who kindly gave us advice and assistance.

For success of this project, I needed a helping hand from any person or group, so I will thank almighty GOD who inspired me with patience and great credit to everyone who contributed and stood by me for the success of this project, through their assurance of our faithful friendship, love, and sincere appreciation.

Hothyfa M.A Al- Zhoor

Abstract

Background: Teaching and learning using simulation has been proven to be effective in today's rapidly evolving nursing curriculum. One of the fastest-growing technologies in healthcare is virtual reality. Virtual reality allows users to view and interact with a computer version of a physical environment, whether that world is real or fictional.

Aim: This study aimed to find out the effect of educational on student nurse's knowledge and practice for post cardiac surgery care and compare between using virtual reality program versus conventional educational program through a simulation lab at Arab American University-Palestine.

Method: A Quasi-experimental design used, A Pre-test for student knowledge was conducted before intervention, and the post-tests were given after the educational program via VR for the interventional group or traditional lectures for the control group, The study sample comprised 80 nursing students registered in the Adult 3 course (advance), The level of knowledge and practice assessed before and after the educational intervention using self-administrative questionnaire, Data analyzed by using the statistical software Statistical Package for Social Sciences (SPSS) version 26. **Findings:** The results showed that a raise in overall knowledge and scoring on practice in both groups, while VR group had the higher knowledge and practice. Demographic data including gender, age, and educational year were also matched both in the control and experimental group. **Conclusion:** The study concluded that the VR group had a significant enhanced competency relating to aspiration of blood, dressing and chest drain compared to the control group instructed through lectures. These findings accord with prior research which asserts that VR can be a very effective mode of learning as well as a tool for teaching and enhancing intricate clinical situations. The study is very useful and points for the idea to impact

of the VR application in the field of nursing education as the method that can help students to connect theoretical knowledge and practice and as the result provide the population with better prepared nurses and better patient outcomes.

Keywords: Virtual Reality, Cardiac surgery, Traditional Lectures, Simulation

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List of Abbreviations

Abbreviation	Full Form
3D	Three-Dimensional
ACS	Acute Coronary Syndrome
AHA	American Heart Association
ANOVA	Analysis of Variance
ARDS	Acute Respiratory Distress Syndrome
BP	Blood Pressure
CABG	Coronary Artery Bypass Grafting
CHF	Congestive Heart Failure
CI	Confidence Interval
CNS	Central Nervous System
COPD	Chronic Obstructive Pulmonary Disease
COVID-19	Coronavirus Disease 2019
CPAP	Continuous Positive Airway Pressure
CRP	C-Reactive Protein
CT	Computed Tomography
ECG	Electrocardiogram
FiO ₂	Fraction of Inspired Oxygen
GPA	Grade Point Average
HR	Heart Rate
ICU	Intensive Care Unit
IT	Information Technology
KAP	Knowledge, Attitudes, and Practices
LA	Left Atrium
LV	Left Ventricle
MI	Myocardial Infarction
Min	Minutes
MRI	Magnetic Resonance Imaging
N/A	Not Available/Not Applicable
NHLBI	National Cardiac, Lung, and Blood Institute
NSTEMI	Non-ST-Elevation Myocardial Infarction
NYHA	New York Heart Association (heart failure classification)
OR	Odds Ratio
Pair	Paired Sample Comparison
PCI	Percutaneous Coronary Intervention
PEEP	Positive End-Expiratory Pressure
PET	Positron Emission Tomography
Post	After the intervention (Post-test)
Pre	Before the intervention (Pre-test)
p-value	Probability Value
QoL	Quality of Life
RCT	Randomized Controlled Trial

XIII

SD	Standard Deviation
Sig.	Significance
SPSS	Statistical Package for the Social Sciences
VR	Virtual Reality
VW	Virtual World
α	Alpha (significance level in hypothesis testing)
β	Beta (probability of Type II error in hypothesis testing)

Chapter One

Introduction

1.1 Background

The care of a patient post open-heart surgery is considered to be complex procedure because of the location and function of the heart. The most frequent types of surgery performed worldwide involve the heart, including coronary artery bypass grafting (CABG) and heart valve surgery. Nearly 800,000 cardiac operations are carried out annually around the globe (Abd-Allah et al., 2016). Open-heart surgery refers to any procedure when the chest is opened and the heart's muscles, valves, or arteries are operated on. Coronary artery bypass grafting (CABG) is the most frequent type of cardiac surgery performed on people, as reported by the National cardiac, Lung, and Blood Institute (NHLBI) (El-gafour et al., 2021).

Due to the complexity of open-heart surgery, patients need constant observation and care after the procedure is complete. After the surgery, most patients require further care in the intensive care unit (ICU) for a few days. There is always a chance of infection, organ damage, and stroke during any kind of open-heart surgery.

These dangers might range from mild to severe, depending on the person. Complications during and after surgery are more likely for patients whose cardiac conditions are more advanced (Mohamed Ali Soliman et al., 2020).

Nurses should promote continuity of treatment with the goal of optimizing health outcomes for their patients while also decreasing their overall healthcare expenditures.

Early extubation after open-heart surgery, for instance, is a crucial component of fast-track protocols that reduces, may reduce, the development of pulmonary complications in the postoperative period while decreasing overall length of stay in the hospital, thus ensuring best practices and patient safety.

Lessen the risk of pulmonary problems for cardiac surgery ICU patients (Öztepe & Kanan, 2021). The scarcity of nurses is not just an issue in underdeveloped nations; it is felt just as strongly in the industrialized world. It has been estimated, for instance, that nurse staffing shortages will reach 30 percent by 2020. Long hours, insufficient supplies, a lack of space that compromises patients' right to privacy, a lack of positive connection and cooperation from patients, a lack of hospital stabilization, and a lack of professional satisfaction are all cited as reasons for nurses to leave the profession (Traverse et al., 2019).

To help their students successfully navigate each new phase of their study, nurse educators are under continual pressure to find new and creative approaches to instruction (Saab et al., 2021). VR and other cutting-edge technologies have been increasingly prevalent in nurse education over the past decade, and especially in the wake of the COVID-19 epidemic (Morin, 2020). VR encompasses "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" (Lee et al., 2023).

Because virtual reality operates on the premise that a virtual world, real or imagined, can be created, which allows students to not only visualise the content but also interact with it (Zackoff et al., 2020), it has the potential to revolutionize the way in which education is delivered. (Foronda et al., 2020)note that virtual reality (VR) provides a more immersive medium for the transfer of theoretical and clinical learning in nursing education than more

traditional teaching and learning methodologies, repeated exposure to theoretical knowledge and related clinical skills can help nursing students make the transition from theory to practice (Foronda et al., 2020). Virtual reality (VR) has been shown to improve nursing students' skill competency and learning outcomes, especially when students' access to clinical practicums is limited, as it was during the current pandemic. Some of the advantages of virtual reality in undergraduate nursing education that are just now being uncovered by research include the following: the ability to engage in interactive learning in a non-threatening setting (Zackoff et al., 2020); greater access and flexibility for the learner (Mendez et al., 2020); a platform for presentations and lectures; and the chance to ask questions (Benham-Hutchins & Lall, 2015). Teaching chemotherapy administration, nursing competence training, intravenous catheter insertion, and phlebotomy training are just a few examples of recent interventional studies where VR proved effective in nurse skill acquisition (Chan, 2023).

A recent randomized controlled experiment indicated that in addition to improving skill acquisition, virtual reality also benefited nursing students in the areas of information retention, clinical reasoning, self-efficacy, and happiness with the learning experience (Padilha et al., 2024). VR training was also found to be more effective than traditional training methods in delivering procedural knowledge to undergraduate nursing students in a recent systematic review of 14 trials (Hou et al., 2024). Evidence suggests that increased immersion leads to better learning outcomes, and nursing students see VR as a way to have fun while they study. Because of its many advantages, VR is increasingly being included into undergraduate nursing programs (Lange et al., 2020). VR has become standard in a number of nursing education programs, but for many students, it is still a novel experience.

Recent studies that have investigated the use of VR by nursing students have mostly ignored the potential use of VR in nursing programs where VR is not yet incorporated in favour of focusing on narrow settings such as airway management (Botha et al., 2021) and nursing skill training (Chang & Lai, 2021). (Alfaisal et al., 2024) conducted a systematic review and meta-analysis and came to the conclusion that, at the present time, virtual reality should be utilized to complement traditional teaching and learning techniques rather than as a solo strategy. This information is crucial for nursing schools who are looking for ways to include tech-based learning into their curricula to successfully implement and maintain virtual reality equipment (Alfaisal et al., 2024).

When it comes to patients' health, nurses are typically the first point of contact, and they are well-aware of the significance of maintaining open lines of communication on a regular basis. It is the responsibility of nurses to help patients improve their ability to self-manage their chronic diseases (Coates, 2017). Today's digital tools present excellent chances for nurses to help their patients improve their health-related literacy in order to make better use of available online health resources (Krick et al., 2019).

Students in the nursing profession play a vital role in the healthcare sector and make significant contributions to the clinical setting's IT infrastructure. Tubaishat (2014) conducted a cross-sectional research to gauge fourth-year nursing students' perspectives on medical technology. The results of this research support the idea that senior nursing students might benefit from additional training in the use of technology in order to better prepare them for careers as registered nurses, also, nursing students have an optimistic view on technology. Technology will continue to improve in its ability to monitor, educate, and support individual patients in engaging in health-related behavior's (Tubaishat, 2014).

Holden et al. (2016) argue that understanding nurses' attitudes towards new technology is crucial for incorporating them into clinical practice. The way nurses feel about using new health technologies can be a deciding factor in how well such technologies are adopted. The purpose of this meta-analysis was to draw conclusions from studies that examined nurses' and nursing students' views on the use of technology in patient care (Holden et al., 2016).

In particular, Darvish et al. (2014) argue that anytime, everywhere access to e-learning opportunities made possible by advances in information technology may greatly improve the nurse management of patient care scenarios (Darvish et al., 2014). (Moore & Jayewardene, 2014) conducted a study among medical professionals and found that they acknowledged the benefits of gadgets like smartphones and healthcare applications in facilitating better patient access to information, decision-making, and efficiency in treatment. In comparison to the 81% of doctors who reported using their phones at work, 58% of nurses reported doing the same, they provide examples of how healthcare workers might employ such technology to improve patient education. (Moore & Jayewardene, 2014).

1.2 Virtual Reality and Virtual World Definitions

Virtual reality refers to a computer-generated simulation of a three-dimensional environment that can be interacted with in a seemingly real or physical way by a person using special electronic equipment, such as a VR headset (Anthes et al., 2016). While A virtual world, sometimes also referred to as a virtual environment, is a computer-simulated space that may mimic aspects of the real world or be entirely fantastical or fictional. Unlike VR, which is more immersive and usually experienced through specialized hardware like headsets, virtual worlds are often accessed via standard computing devices and allow users to interact with each other

and with the environment. Virtual worlds can be social platforms, gaming environments, or educational spaces, offering various levels of interactivity and realism. Examples include virtual classrooms, online gaming environments, and social virtual reality platforms (Auda et al., 2019). VR typically immerses users in an artificial environment where they can engage with objects and perform actions, often used for training, education, gaming, and simulations. Improvements in processing speed and multimedia capacity have paved the way for wider usage of virtual reality. VR systems often comprise head-mounted displays (HMDs), headphones, and other audio-visual components, and sometimes haptic devices that are worn on different portions of the body (Gandhi & Patel, 2018). Brigham (2017) claims that the purpose of virtual reality is to create a sensation of total immersion in another environment. Through the usage of HMDs, the user's actual environment is hidden and replaced with a simulated one. There is a growing body of work on VR, and it has found a home in specialised industries including the military, engineering, and architecture. Using an immersive headgear (Oculus Rift™) and haptic gloves, engineering students were able to execute a virtual assembly work with more efficiency (Brigham, 2017).

While virtual reality has many benefits, it also has a hefty price tag due to the requirement for specialised technology and powerful computer graphics processing capabilities. Disorientation, nausea, and headaches have been observed by VR users. This is due to anthropomorphism, which tricks us into thinking the experience is 'real' rather than virtual. Another difficulty with virtual reality is that it limits your movement around the area, which might be dangerous if your sight and hearing are impaired. Users plug into a high-powered computer/gaming system or phone and don a headset and headphones that generate surround-

sound effects. To facilitate user interaction with the VW, some VR systems include laser sensors strategically placed around the room and controls (Gandhi & Patel, 2018).

