



Arab American University
Faculty of Graduate Studies

**The Effect of Immersive Virtual Reality Airway Management as A
Learning Strategy on Performance, Self-Efficacy, and Emotional
Intelligence among Nursing Students in the West Bank/ Palestine**

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**This thesis was submitted in partial fulfillment of the requirements
for the Doctorate's degree in Nursing**

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Thesis Approval

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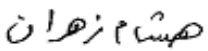
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Declaration

I declare that this thesis was composed by myself and that the work contained herein is my own, except where it states otherwise by references or acknowledgment, the work presented is entirely my own.

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Dedication

I dedicate this work ,,,,,,,,,,

To those who have supported me in my doctorate journey, my supporter, benefactor, and lover enthusiast “To my loving “parents” who taught me the meaning of patience and strength.

To my “dear wife” who strengthened me with this achievement to fulfill my dream”.

Moreover, I dedicate this work to my son (Aws) and daughters (Alma and Qamar) who inspire me to continue my journey.

Special thanks to those who taught me that achieving goals is possible but the road is not easy, these goals are achieved with patience, perseverance, and self-confidence.

Moreover, I dedicate this effort to my friends who provided me inspiration and energy and everyone who helped me cross this journey.

I would also like to extend my thanks to the students who participated in this study.

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Also, I would like to thank distinguished professors in the discussion committee for accepting to be members in the discussion of my dissertation.

ABSTRACT

Background: Management of the airway is a fundamental competency that nursing students should have. There is a lack of studies examining the effect of virtual reality airway management in Arab countries including Palestine. Thus, this study aimed to evaluate the effect of virtual reality airway management as a learning strategy on emotional intelligence, self-efficacy, and performance among nursing students in the West Bank/Palestine.

Methods: A pre–post-test control group design was used and 190 participants were randomly selected from the Arab American University at Palestine and categorized into experimental group (n=95) and control group (n=95). The experimental group received virtual reality airway management and the control group received traditional learning. A structured self-reporting questionnaire included the New General Self-Efficacy Scale, and the Wong Law Emotional Intelligence Scale, and an observation method was utilized to collect data. Additionally, an airway management skill testing checklist was used to evaluate students' performance.

Results: After the intervention, 88.4% of the experimental group passed in airway management, while 33.7% of the control group passed. Also, the mean scores of self-efficacies for the control group and experimental groups were 4.05 (SD=0.14) and 4.24 (SD = 0.28), respectively, indicating high self-efficacy. The mean scores of emotional intelligence for the control group and experimental groups were 4.19 (SD=0.13) and 5.48 (SD = 0.39), respectively, indicating high emotional intelligence. There were differences between the two groups after intervention in performance, self-efficacy, and emotional intelligence ($p < 0.01$), indicating the experimental group had higher mean scores in the aforementioned variables compared to the control group.

Conclusions: Virtual reality simulation improved students' performance, self-efficacy, and emotional intelligence in comparison with traditional learning. Virtual reality experiences could

be a supplement to traditional learning; thus, this study supports incorporating virtual reality in nursing courses to minimize the need for clinical settings for clinical courses.

Keywords: Airway management; Emotional intelligence; Performance; Self-efficacy; Virtual reality

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LIST OF ABBREVIATIONS

Abbreviation	Meaning
AAUP	Arab American University at Palestine
ABCDE	Airways, breathing, circulation, disability, and exposure
ACLS	Advanced cardiac life support
ADHD:	Attention deficit hyperactivity disorder
AED	Automated external defibrillator
AHA	American Heart Association
AI	Artificial intelligence
AR	Augmented reality
ARAT	Action research arm test
ASD	Autism spectrum disorder
BSN	Bachelor of Science in Nursing
BT	Blood transfusion
CBT	Cognitive behavioral therapy
CDM	Clinical decision-making
CI	Confidence Interval
COPD	Chronic obstructive pulmonary disease
CP	Cerebral palsy
CPR	Cardiopulmonary Resuscitation
CRPGs	Computer role-playing games
CVI	Content Validity Index
EEG	Electroencephalogram
EM	Emotional intelligence
FNSs	First-year nursing students
GPA	General point average
GSE	General self-efficacy scale
HGS	Hand grip strength
HMD	Head-mounted display
HRV	Heart rate variability
IP	In-person therapy
IRB	Institutional Review Board
IVR	Immersive virtual reality
M	Mean
MCI	Mass casualty occurrences
MHNPS	Mental health nursing practice simulation
N	Number
NGSE	New general self-efficacy scale
NGT	Nasogastric tube
NIVR	Non-immersive virtual reality
NLN	National League for Nursing
OCD	Obsessive-compulsive disorders
OEA	Evaluation of others' emotions
OECD	Organization for Economic Cooperation and Development
PBL	Problem-based learning