1.3 Statement of Problem

Nursing education continually seeks innovative and effective teaching methods to enhance students' learning experiences and competencies. Traditional teaching methods, primarily through lectures, have limitations in providing hands-on, immersive learning experiences essential for complex clinical skills. VR technology has emerged as a promising tool in healthcare education, offering an interactive and immersive learning environment that can simulate real-life clinical scenarios. Despite the potential benefits, there is limited research on the effectiveness of VR in teaching post-cardiac surgery care to nursing students (Mystakidis et al., 2021).

Patients undergoing open-heart surgery rely heavily on the nursing staff to help reduce the risk of complications. Education and evaluation-based illness management. Critical care nurses face the additional difficulty of balancing theoretical knowledge, assessment skills, and problem-solving abilities in order to deliver the best possible nursing care and sustain high-quality results (Barr et al., 2013).

Changing the learning methods and a lack of mean that nursing programs need to adapt in order to meet the needs of their students. There were not enough professors, clinical locations, classroom space, clinical preceptors, or funds in 2018 to accept all 75,029 qualified candidates to bachelor's degrees and nursing postgraduate courses in the United States (Juraschek et al., 2019).

The purpose of nursing education is to increase the likelihood of nursing students use what they learn in the classroom in real-world settings. However, students' access to clinical

experience with actual patients is hampered by short clinical practice time. Uysal (2016) notes that a lack of clinical practice, which helps students prepare for the real clinical setting, can lead to nursing process mistakes that put patients at risk. There are a number of obstacles that nursing educators must overcome in order to successfully bridge the gap between theory and practice in the classroom. Educators in the nursing field have adapted a variety of teaching tactics, such as simulation experience, to ensure that their students receive a high-quality and secure education (Oermann et al., 2024).

Teaching and learning using simulation has been proven to be effective in today's rapidly evolving nursing curriculum. Simulation is essential in nursing education, as indicated by the National Council of State Boards of Nursing. More and more schools are turning to simulation to teach nursing since it allows students to put into practice what they've learnt in the classroom. Students may practice a wide range of clinical scenarios, making judgements and reflecting on their actions in real time through simulation (McCafferty et al., 2022).

Virtual reality is becoming increasingly popular and widely used in the healthcare industry and health education. The international health literature has seen a dramatic increase in the usage of virtual reality (VR) in recent years. Stroke rehabilitation, medical education, surgery training, management of chronic pain, health promotion, and treatment of anxiety and other psychiatric disorders are just a few recent examples of healthcare settings where VR was used successfully (Rizzo et al., 2019). In the wake of the recent COVID-19 outbreak, VR has become increasingly popular as a means of providing medical treatment that was previously impossible with more traditional methods. Physical and cognitive rehabilitation, pain management, treatment of psychological disorders, surgery, training of healthcare professionals, a VR-based mobile COVID-19 mobile application, and patient distraction were all identified as health-related

uses of VR in the literature review (Chan, 2023). A recent scoping assessment concluded that evidence for the application of VR in nursing is lacking (Hou et al., 2024). Virtual reality (VR) is commonly used to teach nurses and nursing students how to do a variety of tasks, such as dressing wounds, performing urinary catheterization, and giving medications. It is, however, not yet known how nursing students and other aspiring healthcare professionals feel about VR technology or if they favor its usage in healthcare delivery (Foronda et al., 2020).

In Palestine, there is no studies exploring the use of VR in nursing education. The scarcity of research in this region makes it challenging to determine the viability and effectiveness of VR technology in improving nursing students' knowledge and practical skills in post-cardiac surgery care. Specifically, there is a need to investigate whether the use of VR technology can significantly enhance nursing students' competencies in critical post-cardiac surgery procedures such as blood aspiration, dressing, and chest drain management, compared to conventional teaching methods. This study is considered one of the first studies in this field.

Some studies (Padilha et al., 2024, Hou et al., 2024, Alfaisal et al., 2024) have shown positive effects from virtual reality, while others have found no impact. For that this study conducted in order to help in filling of this gap.

1.4 Objectives

1.4.1 Main Objective

This study was aims to find out the effect of educational on student nurse's knowledge and practice for post cardiac surgery care and compare between using virtual reality program versus traditional educational program through lecture at Arab American University- Jenin.

1.4.2 Specific Objectives

1. To assess the effectiveness of the traditional lecture-based program in enhancing student nurses' knowledge and practice of post-cardiac surgery care.
2. Explore relationship between student nurses' engagement levels and other socio-demographic characteristics the effectiveness of each educational method in improving knowledge of post-cardiac surgery care.

1.5 Research Questions:

1. What is the effect of an educational program on student nurses' knowledge and practice for post-cardiac surgery care among third- and fourth-year's student nurses at Arab American University- Jenin?
2. How does the use of a virtual reality program compare to a traditional lecture-based educational program in enhancing student nurses' knowledge and practice for post-cardiac surgery care among third- and fourth-year's student nurses at Arab American University- Jenin?
3. How do socio-demographic characteristics (e.g., gender, age, educational year) relate to the effectiveness of each educational method in improving student nurses' knowledge and practice of post-cardiac surgery care among third- and fourth-year's student nurses at Arab American University- Jenin?
4. What specific aspects of post-cardiac surgery care (e.g., blood aspiration, dressing, chest drain management) show the most significant improvement through VR-based education

compared to traditional lectures among third- and fourth-year's student nurses at Arab American University- Jenin?

1.6 Hypotheses

- There is no significant differences between the education of post-cardiac surgery care and via virtual reality program on knowledge among third and fourth year's student nurses at Arab American University- Jenin at $\alpha \leq 0.05$.
- Student nurses who undergo the virtual reality program will not exhibit a significant improvement in their knowledge of post-cardiac surgery care compared to those who do undergo the traditional lecture-based program.
- Student nurses who undergo the virtual reality program will not exhibit a significantly greater improvement in their knowledge of post-cardiac surgery care compared to those who undergo the traditional lecture-based program.

1.7 Significant of Study

As virtual reality technology develops and becomes more accessible, it is revolutionizing the way nurses are educated. Virtual reality is becoming increasingly popular as a teaching tool in the field of nursing education (Wright et al., 2023). This tool is being used to teach a wide range of nursing concepts, such as leadership, communication, decision-making, critical thinking, inclusiveness, health assessment, and disaster triage. Nursing students can improve their cognitive and skill mastery, which are typically measured by how well they understand concepts and how well they can demonstrate a procedure or technique, through the use of virtual reality (VR) in simulations, which allows for repetitive, hands-on training (Mendez et al., 2020). Furthermore, virtual reality simulations can provide nursing students with a risk-free setting in

which to practice their abilities (Wright et al., 2023). Students in a research strongly favored the usage of virtual simulation in the future of nursing education (Foronda et al., 2020).

While virtual reality offers numerous potential benefits, not all studies have shown it to be more successful than more traditional approaches (Rizzo et al., 2019).

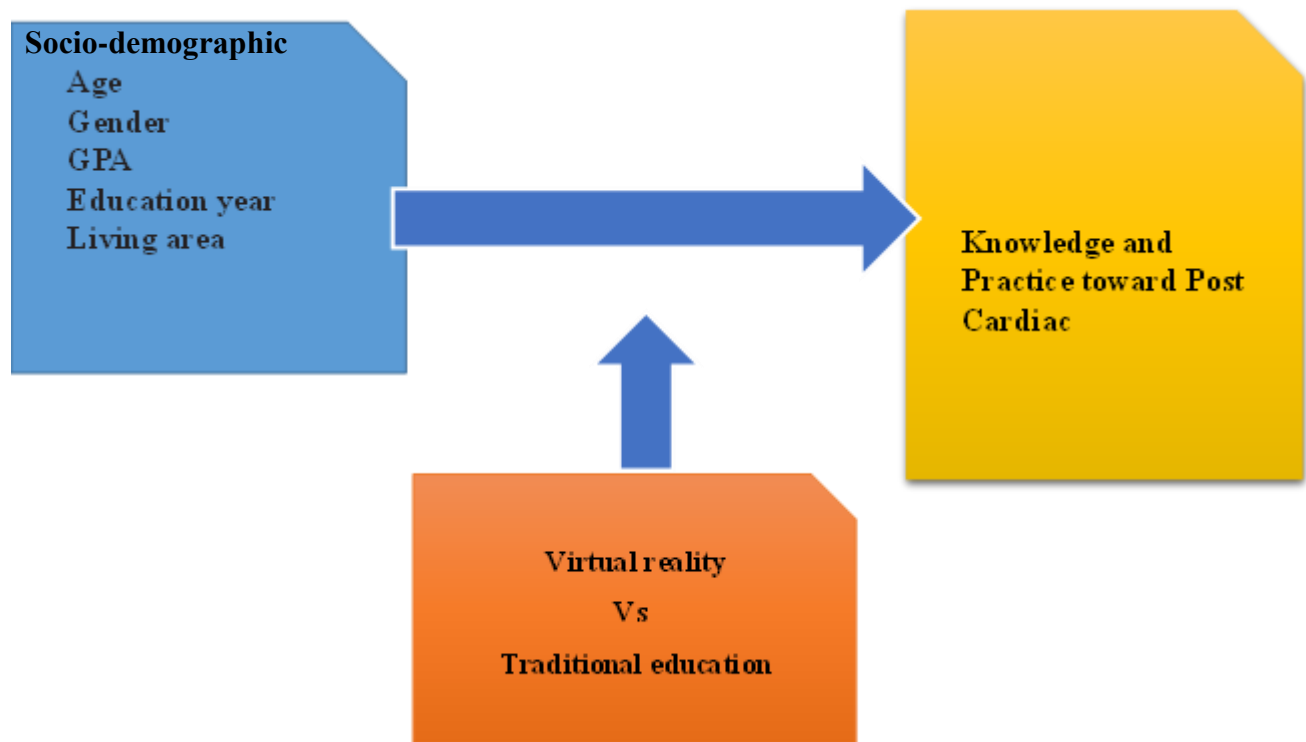
Therefore, the finding of this study is hoped to identify the effectiveness of VR in nursing student training for patient post cardiac surgery, and based on the findings and by taking cost, time and feasibility, we can give strong recommendations on how we can intervene to improve the nursing student education performance. This study may assist in identifying the training via VR in student knowledge and practice, this study may assist in identifying possible areas of future research to provide evidence-based solutions for clinical practice, education and policy development and evidence-based policy can be developed in order to effect changes in the practice of EMS. This study may provide information to assist in policy development within using of VR in nursing student training for patients post-cardiac surgery.

1.8 Theoretical Framework

The researchers in the present study were guided by two different theoretical models. They were Patricia Benner's "novice to expert" theory and David Kolb's "experiential learning theory (Hopkins, 1993).".

1.9 Conceptual Framework

Figure 1.1 explains the conceptual framework of the study. The independent variables are demographic data (gender, age, address, educational year, GPA), dependent variables which are the level of knowledge and practice.



Definition of Terms

Open- heart surgery: It refers to post coronary artery bypass graft and valve replacement surgeries, Mitral valve regurgitation(MR), Mitral valve prolapse (MVP), Aortic stenosis (AS), Aortic regurgitations (AR), Pulmonary valve stenosis (PVS), Pulmonary regurgitation (PR), Tricuspid valve stenosis (TS) and Tricuspid regurgitation (TR)within 10 days of the surgery (Vervoort et al., 2020).

Nursing care for Post cardiac surgery patients. It is a critical skill for nursing students and nurses practicing in all healthcare settings. It determines patients' problems, designs care plans, implements interventions, and evaluates care (Solà-Miravete et al., 2018). Improper assessment may lead to poor planning and inadequate care management. The physical examination assesses

the patient's health status and evaluates their progress after treatment. Learning basic and advanced Post cardiac surgery care skills is essential to many undergraduate and postgraduate nursing curricula (Egilsdottir et al., 2019). **For this study**, nursing care includes the identification of knowledge and practice blood aspiration from Central Venous Catheter, Central Venous Catheter dressing, Sternotomy Dressing and chest drain.

A virtual reality experience is composed of qualities that make the experience real (Perez-Marcos, 2018). Virtual reality is a simulated 3-dimensional environment created by computer technology. The impact of this digital approach on a profession that requires students to communicate and perform hands-on physical assessment is yet unknown. However, clinical experiences of floor nursing staff and educators point out a more considerable lack of self-efficacy and self-proficiency in students 'capacity to perform the physical assessment in the actual, real-world setting. **For this study** specific evidence based program designed to involves the use of VR headsets and software that allow nursing students to engage in interactive, hands-on training exercises related to post-cardiac surgery care. The effectiveness of VR will be measured by improvements in students' knowledge and practice skills as compared to traditional education lecture-based methods.

1.10 Theoretical framework

1.10.1 Benner's Novice to Expert Theory

Nursing education has been revolutionized by Patricia Benner's groundbreaking notion of beginner to expert (Bowen & Prentice, 2016). The evolution of nurses into experts is best described by Benner's idea of the novice expert. Nurse's level of competence might drop when confronted with a new challenge, such as advanced technology (Smith, 2012). Students at the

intermediate level of the nursing curriculum may face a crisis of confidence at their first exposure to the blood, sweat, tears, and odours of the acute-care environment, despite having practiced assessment skills on a virtual patient. Benner (1984) outlined three essential characteristics for effective nursing practice. The first is using general rules as a foundation for specific cases. Pain perception, nonverbal clues, intuitive grasp (Bowen & Prentice, 2016), and sensory signals are all examples of abstract concepts that can be difficult to recreate, even with cutting-edge technology. The second tenet was familiarity with the clinical setting, and the third was the transformation from observer to actor. One defining feature of nursing education is its emphasis on clinical knowledge, and Benner (2001) agreed that didactic learning alone could not provide clinical skill.

1.10.2 Kolb's Experiential Learning Model

Kolb's model of experiential learning served as the study's second conceptual framework. Kolb (2014) argued that learning takes place when a learner combines active participation in a real experience with reflective observation and application of previously gained information to novel contexts. Buck and Akerson (2016) urged educators to consider the discrepancy between stated and shown values in educational settings via the lens of experiential learning. This discrepancy between theory and practice and didactic versus practical variances in physical assessment abilities may be familiar to intermediate-level nursing students who are preparing for their first patient and clinical contact. Let's go on to the research problem statement (Buck & Akerson, 2016).

Chapter Two

Literature Review

2.1 Introduction

The literature review chapter is an essential component of research work, providing a comprehensive overview of existing knowledge and research related to the chosen topic (Taherdoost, 2023). In this chapter, we will explore the relevant literature on the impact of educational programs on nursing students' knowledge and practice in post-cardiac surgery care. The purpose of this literature review is to identify gaps, inconsistencies, and emerging trends in the field, setting the foundation for the current study.

Search Strategy

To retrieve articles for my literature review, a systematic and comprehensive search was conducted using two primary databases: Google Scholar for grey literature and PubMed for peer-reviewed scientific articles. This dual approach ensured coverage of a wide range of sources, ensuring high-quality published research.

This study began by identifying and utilizing a set of targeted keywords relevant to my research topic. These keywords included "virtual reality," "nursing education," "post-cardiac surgery care," To refine my search results and improve the precision of my search, I applied Boolean operators such as AND, OR, and NOT. This helped in combining different keywords effectively and excluding irrelevant results.

Screening Process

The search process was methodical and thorough. Initially, I screened the titles and abstracts of the retrieved articles to determine their relevance to my research. This preliminary screening was crucial in filtering out studies that did not directly address the educational programs' impact on nursing students' knowledge and practice in post-cardiac surgery care. After the initial screening, I proceeded to review the full texts of the selected articles to ensure that they met the criteria for inclusion in my literature review.

Inclusion and Exclusion Criteria

To maintain the quality and relevance of the literature, I applied strict inclusion and exclusion criteria. The inclusion criteria focused on:

- Peer-reviewed studies to ensure the reliability and academic rigor of the included research.
- Studies that directly addressed educational programs (VR and traditional) and their impact on nursing students' knowledge and practice in post-cardiac surgery care.
- Studies conducted within similar educational settings or involving similar demographics to ensure relevance.

Conversely, the exclusion criteria were designed to filter out:

- Articles that were not peer-reviewed, such as opinion pieces or anecdotal reports, to maintain the academic integrity of the review.
- Studies that did not focus on educational programs or post-cardiac surgery care, as these were outside the scope of my research.

Outcome

By following this systematic search and screening process, I established a comprehensive and high-quality foundation for this dissertation. This approach ensured that the literature review included only the most relevant and methodologically sound studies, providing a solid basis for understanding the impact of educational programs on nursing students' knowledge and practice in post-cardiac surgery care. The rigorous selection process also ensured that the insights and conclusions drawn from the literature were well-supported and credible.

To further organize this literature review chapter, the procedures in the reviewed studies will be examined based on methodology, sample type, measurement tools and instruments, and findings. Additionally, the obtained results will be filtered by including only articles published in scientific journals, guaranteeing the relevance of the selected sources. Furthermore, the focus will be on clinical trials and studies that assess the impact of educational interventions on nursing students' competencies in post-cardiac surgery care, considering the need for long-term follow-up to evaluate outcomes.

This literature review on the effectiveness of VR and traditional educational programs in nursing education aims to compile and synthesize the existing literature, highlighting possible directions for future research. This information will help determine ways to make nursing education more effective and improve patient care outcomes in post-cardiac surgery settings.

When new technologies are integrated into classrooms, students are able to learn more effectively. Rapid communication (email and text messaging), social media, virtual reality, and artificial intelligence have all helped greatly to both teachers and students in the dissemination and acquisition of information. However, there is a lack of literature and study on the long-term

effects of technology on fundamental human values like empathy, compassion, and respect for the elderly in acute care settings.

In order to succeed in the field of nursing, students must acquire both theoretical and practical expertise. As a result, knowledge alone is insufficient, Modern health problems are shaped by the complex interplay of individuals, populations, and their environments (Quick et al., 2016).

2.2 Usage of Technology in Nursing

The study of nursing and the implementation of educational technology work hand in hand. Automated intravenous pumps, health applications, and ward-specific devices like dialysis machines, electrocardiogram (ECG) equipment, and breathing machines are just some of the necessities that a student nurse must know how to utilize by the time they graduate. Hospitals do not account for this in their use of patient documenting software, notably in Finland. To ensure that newly graduated RNs are technologically literate, they are required to complete relevant and up-to-date coursework. Medical research publications that are more than 5 years old are often not used in teaching because of concerns regarding their continued applicability (Hernon et al., 2023).

The World Health Organization's most recent update to its guideline for European Union standards for nursing and midwife education (2009) stresses the need of the RN having a thorough understanding of the tools and technologies used in the workplace to ensure the safety of patients at all times. In other words, by the time they graduate, RNs should be well-versed in, if not experts in, the use of technological tools in healthcare (Silveira & Cogo, 2017).

Metzler and Barnes (2014) refer to the complexity of technological interactions as evidence that these ideas may be lacking from the culture of mechanical and computer engineering (Metzler & Barnes, 2014).

There are "psychological, philosophical, and even spiritual issues bearing significant implications for traditional nursing values" that make human-robot interactions difficult. Many high-risk industries, such as commercial aviation, nuclear power generation, and the military, employ human patient simulators to educate their personnel. In this application, simulation has been shown to be as effective as or more so than more traditional approaches. While technical skills and knowledge are crucial in the aforementioned fields, nursing stands out due to its emphasis on interpersonal relationships (Goodchild, 2018).

2.3 VR Technology and it's State in Education

Virtual reality is a computer-generated, simulated version of an environment or experience that can resemble or depart significantly from reality. The capacity to create a realistic simulation of any setting has enormous implications for nursing education, opening up a vast array of study options. A wide variety of VR products and services are currently available. These include both fully immersive VR, in which the computer in the headset simulates the entire environment and all of the equipment used in the environment, and partially immersive VR, in which the computer in the headset simulates only a subset of the environment and none of the interactive tools. Augmented reality (AR) is a technology that uses real-world objects to enhance a virtual one. A mixture or capacity to use both types of technology can allow for diversity of pedagogical options, and both can be employed in some platforms and the medical/nursing field (Shorey & Ng, 2021).

Based on the notion of contextual cognition, which states that students learn best via application and practice in authentic contexts, virtual reality is increasingly being used in the classroom. According to the theory of situated cognition (Anderson et al., 2016), the human body and the external environment both play a role in the process of cognition. Virtual reality (VR) is increasingly being used in the medical and nursing fields for training and skill development . There is a growing tendency to employ simulation as an evaluation tool, particularly to build technical-based skills needed during clinical practice, especially as virtual reality technology advances and becomes more affordable (Pensieri & La Marca, 2019).

Digital technology, virtual reality, and artificial intelligence have become increasingly integral to the theoretical and practical underpinnings of nursing education. Because of the widespread spread of COVID-19, this dependency has skyrocketed. Clinical nurses, who work directly with patients, need to be able to assess their conditions and make treatment decisions based on their patients' sensory, subjective, objective, and non-verbal cues. As the names imply, digital, virtual, and simulated realities cannot replicate the physical world that real patients exhibit. Virtual reality has been studied in depth because of its potential use in the field of nursing education. Skills in technical areas, long-term retention, modest patient benefits, hands-on experience, and safe care for patients (Jones & Barrett, 2017).

When nursing students can detect (symptom recognition) and intervene (clinical reasoning) using evidence-based information (critical thinking), they have demonstrated proficiency in the skills and abilities required for physical assessment. A loss of the situated cognition necessary for the quick completion of life-saving activities in the actual world and the clinical context might result from an excessive dependence on technology. Curriculum designers

for nursing programs should keep in mind that their graduates will be working in the real world, not a simulation (Lange et al., 2020).

The foundations of nursing and nursing education are realism and practical experience. According to Kacan and Pallos (2021), the primary goal of nursing school is to give students the skills they'll need to become competent nurses. Although they argue that using digital tools like gaming, AI, and virtual characters to learn is beneficial, they stress the need of practical experience (Kacan & Pallos, 2021).

2.4 Use of Virtual Reality in Nursing Training

The goal of nursing education is to instill in the student the identity of a professional nurse and to prepare them for professional life via a combination of organised, theoretical, and practical training. Cognitive, emotional, and psychomotor skill development are prioritised in this model of nursing education (Bayram & Caliskan, 2020).

As technology improves and becomes more accessible, studies in which virtual environments are created and their activities are evaluated are becoming more commonplace in the nursing profession, where mock-ups and mannequins have traditionally been used to create virtual reality in education (Yaban & Cetin, 2022).

Nursing is a health profession that requires a substantial amount of psychomotor skills due to its complexity and difficulties in patient care. Virtual reality applications in the training of health workers have been popular as a means for instructors to overcome the challenges faced in translating the theoretical knowledge to the practice (Hernon et al., 2023).

Under the watchful eye of teachers, students in professional skills laboratories practice the techniques they have learned in actual clinical settings. In addition to combining theory and practice, these laboratory exercises assist students overcome clinical anxiety and strengthen their communication skills. There is no danger to the patient, pupils may try again if they mess up, and teachers can offer constructive criticism (Ismailoglu & Zaybak, 2018).

To avoid patient injury while also minimizing mistakes, preventing ethical breaches, adapting to the evolving health technology, meeting the rising demands of patients, and providing excellent treatment, new training methods must be developed and implemented. According to Gundogdu and Dikmen (2017), virtual reality applications are becoming increasingly valuable in nursing education because they allow students to practice a wide variety of clinical scenarios in a safe, controlled environment, thereby lowering their anxiety and boosting their self-confidence (Gündoğdu & Dikmen, 2017).

The use of VR to teach fundamental nursing skills has been shown to improve both students' academic outcomes and their ability to function professionally (Rykkje et al., 2022).

Virtual reality applications have many advantages, including creating an environment as if it were real with three-dimensional audiovisual animations and directing students to learn by experimenting and having them think to make decisions in a complex situation. These benefits include creating an educational environment very close to reality, developing students' pre-clinical skills, integrating theory and practice, and bringing the classroom to the student. Health care training programs teach students a wide range of practical skills, from how to wash their hands and take a patient history to how to create vascular access and do CPR. Students can benefit from virtual reality applications by practicing a wide range of skills, including establishing vascular access safely, delivering basic life support, injecting intravenously,

interviewing patients, and more. The virtual environment allows students to put their theoretical study into practice by using abilities they can't directly witness in a real patient, such as analyzing internal organs (Sarikoc, 2016).

Research conducted by Jung et al. (2012) found that first-year nursing students who participated in an interventional study involving intravenous skill training using a three-group model had a higher rate of successful completion of the skill application when using a virtual reality simulation system that combined virtual reality with a plastic arm model (Jung et al., 2012).

Researchers concluded that simulation is an effective tool that may be utilized in conjunction with traditional teaching strategies in nursing education. Nursing students' skill and satisfaction with the method used to acquire the ability to apply intravenous catheters were positively affected by instruction using the "SIV simulator," according to a different study that compared the effectiveness of using the "SIV simulator" and the "plastic arm model" (Walus, 2018).

Similarly, using a virtual reality program to practice inserting port catheters has been shown to improve students' skills. Students in the virtual reality simulation group learn the procedural stages of urinary catheter administration more quickly and with greater interest (Mendez et al., 2020).

They invest more effort into the process of applying for urethral catheterization (Butt, 2018). Teaching applications that call for surgical asepsis principles, like aspiration, where the order of skill application is complex and requires attention, can benefit from the use of a game-based virtual reality application, as can the teaching of tracheostomy care (Agbo et al., 2023).

Virtual reality model simulations offer the best possible learning environment for students studying nursing skills such as pelvic examination, nasotracheal aspiration, urinary catheterization, and intravenous catheterization. It was determined that the computer-based simulation system created to provide subcutaneous drug administration skills in nursing education improved both students' performance on a subcutaneous injection application task and their ability to deal with the anxiety that typically arises when administering a subcutaneous injection to a real patient (Bodur et al., 2024).

It is challenging to evaluate students objectively due to factors such as the huge number of students, the small number of teaching personnel, and the ongoing renewal and expansion of the abilities that should be learned by students. With virtual reality, a learner may readily apply any ability in the simulated setting at any time and in a variety of ways. The fact that these virtual materials may be recorded makes it simple for several teachers to provide feedback on a student's progress (Rizzo et al., 2019).

When it comes to teaching students advanced and abstract skills like collaboration, problem-solving, critical-thinking, or communication, virtual reality applications are rising to the top of the list as a novel and useful alternative teaching method. The majority of studies have found that including virtual simulation into the nursing curriculum improves students' skill performance and academic outcomes (Foronda et al., 2020).

Virtual reality apps can help students succeed and be more motivated by providing them with experience-based learning, so lowering their anxiety during their first clinical practices, boosting their self-confidence, and strengthening their ability to make sound clinical decisions. Students may practice their skills in a risk-free setting using this program, and they can do so

whenever they choose, without ever having to worry about hurting a patient in the process (Lange et al., 2020).

2.5 Nursing Training for Post-Cardiac Surgery Care

Many cardiac issues can be remedied by undergoing open heart surgery, making it a crucial operation. Myocardial revascularization, repairing or replacing a valve, correcting a structural abnormality (whether congenital or acquired), implanting a mechanical assist device, and heart transplantation are among the most crucial (Abdallah et al., 2017).

When the chest is opened for the purpose of operating on the heart, the procedure is referred to as open heart surgery. The heart itself is not "open," but rather the chest is. Surgery on the heart may or may not include opening the chest cavity. Standard open heart surgery involves the use of a heart lung machine, often known as cardiopulmonary bypass. Abdallah (2016) report that cardiac surgery, including coronary artery bypass grafting (CABG), and valvular surgery, are the most prevalent types of surgery done worldwide. Thirty percent of all fatalities are due to cardiovascular disease, with coronary heart disease being the leading cause of mortality in this category.

Almost 800,000 cardiac operations are performed annually throughout the world. In the postoperative care of patients who have had open heart surgery, the critical care nurse plays a crucial role. The patient having CABG surgery has a right to trust that the nurse caring for them during this time will be competent, compassionate, efficient, and successful. The likelihood of a positive outcome for the patient increases with proper preparation of the patient and their significant others, expertise during the intraoperative phase, and a comprehensive knowledge

base combined with the skill and compassion of the nursing staff during the postoperative phase (Martin & Turkelson, 2016).

Akansel et al. (2021) noted that nurses' knowledge, staff development, and skills can all benefit from ongoing education, writing that nurses should have a formal orientation and training program in-service training and education are crucial to delivering high-quality nursing services as a whole. The quality should also start and conclude with schooling. Continuing education for nurses is still a practical way for nurses to keep up with the ever-developing body of medical knowledge and technology. Nurses benefit from this since it allows them to maintain current skills and learn new ones (Akansel et al., 2021).

2.6 The Use of Virtual Reality in Nursing Practices

Virtual reality apps have recently been implemented as part of nursing initiatives in clinical sectors with the goal of reducing patients' perception of pain, anxiety, and fear while also providing comfort and convenience by diverting their attention (Yaban & Cetin, 2022).

Virtual reality applications used as a form of distraction in clinical medical care have been shown to be effective in the management of pain and anxiety during procedures such as burn wound debridement, injection applications, wound care, toothache, endoscopy procedure, phantom and chronic pain, and chemotherapy applications, Studies have shown that nurses caring for both children and adults can benefit from using virtual reality technology (Öztepe & Kanan, 2021; Radianti et al., 2020; Sosnilo et al., 2021).

Chapter Three

Methodology

3.1 Introduction

The research methodology provides a structured approach to resolving the research issue. Research methodology is the study of how to tackle a research problem in a scientific way. A researcher's research method encompasses all of the strategies and procedures utilized throughout the course of their research. Studies are being conducted in both the physical and social scientific fields. Research in the social sciences serves important and useful functions beyond the realm of academia. In addition to its many other uses, it is quite useful for research on the topic of special education services for children with disabilities. As a result, it facilitates data collection, discovery, and the extraction of important information for further use.

This part describes the research methodology that have been used to clarify the effect of educational on student nurse's knowledge for post cardiac surgery care and compare between using virtual reality program versus traditional educational program through lecture..

It displays the study design, the study setting, the study population, the sample and sampling method, and data collection procedures as well as the validation process of the research instrument that used for data collection and ethical considerations and data analysis are discussed thoroughly.

3.2 Study Design

With the view of achieving research objective, the design of this study was based on A Quasi-experimental design used pre-post questioners to accomplish the aim and the objectives of the

study. Eligible students randomly assigned to one of two groups: An intervention group (VR group) and a control group (traditional lecture group) to evaluate the effects of the educational program intervention on student knowledge.

This study has basically relied on primary data: through structured Pre and post-test Questionnaire. The questionnaire is the major method of data collection. This study was quantitative nature. The data collected from the primary source obtaining requires information. Primary data was collected with the help of a structured questionnaire.

During the research design stage, a logical and practical visualization of the study is often created. In order to determine if programmed learning is more successful than the traditional approach, the researcher selected a suitable research technique. In the section under "Research Methods," all of the procedures and approaches utilized to carry out the research are detailed. Therefore, research methods or techniques are the procedures that researchers use when carrying out research. In essence, for a researcher to be able to find a solution to his research topic, all of the methodologies he employs while doing so must be interrelated.

After a researcher has clearly defined the research topic, the next step is to develop a research design, which lays out the theoretical framework for the study. The development of such a plan allows for research to be as productive as possible, collecting the maximum amount of data. Put simply, research design is there to ensure that meaningful evidence may be collected with minimum investment of time, energy, and effort. An integral part of every research project is the design phase. A study's documented strategy is called a research design. It details the researcher's goals, the study's significance, and the methodology that used to carry it out. There includes a detailed explanation of the problem, questions about the hypothesis, variables, definitions of terminology, people to be included in the sample, instruments to be built, and the

technique to be followed for data analysis. Research design is a defined framework for regulating data collecting properly and inexpensively, as stated by W.Boyd and Westful. "The fundamental plan which guides the data collection and analyses the phases of the project," says Thomos Kinner, who sets out to describe research design. The data collecting technique, data sources, and the kind of information to be gathered are all laid out in the framework.

Pre-test for student knowledge and practice conducted before intervention, and the post-tests were given after the educational program via VR or lectures. Because of its emphasis on level of knowledge and practice on various aspects related to care for post cardiac surgery the programmed teaching approach chosen as the intervention form in this study.

In this study, the pre-test refers to an initial assessment conducted before the educational intervention using either virtual reality (VR) or traditional lectures. The pre-test assesses nursing students' baseline knowledge and practical skills related to care for post-cardiac surgery patients. It serves as a benchmark against which post-test results will be compared to evaluate the effectiveness of the educational intervention.

The post-tests, on the other hand, are assessments administered after the completion of the educational program via VR or lectures. These tests measure the nursing students' knowledge acquisition and improvement in practical skills in caring for post-cardiac surgery patients following the educational intervention. The post-tests aim to determine the impact of the chosen teaching approach (VR or lectures) on enhancing students' competencies in post-cardiac surgery care.

The educational intervention in this study focuses on improving nursing students' level of knowledge and practice in various aspects related to the care of patients after cardiac surgery.

The intervention involves either a VR-based educational program or traditional lectures, chosen based on their potential to effectively enhance students' understanding and proficiency in post-cardiac surgery care.

3.3 Study Setting

In this research the researcher conduct this study in Arab American university students in Jenin - West Bank - Palestine through selection of third and fourth years nursing students at the faculty of nursing

Arab American University (AAUP formerly AAUJ) is the first private Palestinian university, founded in year 2000, in a collaboration with California State University (CSU) in Stanislaus and Utah State University (USU) in Logan. CSU approved AAUP's first Curricula and gave the needed expertise to start the university, USU provided the faculty members and administrators to run the university in its first two years. AAUP serves the educational needs of over 11,300 students, among them there are 40% from Palestine and 55% from the Palestinian homeland and 5% from international countries, by providing a dynamic learning atmosphere that inspires innovation and has a primarily focus on every student's success.

3.4 Study Population

A population refers to the aggregate or totality of objects or individuals regarding which inferences are to be made in a sampling study (Polit & Beck, 2020).

The study population consisted of student nurses enrolled at the Arab American University in Jenin. The study sample consists of 80 third and fourth year nursing students at Arab American University Palestine (AAUP) in Jenin, who are enrolled in the adult three course.

The students are randomly divided into two groups: a control group of 40 students who receive traditional lecture-based education, and an intervention group of 40 students who receive education through a virtual reality (VR) program. These student nurses would be the target participants for your study, as they represent the group that benefits from the educational interventions being investigated.

3.4.1 Inclusion Criteria

Nursing students in the third and fourth years enrolled in advance medical and surgical for nursing (adult 3) course at the Arab American University in Jenin. Those who have not received specialized training in post-cardiac surgery care beyond their standard curriculum.

3.4.2 Exclusion Criteria

Student nurses who have previously undergone training specifically focused on post-cardiac surgery care.

Those who are not currently enrolled or actively participating in nursing coursework or clinical rotations.

A sample is a small proportion of a population selected for intervention and analysis. A sample is a miniature picture of the entire group of aggregate, as the study of total population was quite difficult, so the investigator selected a small representation of the large whole by the use of sampling technique. Sampling is the important aspects of the researches in social science. It is the process of selecting a portion of the universe with a view to draw conclusion about the universe. Randomized, Purposive sampling technique used for the selection of the sample.

3.5 Sample Size

The sample size was 40 students in each group control group and interventional group, a total of 80 students. The sample was identified based on a confidence level (95%), margin of error 5% and response distribution 50. Also, **Statistician consultation** was adopted to ensure sample size calculation for experimental research, the sample size was calculated by using Open EPI program the result was 70 then added 10 to the sample size, the response rate was 100%. <https://www.openepi.com/SampleSize/SSPropor.htm> (Dean AG, 2013). See Appendix D.

3.6 Study Instruments

One of the most crucial parts of any study design is deciding on the best methods and instruments to use while gathering data. Data collection is the process of selecting a representative sample from which pertinent information about the study's topic may be extracted. The character, aim, and extent of the investigation dictate the data gathering technique. One of the most critical factors in data collecting is the availability of resources. The following instruments employed in this investigation: - Survey technique: - A questionnaire is a type of research instrument that gathers data pertinent to a study's aims by use of a predetermined sequence of questions. Following the completion of the pilot research to validate the questionnaire, it utilized for subsequent phases of the study. Detailed guidelines and objectives informed the development of the study's questionnaire. English was the language of preparation and printing for the questionnaire. To gather the necessary data for the study, structured open-ended questions were utilized. The questionnaire is self-administered in English.

The level of knowledge and practice was assessed before and after the educational intervention using self-administrative questionnaire that was retrieved from previous studies then

approved by five nursing professors, Pre-Post test questionnaire was distributed by the course lecturer, and the lecture was given by researcher and lecturer.

The questionnaire used in this study consists of five parts.

1: Demographic information: including gender, age, educational year, address, and grade point average (GPA). The remaining four parts are based on the literature review, with each part focusing on a specific aspect related to post-operative care. See Appendix A.

2: knowledge and practice questions about central venous catheter blood aspirations:

3: contains five questions about central venous catheter dressing.

4: includes eleven questions about chest tube drainage,

5: contains five questions about sternotomy dressing.

The study sample consists of 80 third- and fourth-years nursing students at Arab American University Palestine (AAUP) in Jenin, who are enrolled in the adult three course. The students are randomly divided into two groups: a control group of 40 students who receive traditional lecture-based education, and an intervention group of 40 students who receive education through a virtual reality (VR) program. Each student in the research sample completes a pre-test questionnaire. The control group attends a lecture covering information about the four procedures and then completes a post-test questionnaire identical to the pre-test. The intervention group receives training on the four procedures using the VR program, which includes comprehensive information and allows them to practice virtually.

3.7 Educational Program Intervention

The educational program interventions in the study included traditional lecture-based education for the control group and a virtual reality (VR) program for the intervention group. The content validity of both interventions was ensured through a rigorous process.

For the traditional lecture-based education, the content was developed based on certified medical references and previous literature reviews. The lecture included detailed explanations, pictures, and videos to enhance understanding. The content was reviewed and approved by experts in the field, including intensive care university professors and intensivist physicians, to ensure its accuracy and relevance to post-cardiac surgery patient care.

Similarly, the VR program content was developed based on the same certified medical references and literature reviews. The VR program included an immersive virtual environment with an ICU room and dynamic medical instruments and tools that may be needed for patient care. The virtual patient was designed to simulate real-world scenarios effectively. The content was verified multiple times by educational institutions to ensure its accuracy and effectiveness in training nursing students.

Overall, both the traditional lecture and VR program interventions underwent thorough content validation processes to ensure their validity and reliability in improving students' knowledge and practice in post-cardiac surgery patient care.

3.8 Pilot Study

The purpose of the pilot study is to ensure that the questions in the measuring tools are clear and understandable to the participants. The pilot study conducted before the actual data collection; 20

participants selected from another rehabilitation center rather than the selected one. The data obtained from the pilot study was excluded from the main study because there is some edits on the VR program and lecture.

pilot study involves 10 students in each group compared to the main study and serves several purposes:

1. **Feasibility Assessment:** It evaluates whether the chosen educational intervention (VR or lectures) can be implemented effectively within the study setting (e.g., Arab American University-Jenin) and among the target population (nursing students).
2. **Reliability Check:** It assesses the reliability of the assessment tools (pre-tests and post-tests) used to measure students' knowledge and practice before and after the intervention. This helps identify any potential issues with the instruments and allows for necessary adjustments before the main study. Cronbach alpha was 0.84 for all domains in the questionnaire.
3. **Effectiveness Preview:** It provides an initial insight into the potential effectiveness of the educational intervention in improving nursing students' competencies related to post-cardiac surgery care. This includes observing any trends or early indications of improvement in knowledge and skills among participants.
4. **Refinement of Procedures:** Based on the findings from the pilot study, adjustments can be made to the study procedures, such as refining the educational content delivered through VR or lectures, optimizing the assessment methods, and ensuring logistical feasibility.

3.9 Reliability

Lenz (2010), refers to reliability as the aptitude of an evaluation tool to produce consistent results each time it is applied in similar scenarios.

For data collection, the researcher trained to use VR,

Each questionnaire was reviewed and evaluated by the researcher. A Cronbach's alpha coefficient test in SPSS version 26 software used to assess the reliability of the tools.

All questionnaires were completed under the researcher's supervision to ensure that students completed the questionnaires themselves.

3.10 Data Collection Procedure

The data collection procedure for the study on the effect of using VR for student training for post-cardiac surgery patients compared with traditional lecture without VR was conducted meticulously to ensure accuracy and reliability of the results. The research title was selected after consultation with the supervisor, focusing on increasing nurses' knowledge and practice for post-cardiac surgery care patients, considering limitations in trainer access due to hospital and infection control policies.

The questionnaire was developed based on certified medical references and previous literature reviews from Google Scholar for grey literature and PubMed for peer-reviewed scientific articles. This dual approach ensured coverage of a wide range of sources, ensuring high-quality published research. Agreement on the questionnaire was obtained by sending it to five intensive care university professors and intensivist physicians. This study began by identifying and utilizing a set of targeted keywords relevant to my research topic. These keywords included

"virtual reality," "nursing education," "post-cardiac surgery care," To refine my search results and improve the precision of my search, I applied Boolean operators such as AND, OR, and NOT. This helped in combining different keywords effectively and excluding irrelevant results.

The research template was submitted to and accepted by the IRB committee. See Appendix C.

The study sample comprised 80 third and fourth-year nursing students registered in the Adult 3 course, calculated using the Open EPI program. The students were divided into two groups: a control group and an interventional group. For the control group, questionnaires were distributed in the simulation lab before attending a traditional lecture on post-cardiac surgery patient care. The lecture included detailed explanations with pictures and videos. The same questionnaire was then distributed post-lecture to measure the impact of the lecture on students' knowledge and practice.

For the interventional group, the same procedures were followed, but the traditional lecture was replaced with a VR software program. The VR software contained all the lecture content and provided students with the opportunity to virtually try out procedures. Each student was given a unique code, and after filling out the initial questionnaire, they used the VR software and then filled out the questionnaire again to measure the effect of using the VR program.

The medical procedures in the VR software were verified multiple times by educational institutions to ensure its accuracy. The study was conducted at AAU Jenin, with coordination from the Adult 3 course lecturer. Random groups were assigned for the control and interventional groups. After data collection from all 160 questionnaires.

3.11 Data Analysis

Data analyzed by using the statistical software Statistical Package for Social Sciences (SPSS) version 26. The alpha level for significance set at 0.05. The distribution of the data tested. The descriptive statistics analysis used to describe the sample characteristics, and frequencies to present the distribution of study variables, means, and standard deviation for continuous numeric variables. Frequencies and percentages computed for categorical variables. Means and standard deviation calculated for pre and post-test scores of both the intervention and control groups.

To analyze the mean difference of the pre-test and post-test scores within each group the paired t-test used. Repeated measurement used to find the differences scores of the pre-test and post-test scores of each participant within the intervention group.

One-way ANOVA, and T-test employed to investigate associations between various variables.

3.12 Ethical Considerations

Ethics refers to a system of moral values that is concerned with the degree to which research procedures adhere to professional, legal, and social obligations to the study participants (Polit & Beck, 2020). In order to ensure the inclusion of ethical considerations, the researcher followed a series of measures.

The researcher acknowledges that study is a delicate and confidential subject, and thus has an ethical obligation to follow important ethical principles such as respect, informed consent, beneficence, non-maleficence, honesty, and fairness. These principles explained to the nurse and the Institutional Review Board (IRB).

Prior to initiating data collection, training, the institutional review board (IRB) sought for approval of this project. Academic approval of the study proposal obtained first from the School of Public Health at Arab American University, then ethical approval for this study obtained from the Ethical Committee at Arab American University in Jenin.

This study did not identify any dangers associated with participation. Preservation of sensitive information, protection of identity, and participation based on personal choice.

The study is not considered to cause any harm to the participant.

All participants have the right not to answer any part of the Questionnaire if they consider it had an adverse effect on them.

Privacy and dignity are ensured in this study,

Avoiding harm, right to withdraw, and informed consent

Efforts were made to ensure that participants did not suffer any harm.

They were treated with honor and respect, the questionnaires were carefully phrased to avoid embarrassment or subjecting any

Participant to any form of psychological trauma and very sensitive questions were avoided.

Informed consent related to the purpose and objectives of the study signed by the participants to get their voluntary agreement to participate and they was able to withdraw at any time without penalty, participants were informed that this study is part of an academic requirement. The researcher assured them about anonymity, and confidentiality and explained to them that the study would not pose any physical, social, psychological, or financial risks to them.

The researcher explained that participation in this study may have benefited participants by expanding their understanding of cerebral palsy and having a positive effect on their caregiving practices regarding their children.

Chapter Four

Results

4.1 Introduction

In this chapter, the results of the study are presented and discussed in relation to the research questions and objectives outlined in the previous chapters. The aim of the study was to clarify the effect of using a virtual reality (VR) program or traditional education methods on third and fourth years nursing student post-cardiac surgery at Arab American University- Jenin. The chapter provides a comprehensive analysis of the data collected, focusing on the development of skills and knowledge among the student nurses. The findings are presented in a clear and organized manner, with tables. The results are then discussed in light of the research aim, highlighting the implications for nursing education and practice.

4.2 Socio-Demographic Variables

The socio-demographic characteristics of the participants are summarized in Table 4.1. The majority of participants were female (67.5%), and the rest were male (32.5%). Regarding age distribution, participants were mostly 21 years old (47.5%), followed by 22 years old (31.3%), and 20 years old (8.8%). A small percentage of participants were either 23 years old (6.3%) or 24 years old (6.3%). In terms of educational years, nearly half of the participants were in their fourth year (51.3%), while the other half were in their third year (48.8%). Regarding living place, most participants lived in cities (60.0%), followed by those living in villages (38.8%), and a very small percentage lived in camps (1.3%). Regarding the grade point average, 58.8% of participants scored between 3 and 4, while 41.3% scored between 2 and 2.9.

In general, the results presented in the table imply that, in terms of socio-demographic characteristic, control and interventional groups are similar; there are no considerable differences in gender distribution, educational years, and GPA. The results of the age and living location questionnaire were compared, and while there were considerable differences among them, they were not statistically significant according to the P-values. This balance is necessary so that any difference in outcomes that can be noted in the studies is more likely to be attributed to the interventions that are being tested rather than the baseline characteristics of the groups.

Table 4.1: Socio-Demographic Variables

Socio-Demographic Characteristics	Group	Control	Interventional	Total	P-value
Gender	Male	14 (53.8%)	12 (46.2%)	26 (32.5%)	0.406
	Female	26 (48.1%)	28 (51.9%)	54 (67.5%)	
Age	20 years	7 (100.0%)	0 (0.0%)	7 (8.8%)	0.091
	21 years	16 (42.1%)	22 (57.9%)	38 (47.5%)	
	22 years	9 (36.0%)	16 (64.0%)	25 (31.3%)	
	23 years	3 (60.0%)	2 (40.0%)	5 (6.3%)	
	24 years	5 (100.0%)	0 (0.0%)	5 (6.3%)	
Educational years	3	17 (43.6%)	22 (56.4%)	39 (48.8%)	0.186
	4	23 (56.1%)	18 (43.9%)	41 (51.2%)	
Living location	City	27 (56.3%)	21 (43.8%)	48 (60.0%)	0.141
	Village	12 (38.7%)	19 (61.3%)	31 (38.8%)	
	Camp	1 (100.0%)	0 (0.0%)	1 (1.3%)	

	2-2.9	13 (39.4%)	20 (60.6%)	33 (41.3%)	0.086
Grade point average	3-4	27 (57.4%)	20 (42.6%)	47 (58.8%)	

4.2 comparison of the baseline between Pre-intervention and control groups regarding knowledge.

Table 4.2 A comparison of baseline between Pre-intervention and control groups regarding knowledge scores in the pre-test. the control group had a mean score of 54.78, while the interventional group had a slightly lower mean score of 51.60. However, this difference was not statistically significant (bootstrap bias = -0.14, bootstrap std. error = 2.57, $p = 0.31$).

Table 4.2: Comparison of baseline between intervention and control groups regarding knowledge and practice.

	Control Group	Interventional Group
Total Pre knowledge	54.78	51.60
Sig.	0.31	

4.3 comparison of base line between pre intervention and control groups regarding practice.

In Table 4.3 The comparison of base line between pre intervention and control groups regarding practice scores in the pre-test. scores indicated the mean for interventional group was 47.5 while the control group was 49.3. The T-test results for mean difference between the pre-test scores was 0. 58; this showed that there was no difference of the two groups at the beginning of the study in terms of the practice score.

In Table 4.3: comparison of base line between pre intervention and control groups regarding practice.

	Control Group	Interventional Group
Total Pre practice	49.3	47.5
Sig	0.58	

4.3 Level of knowledge Pre-Test and Post-Test on Each Dimension Related to Care for Patient Underwent Cardiac Surgery Using Paired Sample T-test

In Table 4.2 showed the paired sample t-test was used to compare the mean scores on different dimensions related to the care for patients who underwent cardiac surgery, before and after the intervention. The results showed a significant improvement in knowledge scores from pre-test to post-test for all dimensions. For blood aspiration, the mean score increased from 57.4 (SD = 20.3) to 78.3 (SD = 14.3), with a significant difference of -20.9 ($p < 0.001$). Similarly, for dressing, the mean score increased from 52.3 (SD = 21.9) to 76.0 (SD = 16.4), with a significant difference of -23.8 ($p < 0.001$). For chest drain care, the mean score increased from 40.6 (SD = 13.1) to 66.1 (SD = 18.6), with a significant difference of -25.5 ($p < 0.001$). Regarding sternotomy dressing, the mean score increased from 62.3 (SD = 25.3) to 84.3 (SD = 16.4), with a significant difference of -22.0 ($p < 0.001$). Finally, for the total knowledge score, the mean score increased from 53.2 (SD = 15.0) to 76.2 (SD = 12.4), with a significant difference of -23.0 ($p < 0.001$).

Table 4.3: Level of knowledge pre-test and post-test on each dimension related to care for patient underwent Cardiac surgery using paired sample T-test

Pair	Mean/100	Std. Deviation	Sig. (2-tailed)
Blood aspiration Pre	57.4	20.3	0.000
Blood aspiration Post	78.3	14.3	
Blood aspiration Pre - Blood aspiration Post	-20.9	22.5	
Dressing Pre	52.3	21.9	0.000
Dressing Post	76.0	16.4	
Dressing Pre - Dressing Post	-23.8	26.8	
Chest Drain Pre	40.6	13.1	0.000
Chest Drain Post	66.1	18.6	
Chest Drain Pre - Chest drain Post	-25.5	19.5	
Sternotomy dressing Pre	62.3	25.3	0.000
Sternotomy dressing Post	84.3	16.4	
Sternotomy dressing Pre - Sternotomy dressing Post	-22	24.8	
Total Pre	53.2	15.0	0.000
Total Post	76.2	12.4	
Total Pre - Total Post	-23	17.9	

4.2.4 Comparison of knowledge score in pre-test and post-test for Interventional group with control group

In Table 4.4 The comparison of knowledge scores between the interventional and control groups in the pre-test and post-test. In the pre-test, the control group had a mean score of 54.78, while the interventional group had a slightly lower mean score of 51.60. However, this difference was not statistically significant (bootstrap bias = -0.14, bootstrap std. error = 2.57, $p = 0.31$). In the post-test, there was a notable increase in the mean score for both groups, with the control group scoring 71.35 and the interventional group scoring 80.95. The difference in mean scores between the two groups in the post-test was statistically significant, favoring the interventional group (bootstrap bias = 0.01, bootstrap std. error = 1.94, $p = 0.00$). This suggests that the intervention, either the virtual reality program or the educational sessions, had a positive impact on knowledge acquisition, particularly in the interventional group.

Table 4.5: Comparison of knowledge score in pre-test and post-test for interventional group with control group

Group	Total Pre knowledge	Total Post Knowledge
Control	54.78	71.35
Interventional	51.60	80.95
Sig.		0.001

4.2.5 Comparison of practice score in pre-test and post-test for Interventional group with control group

Table 4.5, as a comparison of practice scores between groups: including the interventional group using the VR based education and the control group using the traditional lecture based education. It gives the total practice scores for both groups during the pre-test and post-test periods as shown in the table below. The pre-test scores indicated the interventional group was 59, while the control group was 49 in the practice test. The control group's practice score was 42, which was a lower score than the interventional group of 47.5. The T-test results for mean difference between the pre-test scores was 0.58; this showed that there was no difference of the two groups at the beginning of the study in terms of the standard deviation. This implies that the practical skill sets of the two groups were comparable at the beginning of the study which makes them ideal for comparison concerning the effects of the educational intercessions. In this post-test, the percentage score for practice in the control group rose to 67.27 while the practice score for the interventional increased tremendously to 78.12. Analyzing the results of the post-tests and using two sample t test, the p-value was equal 0.001 showed the difference in the practice scores following the intervention was also significantly different. With such a notable difference, the results indicate that the VR based education had a more positive impact on practical knowledge compared to the traditional lecture based education.

Table 4.6: Comparison of practice score in pre-test and post-test for interventional group with control group

Group	Total Pre Practice	Total Post Practice
Control	49.3	67.27
Interventional	47.5	78.12
Sig.	0.58	0.001

4.4 Compared pre-test results with post-test results according to Socio-demographic characteristics

In Table 4.3 the comparison of pre-test and post-test results according to socio-demographic characteristics. There was no significant difference in the mean total scores between male and female participants, with scores of 53.2 and 77.7 for males and 53.2 and 75.4 for females, respectively ($p = 0.99$). However, when according at age groups, there were significant differences in mean total scores. Participants aged 20 had a mean total score of 39.1 in the pre-test, which increased to 70.4 in the post-test ($p = 0.03$). Similarly, participants aged 21, 22, 23, and 24 also showed significant improvements in their mean total scores from pre-test to post-test. Regarding educational years, participants in the fourth year had a higher mean total score in both the pre-test (56.5) and post-test (76.9) compared to those in the third year (49.7 and 75.4, respectively), with a significant difference ($p = 0.04$). There were no significant differences in mean total scores based on the address or grade point average of the participants ($p > 0.05$).

Table 4.7: Compared of pre-test result with post-test result according to Socio-demographic characteristics

Variable	Group	Mean Total Pre	Mean Total Post	Sig.
Gender	Male	53.2	77.7	0.99
	Female	53.2	75.4	
Age	20	39.1	70.4	0.03
	21	53.2	75.9	
	22	53.1	77.5	
	23	60.2	78.4	
	24	65.8	76.6	
Educational years	3	49.7	75.4	0.04
	4	56.5	76.9	
Address	City	53.8	76.0	0.89
	Village	52.2	76.5	
	Camp	55.0	75.0	
Grade point average	2-2.9	50.9	75.0	0.25
	3-4	54.8	77.0	

4.2.6 Comparison in time of education for interventional group and control group

In Table 4.6 the comparison of the duration of education between the interventional and control groups revealed significant differences. The control group received education for an average duration of 120 minutes, while the interventional group received education for only 20 minutes.

This difference in duration was statistically significant ($p = 0.000$), indicating that the education provided to the two groups differed significantly in terms of time investment.

Table 4.8: Comparison in time of education for interventional group and control group

Group	Mean	Sig.
Control	120 Min	0.000
Interventional	20 Min	

Summary

This chapter aims to present and analyze the findings of the study conducted to compare the impact of implementing a virtual reality (VR) program with the traditional educational approach among the third and fourth years nursing students in terms of their skills and knowledge gained after handling cardiac surgery cases at the Arab American University-Jenin. Data analysis reveals a raise in overall knowledge and scoring on practice in both groups, while VR group had the higher score. Demographic data including gender, age, and educational year were also matched both in the control and interventional group. The findings include that VR improved the score for both knowledge and practice compared to traditional lectures, the education period for the VR group was only twenty minutes contrasting to the control group's two hours. This implies that VR could be used as a better tool in enhancing education within nursing training.

Chapter Five

Discussion

5.1 Introduction

The objective of the research was to establish the effects of educational change – virtual reality (VR) programs as compared to traditional didactic teachings – on the stock of information possessed by the student nurses in connection with the matter of post-cardiac surgery care. This section offers a detailed discussion of the findings; it also discusses the findings in relation to the study objectives and existing literature. Moreover, the potential significances influence that has on the nursing education and practice are analyzed.

5.2 Discuss the Results

5.2.1 Discuss the Socio-Demographic Characteristics

The equality on gender, age, years in education, their living area, and their GPA between the two groups of control and interventional is very vital since it minimizes the possibility of getting variations of the outcomes due to the education interferences. The participants were more female students, 67.5% female and 32.5% male a trend typical of the nursing students, as previous studies indicate that the nursing students population comprises more women (Budden et al., 2013). Concerning age, about half of the participants, 47.5%, were 21-year-old participants; the other half was 31. 3% of 22-year-old participants, which represents the age range of nursing students, usually in their early twenties (National League for Nursing, 2014). Overview of Study Participants. The participants were nearly evenly divided between third-year (48. 8%) and fourth-year (51.3%) nursing students, which was crucial for evaluating effects of educational

changes at different semester of the nursing program. Prevalent places of participants' domicile were cities 60.0 %, villages 38.8% and camps 1.3%. While living location can impact on availability of educational facilities and opportunities to gain the practical experience, there were no differences in the baseline characteristics based on the living location to be significant. About half of the participants fell within the 3-4 GPA range (58.8%) which suggests that the participants are academically in good standing and premised on which the current study established the initial knowledge levels of learners in the group. The balance of distribution of study participants by socio-demographic characteristics also enhances the reliability of comparing the two educational interventions.

5.2.2 Discuss the Effectiveness of Educational Interventions

The first research aim was to assess the effect that VR has on the amount of knowledge that student nurses have compared to traditional methods. The findings generated by the paired sample t-test appear in Table 4.2 demonstrate first-time knowledge enhancement from pretest to posttest regarding key characteristics of post-operative cardiac surgical care. Improved mean knowledge scores for blood aspiration climbed to 57.4 (SD = 20.3) to 78.

While the above discussion gives the general range, it will be useful to know the number of students who have chosen specific course options. $M = 3$ (SD = 14.3) ($F = 63.21$ $p < 0.001$), this shows that both educative intercessions boosted the learner's comprehension of this important process. This is in line with other research studies that have shown that practicing clinical skills through Simulation Based Learning is very effective in enhancing clinical skills (Cant & Cooper, 2010). For dressing techniques, scores increased from a mean of 52 to 60 which is an improvement of 8 points. 3 (SD = 21.9) to 76 minutes, Group II was also found to require significantly more time ($M = 58.0$ (SD = 16.4) ($p < 0.001$), It is, therefore, apparent that

dressings play a vital role especially in post-surgery patients as it helps in avoiding infections, and enhancing the rate at which wounds heal. Similar observations were made by Kim et al. (2016) who revealed enhanced nursing competencies due to simulation-based education. Knowledge about chest drain care also improved notably as the scores shifted from an initial 40.6 (SD = 13.1) to 66. This improvement showcases just how far-reaching the educational techniques are preferred in teaching complicated, practical procedures that are pivotal in patients' healing processes.

This is in line with studies conducted by Kaddoura (2010) which affirmed the fact that simulation training improves critical thinking and clinical competencies. These results are in coherence with previous research highlighting on the benefits of using VR in nursing education; as VR significantly improves knowledge and comprehensibility of elaborate and advanced clinical procedures because of its ability to create actual simulations (Farra et al., 2013; Padilha et al., 2018). These improvements in essential aspects of care necessary in the recovery of post-cardiac surgical patients are in line with evidence demonstrating the effectiveness of VR and simulation in developing and improving the quality of nursing knowledge and skills (Cant & Cooper, 2010; Kim et al., 2016; Kaddoura, 2010; Farra et al., 2013; Padilha et al., 2018).

5.2.3 Discuss the Comparative Analysis of VR and Traditional Education

One of the specific aims was to establish how the outcomes of the VR program differ from those of traditional lecture-oriented learning. Table 4.6 indicates the t-test results of the knowledge scores of the interventional group (VR) and the control group (lecture-based) between the pre-test and post-test. The control group was found to have a slightly higher mean score (54.7) than the interventional group (51.6) before the intervention but the difference is not statistically

meaningful with a p-value of significance of 0.31 hence the two groups are equivalent in terms of prior knowledge. The results of post-test show a significant increase of interventional group (80.95) compared to control group (71.3) p-value= 0.001. This difference means that the VR program was a greater aid as to the knowledge boost when compared to traditional lectures. The advantage of using VR in this study has some empirical evidence which show that there are gains in learning paradigm by implementing VR because it enables creation of real life models that aids in learning and undertakings (Cant & Cooper, 2014; Lau & Lee, 2019). Others studies have shown the same; For instance, Yuan et al. (2018) concluded that the simulation based education have enhanced the clinical skills and knowledge of the nursing students in a significant way. Moreover, Li et al. (2020) proved that VR training could be effective more than the traditional methods in clinical assessment. Altogether, these studies underscore the role of virtual reality as a versatile and promising modality for enriching nursing curricula and enhancing the efficacy of students' learning and performance in clinical arenas.

The result of non-significance in pre-test mean difference ($t = 1.58$, $p = 0.58$) further supports the rationale that both the groups possessed the similar level of practical knowledge. This is important especially when trying to establish the reasons for the differences in the post test scores in relation to the educational interventions rather than prior differences in skills. The changes in the post- test practice score of the interventional group from 47.5 to 78.12 are still higher than the changes of the control group from 49.3 to 67.27 showing that VR-based education has better learning outcomes than traditional strategies. The p-value of 0.001 is statistically significant which means that the observed improvement is not due to chance. These finding are in agreement with the literature on the benefits of using VR in health care education. Due to the inherent interactivity and repetitiveness of clinical skills, there are improved skill

acquisition and retention through the use of VR. (Moro et al. , 2017; Harrington et al. , 2018). Even though the implementation of VR based education was for a shorter time (as presented in Table 4. 6), the interventional group obtained much higher mean post test scores. This indicates that not only does VR enhance practical abilities but does so in a shorter amount of time, which can prove to be particularly useful in time-sensitive learning environments (Jensen & Konradsen, 2018; Liaw et al. , 2018).

This is in consideration with other literature reviews and meta-analysis that looked into the utilization of VR training to learning enhancement among both the HC and the non- HC staff (Chavez & Bayona, 2018; Kyaw et al. , 2019; Merchant et al. , 2014; Rourke, 2020).

In total, such works evidence the necessity of developing virtual reality as a training aid that fosters learning in an engaging context. The cognitive processing of virtual reality might be explained by Kolb's experiential learning model of knowledge acquisition, which occurs through the following steps: concrete experience, reflective observation, theory, and active experimentation. Concerning the use of VR in nursing, this technology entails the use of simulations that provide actual patient care experiences as carried out in actual settings, although it is done virtually, and hence can be controlled. The above-noted hands-on learning also allows for the improvement of learning and retention of knowledge and physical skills in order to have immediate positive educational impacts (Chan, 2012).

Chavez and Bayona (2018) established that VR enhances students' participation in learning and completion of activities through engrossing and authentic images and interaction. This increased activity is very useful for learning because it entails students participating, thinking, and solving problems. For this reason, it is easy to understand that the situations simulated in VR are more complex and diverse compared to those that a student will experience

during clinical placements, due to the scope that the technology has to offer. Therefore, student can gain the confidence they need to effectively handle different clinical situations that are evident in their high knowledge scores. Another way that makes the use of VR less mentally taxing is the fact that a significant amount of cognitive load is generated through visual and kinesthetic learning which critical components of effective learning and retention are in the long-term.

5.2.4 Discuss the Cost-Effectiveness and Time of Educational Methods

The difference in the education time between the control and the interventional group. While the control group spent an average of 120 minutes on education, the interventional group was given only 20 minutes of education. This difference in the duration of the education provision was therefore statistically significant [$t(287) = 15.97, p = 0.000$], suggesting that the time devoted to the education of the two groups of students was significantly different. Nevertheless, the duration of the VR intervention was shorter than that of the traditional training and the results indicated that the knowledge acquired after the VR intervention was significantly higher which means that not only is VR training more efficient than the traditional training, but is also more effective. This efficiency is further backed up by research work that has established VR as a time-effective approach to education (Cant & Cooper, 2014; Lau & Lee 2019).

First, the input and dissemination of extensive information that VR is capable of providing is more efficient and effective. In this case, learners are assured of engaging hence are able to grasp more knowledge as opposed to constant lectures in a classroom setting. This is in consonant with the views of Merchant et al. (2014) and Kyaw et al. (2019) who noted that, through the use of VR training, required time to achieve learning gains is considerably cut down. In addition, VR

can give feedback to the learner immediately and give them the chance to experience the scenario again and again as necessary , this supports the learning process and enables learners to master skills(Rourke, 2020). These daily adaptations and repetitions are well-known for their positive impact on learning and the results of the interventional group with significantly less training time.

5.3 Strength and limitations

Strengths and the limitations of the current study was:

5.3.1 Strength

The study has several strengths that establish its value in advancing the field of nursing education. The study's focus on post-cardiac surgery care provides beneficial insights into the effectiveness of VR training on actual clinical performance and patients' wellbeing. In this regard, to the best of our knowledge, this is one of the scarce interventional and VR studies in the Palestinian context that can be taught in universities in lab environments. The course successfully combines academic information with policy implementation, using realistic patient cases and enhancing students' interest.

It has embraced the use of Virtual Reality technology which is modern and suitable with the latest advancements in technology and learning. The study comparing VR-based education with more conventional approaches to education also helps identify the strengths of the VR method in improving knowledge and competencies of nursing students. The socio-demographic data of participants were also matching between control group and interventional group, thus reducing the possibility of preexisting differences and confounding variables, which could influence the results here reported. Considering the relatively large sample size, the large and diverse number of participants strengthens the study's credibility and reliability. From various angles of post-cardiac surgery care including blood aspiration, dressing techniques, and chest drain care, the whole rounded picture of VR system can be assessed.

5.3.2 Limitation of the study

Several limitations should be taken into consideration as the result of this study is being interpreted. First, and perhaps the most important, the study was performed in a single health-care facility, which might affect the external validity of the results. Besides the study targeted only third and fourth years nursing students; thus, the findings cannot be generalized to the other years of study or nursing practice. Of the limitations, the present study sample size was somewhat small, and this may limit the statistical power of the study. In addition, the study only looked at the occurrence of knowledge gains and practice changes in the short term, right after the educational interventional and did not follow up the participants later to find their retention of the acquired knowledge and skills. It also did not attempt to capture the perception and satisfaction of the students on the effects of the educational intercessions; understanding of the student's perceived benefits and drawback of the VR-based education would have been crucial. The following are important directions for future research to help develop a more accurate view of the effects of VR technology on nursing education and practice.

5.4 Implication for This Study

5.4.1 Implication for Practice

In general, the implications related to the findings of this study can be discussed in terms of nursing practice. Nurses who receive education through virtual reality models are likely to be more competent in delivering care to cardiac surgery patients resulting to high patient satisfaction. VR technology gives nurses a safe platform to train and rehearse on in order to build up their competence and confidence as they perform handling in real clinical scenarios. Furthermore, VR-based education can also provide more effective and cost-saving training for nurses in contrast to traditional methods since the procedures can be repetitively trained without using expensive equipment. This technology can also be helpful in continuing education to ensure that practicing nurses are up to date in their field. In addition, VR programs can also assist in implementing a consistent curriculum where all the nurses are trained equally regardless of their training institution.

They can also foster cooperation between various professions by enabling nurses to work with others in a coherent manner. VR has suggested that remote learning can be of advantage to nurses who serve rural or hard-to-reach regions. In conclusion, incorporating VR technology in nursing practice can go a long way in enhancing the kind of education and training that nurses undergo hence enhancing the experience of the patients as well as improving the overall experience of the healthcare providers.

Based on the findings of this study, several recommendations can be made to enhance nursing education and practice:

1. **Integration of VR into Nursing Curriculum:** Nursing schools should consider integrating VR technology into their curriculum to enhance the learning experience and improve practical skills acquisition among student nurses.
2. **Collaboration with Clinical Settings:** Collaboration between educational institutions and clinical settings can help bridge the gap between theory and practice. Clinical simulations using VR could be aligned with real-world scenarios, providing students with a more comprehensive learning experience.
3. **Cost-Effectiveness Analysis:** Conducting a cost-effectiveness analysis comparing VR education to traditional methods would help institutions make informed decisions about resource allocation.
4. **Accessibility and Equity:** Efforts should be made to ensure that VR technology is accessible to all students, regardless of their background or location.

5.5 Recommendations for Future Research

1. **Longitudinal Studies:** Conduct longitudinal studies to assess the long-term retention of skills, knowledge, and practice gained through VR training compared to traditional methods.
2. **Expanded Sample Size:** Increase the sample size to enhance the generalizability of the findings. Including students from multiple nursing schools could provide a broader perspective.
3. **Diverse Procedures:** Include a wider range of medical procedures beyond the four you have studied to evaluate the effectiveness of VR training in various contexts.

4. **Qualitative Analysis:** Incorporate qualitative methods such as interviews or focus groups to gain deeper insights into the students' experiences and perceptions of VR training.
5. **Technological Advancements:** Investigate the impact of different types of VR technology (e.g., augmented reality, mixed reality) on nursing education to determine which tools are most effective.
6. **Cost-Benefit Analysis:** Conduct a cost-benefit analysis to compare the financial and educational benefits of VR training versus traditional methods.
7. **Faculty Training:** Research the necessary training and support required for faculty to effectively integrate VR into their teaching practices.
8. **Impact on Clinical Practice:** Evaluate the impact of VR training on actual clinical practice and patient outcomes to determine if the skills learned in a virtual environment translate to real-world settings.
9. **Interdisciplinary Studies:** Explore the use of VR training in interdisciplinary healthcare education, involving other healthcare professionals such as doctors, pharmacists, and physical therapists.
10. **Student Engagement, Motivation and satisfaction:** Investigate how VR training affects student engagement and motivation compared to traditional lecture-based learning.

5.6 Conclusion

The study finds that the use of Virtual Reality (VR) programs in teaching and training of nursing students improves the acquisition of knowledge and skills in post-cardiac surgery identification relative to the traditional didactic approach. As concluded by the findings, it is evident that using

the VR-based education results in gaining enhanced knowledge in a shorter period and higher levels of skills improvement during the training period. The study revealed that the VR group had a significant enhanced competency relating to aspiration of blood, dressing and chest drain compared to the control group instructed through lectures.

These findings accord with prior research which asserts that VR can be a very effective mode of learning as well as a tool for teaching and enhancing intricate clinical situations. The study is very useful and points for the idea to the VR application in the field of nursing education as the method that can help students to connect theoretical knowledge and practice and as the result provide the population with better prepared nurses and better patient outcomes.

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Appendices

Appendix 1: The Questionnaire

الجامعة العربية الأمريكية
ARAB AMERICAN UNIVERSITY



Post graduate college

Critical care of nurses

Dear Participant,
Regards

Thank you for taking the time to complete this questionnaire about "post cardiac surgery nurses care, This questionnaire is part of a research study aimed to assess AAUP student nurses knowledge, attitudes, and practices related to significant role of care for post cardiac surgery in minimizing and preventing potential problems and complications and increase knowledge by providing safe and effective care practices to ensure appropriate care delivery and quality.

Your responses will remain confidential and will only be used for research purposes. Therefore, there is no need to provide your name or any identifying information.

The questionnaire is composed of 4 sections and should take approximately 5-10 minutes to complete. We appreciate your careful consideration and thoughtful responses to each question.

If you have any questions or concerns about the study or the questionnaire, please do not hesitate to contact us.

Thank you again for your participation and valuable input.

Sincerely,

Hothyfa. M, Zhoor

Phone and WhatsApp: 00972598518841

Email: Alzhoorhothyfa@gmail.com

Supervisor: Dr. Sajed Gawadrah

Phone: 0599730911

Section One: Demographic Data

Student random number

- 1) Gender: ☐ Male ☐ Female
- 2) Age:
- 3) Educational years:
- 4) Address: ☐ city ☐ village ☐ camp ☐ other
- 5) Grade Point Average

Section Two: Please mark the correct answer about blood aspiration from *Central Venous Catheter (CVC)*

NO.	Questions	Yes	No
1	Daily wiping of the outer surfaces of the catheters with an antiseptic reduces the colonization of microorganisms in the catheter area.		
2	Sterile water for injection should be used for flushing and locking in order to ensure CVC lumen patency.		
3	To remove accumulations in the lumen during flushing and locking, calculate the internal volume of the catheter and the connections and use saline in a volume twice the volume (10 ml).		
4	Larger volumes of flushing may be required for parenteral nutrition, contrast agent, blood, and other viscous solutions.		
5	If dextrose solution was used, which can act as a medium for		

	microorganisms, CVC should be flushed with saline solution.		
6	There is evidence that saline flushing is just as effective as heparin.		
7	The effective heparin dose and concentration for flushing CVC are unknown.		
8	When using IV bags/bottles as a washing solution, multiple attempts may increase the risk of infection.		
9	Before flushing and locking, connection surfaces (three-way tap or needleless connector surfaces) must be disinfected.		
10	If the CVC is still being used, the infusion should be stopped for at least 10 minutes before drawing blood.		
11	Blood should not be drawn from the lumen used for drug infusion if the therapeutic drug level is to be determined.		
12	Before taking the blood sample, blood should be drawn 1.5–2 times the volume of the internal catheter lumen. For adults, 5 ml is sufficient.		
13	Blood should not be re-infused through the CVC after blood sample collection to avoid contamination and clotting.		
14	A 10 ml syringe should be used when drawing blood from the CVC.		
15	A proximal lumen of the CVC must be reserved for blood sampling. It is best to choose an unused or intermittent lumen.		

Section Three : Please mark the correct answer about *Central Venous Catheter (CVC)* dressing.

NO.	Questions	Yes	No
1	Transparent dressings containing antiseptic (chlorhexidine) should be used for CVC care.		
2	The transparent dressings should be changed every 5– 7 days, and the gauze should be changed every day.		
3	As an alternative to 2% chlorhexidine gluconate in 70% alcohol, a 10%		

	povidone-iodine + 70% alcohol solution can be used to dress the CVC.		
4	After wiping the skin with a povidone-iodine + 70% alcohol solution, it should be allowed to dry for five minutes in CVC care.		
5	After dressing the catheter insertion site, it should be wiped dry with gauze		

Section Four: Please mark the correct answer about *chest drain*.

NO.	Questions	Yes	No
1	Chest drains are inserted to allow the withdrawal of air, blood or fluids from the chest cavity. It is performed most of the time under general anesthesia .		
2	Fluctuation of the fluid level in the drainage tubing (“swinging”) and/or bubbling during normal respiration is not a true way of knowing if the tube is patent.		
3	Additional pain medication should be administered during the insertion of a chest drain.		
4	The chest drainage system must be kept below the drain insertion site.		
5	A bubbling chest drain should never be clamped.		
6	Regular milking of tubes help to maintain patency.		
7	Both the amount and color of any fluid draining at least daily must be charted.		
8	It is important to drain large effusion faster to enable patient have a quick recovery.		
9	When mobilizing, ensure the drainage system is kept above the waist level.		

10	Suction should never be applied to a chest drain.		
11	Change the dressing only when they are soaked.		

Section Five : Please mark the correct answer about wound care (Sternotomy Dressing)

Notes: WOW means medical trolley that carry equipment such as face mask, gloves, and gown.

NO.	Questions	Yes	No
1	Remove the old dressing that covers the wound. Trash the dressing.		
2	Wipe the wound gently with the cotton ball anti-clockwise around the wound once in one motion; and then trash the cotton ball.		
3	Pick a piece of gauze with forceps and use it to cover the wound		
4	Use the four short strips of surgical tape that have been prepared previously		
5	secure the square gauze on the wound, one strip for each edge of the gauze.		

Thank you

Appendix 2: Distribution of correct answers for pre-test and post- test

Procedure	Pre-test correct	Post-test correct
blood aspiration from Central Venous Catheter (CVC)		
Daily wiping of the outer surfaces of the catheters with an antiseptic reduces the colonization of microorganisms	58 (72.5%)	73 (91.3%)
Sterile water for injection should be used for flushing and locking in order to ensure CVC lumen patency	50 (62.5%)	70 (87.5%)
To remove accumulations in the lumen during flushing and locking, calculate the internal volume of the catheter and use saline in a volume twice the volume (10 ml)	52 (65.0%)	67 (83.8%)
Larger volumes of flushing may be required for parenteral nutrition, contrast agent, blood, and other viscous solutions	48 (60.0%)	66 (82.5%)
If dextrose solution was used, which can act as a medium for microorganisms, CVC should be flushed with saline solution	48 (60.0%)	70 (87.5%)
There is evidence that saline flushing is just as effective as heparin	41 (51.3%)	65 (81.3%)
The effective heparin dose and concentration for flushing CVC are unknown	34 (42.5%)	45 (56.3%)
When using IV bags/bottles as a washing solution, multiple attempts may increase the risk of infection	58 (72.5%)	67 (83.8%)
Before flushing and locking, connection surfaces (three-way tap or needleless connector surfaces) must be disinfected	57 (71.3%)	74 (92.5%)
If the CVC is still being used, the infusion should be stopped for at least 10 minutes before drawing blood	37 (46.3%)	58 (72.5%)
Blood should not be drawn from the lumen used for drug infusion if the therapeutic drug level is to be determined	43 (53.8%)	61 (76.3%)
Before taking the blood sample, blood should be drawn 1.5–2 times the volume of the internal catheter lumen. For adults, 5 ml is sufficient	44 (55.0%)	65 (81.3%)
Blood should not be re-infused through the CVC after blood sample	49	64

Procedure	Pre-test correct	Post-test correct
collection to avoid contamination and clotting	(61.3%)	(80.0%)
A 10 ml syringe should be used when drawing blood from the CVC	49 (61.3%)	60 (75.0%)
A proximal lumen of the CVC must be reserved for blood sampling. It is best to choose an unused or intermittent lumen	22 (27.5%)	34 (42.5%)
Central Venous Catheter (CVC) dressing.		
Transparent dressings containing antiseptic (chlorhexidine) should be used for CVC care	49 (61.3%)	75 (93.8%)
The transparent dressings should be changed every 5– 7 days, and the gauze should be changed every day	44 (55.0%)	65 (81.3%)
As an alternative to 2% chlorhexidine gluconate in 70% alcohol, a 10% povidone-iodine + 70% alcohol solution can be used to dress the CVC	46 (57.5%)	68 (85.0%)
After wiping the skin with a povidone-iodine + 70% alcohol solution, it should be allowed to dry for five minutes in CVC care	44 (55.0%)	62 (77.5%)
After dressing the catheter insertion site, it should be wiped dry with gauze	26 (32.5%)	34 (42.5%)
Chest drain.		
Chest drains are inserted to allow the withdrawal of air, blood or fluids from the chest cavity. It is performed most of the time under general anesthesia	11 (13.8%)	36 (45.0%)
Fluctuation of the fluid level in the drainage tubing (“swinging”) and/or bubbling during normal respiration is not a true way of knowing if the tube is patent	20 (25.0%)	50 (62.5%)
Additional pain medication should be administered during the insertion of a chest drain	59 (73.8%)	66 (82.5%)
The chest drainage system must be kept below the drain insertion site	53 (66.3%)	70 (87.5%)
A bubbling chest drain should never be clamped	50 (62.5%)	64 (80.0%)

Procedure	Pre-test correct	Post-test correct
Regular milking of tubes help to maintain patency	23 (28.8%)	43 (53.8%)
Both the amount and color of any fluid draining at least daily must be charted	58 (72.5%)	67 (83.8%)
It is important to drain large effusion faster to enable the patient to have a quick recovery	19 (23.8%)	32 (40.0%)
When mobilizing, ensure the drainage system is kept above the waist level	22 (27.5%)	47 (58.8%)
Suction should never be applied to a chest drain	25 (31.3%)	57 (71.3%)
Change the dressing only when they are soaked	19 (23.8%)	49 (61.3%)
Wound care (Sternotomy Dressing)		
Remove the old dressing that covers the wound. Trash the dressing.	61 (76.3%)	79 (98.8%)
Wipe the wound gently with the cotton ball anti-clockwise around the wound once in one motion; and then trash the cotton ball	49 (61.3%)	67 (83.8%)
Pick a piece of gauze with forceps and use it to cover the wound.	43 (53.8%)	62 (77.5%)
Use the four short strips of surgical tape that have been prepared previously.	44 (55.0%)	64 (80.0%)
Secure the square gauze on the wound, one strip for each edge of the gauze.	52 (65.0%)	65 (81.3%)

Appendix 3: IRB Approval

Arab American University- Palestine
Deanship of Scientific Research
IRB committee
Tel: 04-241-8888, ext 1196
E-mail: irb.aaup@aaup.edu



الجامعة العربية الأمريكية - فلسطين
عمادة البحث العلمي
لجنة أخلاقيات البحث العلمي
تلفون: 1196 ext 04-241-8888
البريد الإلكتروني: irb.aaup@aaup.edu

IRB Approval Letter

Study Title: The effect of post cardiac surgery care program via virtual reality on knowledge and practice for nurses students

Submitted by: Hothyfa Mohammed Abd Alazeez Zhoor

Date received: 13th April 2023

Date reviewed: 12th May 2023

Date approved: 12th May 2023

Your Study titled "the effect of post cardiac surgery care program via virtual reality on knowledge and practice for nurses students" With archived number 2023/A/81/N was reviewed by the Arab American University IRB committee and was approved on 12th May 2023.

Reham Khalaf-Nazzal, MD, PhD
IRB committee chairman
Arab American University of Palestine



General Conditions:

1. Valid for 4 months from date of approval.
2. It is important to inform the committee with any modification of the approved study protocol.
3. The committee appreciates a copy of the research when accomplished.

لجنة أخلاقيات البحث العلمي في الجامعة العربية الأمريكية

IRB at Arab American University

Appendix 4: Sample Size Calculation By OpenEpi

6:08 2024/6/4

OpenEpi - Toolkit Shell for Developing New Applications

[Expand All](#) | [Collapse](#)

- Home
- Info and Help
 - Language/Options/Settings
 - Calculator
- Counts
 - Std.Mort.Ratio
 - Proportion
 - Two by Two Table
 - Dose-Response
 - R by C Table
 - Matched Case Control
 - Screening
- Person Time
 - 1 Rate
 - Compare 2 Rates
- Continuous Variables
 - Mean CI
 - Median/%ile CI
 - t test
 - ANOVA
- Sample Size
 - Proportion
 - Unmatched CC
 - Cohort/RCT
 - Mean Difference
- Power
 - Random numbers
- Searches
 - Google--Internet
 - PubMed--MEDLARS
- Internet Links
- Download OpenEpi
- Development

Start

Enter

Results

Examples

Help

Sample Size for Frequency in a Population

Population size(for finite population correction factor or $fpc(N)$): 550
 Hypothesized % frequency of outcome factor in the population (p): 94.5% \pm 5
 Confidence limits as % of 100(absolute \pm %)(d): 5%
 Design effect (for cluster surveys- $DEFF$): 1

Sample Size(n) for Various Confidence Levels

ConfidenceLevel(%)	Sample Size
95%	70
80%	33
90%	52
97%	84
99%	111
99.9%	160
99.99%	201

Equation

<https://www.openepi.com/SampleSize/SSPropor.htm>

1/2

6:08 2024/6/4

OpenEpi - Toolkit Shell for Developing New Applications

Sample size $n = [DEFF * Np(1-p)] / [(d^2 / Z^2)_{1-\alpha/2} * (N-1) + p * (1-p)]$

Results from OpenEpi, Version 3, open source calculator--SSPropor
Print from the browser with ctrl-P
or select text to copy and paste to other programs.

It looks like there are no examples for this exercise.

الملخص

الخلفية: لقد ثبت أن التعليم والتعلم باستخدام المحاكاة فعال في المناهج التمريضية التي تتطور بسرعة في الوقت الحالي. تُعتبر تقنية الواقع الافتراضي واحدة من أسرع التقنيات نموًا في مجال الرعاية الصحية. يتيح الواقع الافتراضي للمستخدمين رؤية والتفاعل مع نسخة حاسوبية من بيئة مادية، سواء كانت هذه البيئة واقعية أو خيالية.

الهدف: هدفت هذه الدراسة إلى معرفة تأثير التعليم على معرفة وممارسة طلاب التمريض فيما يتعلق برعاية المرضى بعد جراحة القلب، والمقارنة بين استخدام برنامج الواقع الافتراضي مقابل البرنامج التعليمي التقليدي من خلال مختبر المحاكاة في الجامعة العربية الأمريكية - فلسطين.

الطريقة: تم استخدام تصميم شبه تجريبي. أجري اختبار قبلي لقياس معرفة الطلاب قبل التدخل، وتم تقديم اختبارات بعدية بعد البرنامج التعليمي عبر الواقع الافتراضي للمجموعة التجريبية أو المحاضرات التقليدية للمجموعة الضابطة. شملت عينة الدراسة 80 طالبًا في التمريض مسجلين في مساق "البالغين 3". تم تقييم مستوى المعرفة والممارسة قبل وبعد التدخل التعليمي باستخدام استبيان ذاتي الإدارة. تم تحليل البيانات باستخدام برنامج الحزمة الإحصائية للعلوم الاجتماعية (SPSS) الإصدار 26.

النتائج: أظهرت النتائج زيادة في المعرفة العامة والدرجات المتعلقة بالممارسة في كلا المجموعتين، بينما كانت مجموعة الواقع الافتراضي تتمتع بمستوى أعلى من المعرفة والممارسة. تم مطابقة البيانات الديموغرافية بما في ذلك الجنس والعمر والسنة التعليمية في كلا المجموعتين التجريبية والضابطة.

الخلاصة: خلصت الدراسة إلى أن مجموعة الواقع الافتراضي أظهرت تحسناً ملحوظاً في الكفاءة فيما يتعلق بسحب الدم، والتضميد، وتصريف الصدر مقارنة بالمجموعة الضابطة التي تلقت التعليم من خلال المحاضرات. تتفق هذه النتائج مع البحوث السابقة التي تؤكد أن الواقع الافتراضي يمكن أن يكون وسيلة فعالة للتعليم وكذلك أداة للتدريس وتعزيز المواقف السريرية المعقدة. تعتبر الدراسة ذات فائدة كبيرة وتشير إلى أن تطبيق الواقع الافتراضي في مجال تعليم التمريض يمكن أن يساعد الطلاب في ربط المعرفة النظرية بالممارسة، مما يؤدي في النهاية إلى توفير ممرضين أكثر استعدادًا وتحقيق نتائج أفضل للمرضى.

الكلمات المفتاحية: الواقع الافتراضي، جراحة القلب، المحاضرات التقليدية، المحاكاة.