Abbreviation	Meaning
PDCA	Plan-do-check-act
PPE	Personal protective equipment
PTSD	Post-traumatic stress disorders
RCTs	Randomized control trials
ROE	Regulation of emotions
SD	Standard Deviation
SE	Self-efficacy
SEA	Evaluation of one's own emotions
SLS	Simulation learning systems
SPs	Specific phobias
SSCS	Social skills and communication
TP	Traditional equipment
UE	Upper extremity
UOE	Utilization of emotions
VIEW	Virtual interactive environment workstation
VIVED	Virtual visual environment display
VR	Virtual reality
VRE	Virtual reality environment
VRET	Virtual reality exposure therapy
VRICS	Virtual reality infection control simulation
VRS-PBL	Virtual reality simulation problem-based learning
VRT	Virtual reality therapy
WHO	World Health Organization
WLEIS	Wong Law emotional intelligence scale
WMFT	Wolf motor function test

CHAPTER ONE

INTRODUCTION

Background of the Problem

Airway management is a critical aspect of patient care, and it is an essential skill that nursing students must learn (Miranda et al., 2021). The prevalence of airway disorders like asthma and chronic obstructive pulmonary disease (COPD) varies by country and region (Adeloye et al., 2022). World Health Organization (WHO) estimated that asthma affected 262 million people globally and resulted in 455,000 deaths and COPD affected an estimated 65 million people globally and resulted in 3.23 million deaths in 2019 (WHO, 2020). The prevalence of these conditions is higher in low- and middle-income countries (WHO, 2020). Other airway disorders such as bronchiectasis, cystic fibrosis, and interstitial lung disease also have varying prevalence rates. The prevalence rates of airway disorders are constantly changing due to factors such as environmental pollution and lifestyle changes (Chatkin et al., 2022; D'amato et al., 2016).

Innovative technologies such as Virtual Reality (VR) are gradually widespread all over the world (Hamad & Jia, 2022). VR utilizes computer technology to plan a three-dimensional (3D) virtual environment, where user interaction is conducted by senses such as vision, touch, smell, and hearing (Martin et al., 2021). The users can enter a virtual world utilizing a headset with a hand-held controller or desktop (Gadelha, 2018; Hamad & Jia, 2022).

VR may bridge the gap between theory and practice (Foronda et al., 2016; Kalisch et al., 2015) because students perceive themselves in realistic world situations (Lim & McIvor, 2015). The students can learn in a safe environment, which provides them with feedback and self-correction till they become competent in performing skills through coordinated experiences

(Aebersold, 2018). VR simulation allows timeless practices of procedures and gives immediate feedback to students and instructors. Also, it has benefits in decreasing patients' errors and meeting healthcare anticipations (Son et al., 2022). This technology provides students with opportunities to critically analyze patients' conditions, demonstrate procedures and skills, and experience their emotions in a controlled environment without any danger to patients (Guan et al., 2022; Javid & Haleem, 2020). It permits students to exceed their abilities by using other methods rather than a manikin, minimizes the differences in clinical areas, and trains on various skills (Plotzky et al., 2023 Son et al., 2022) in addition to realistic life nursing clinical practices (Plyzky et al., 2023).

VR airway management training can provide opportunities for participants to improve their performance, self-efficacy (SE), and emotional intelligence (EI) (Chiang et al., 2022; Ding et al., 2020; Lee et al., 2023; Rushton et al., 2020). The performance can be measured by the accuracy and speed of the participant's actions (Lochmannová et al., 2022). Also, SE can influence the participant's willingness to engage in the task and their ability to overcome challenges (Ding et al., 2020). High SE is correlated with effective clinical decision-making (CDM) and problem-solving processes (Hwang & Oh, 2021). Conversely, negative SE leads to negative consequences like stress, anxiety symptoms, fatigue, or poor work performance (Duncan, 2020). SE is a strong requirement for work commitment and performance (Barbaranelli et al., 2018).

Additionally, EI is a type of intelligence that defines the competencies in the emotional recognition of oneself and others (Wiśniewska-Paź, 2018). It refers to the ability to recognize, understand, and manage one's own emotions and those of others (Mayer, 2004). It is perceived as a central measure that influences nurses' job performance (Restubog et al., 2020) because it reflects the distressing influence on work experiences (Nightingale et al., 2018). EI improves job well-being (Li et al., 2021) and promotes SE and a positive self-image among nurses by enabling them

to understand and regulate their emotions which results in effective CDM (Kim & Sohn, 2019) and effective problem-solving (Ndawo, 2021) that enhance delivering safe and appropriate care (Zaki et al., 2018).

Overall, the use of VR in airway management training has the potential to improve the competencies of healthcare professionals including nurses and nursing students, reducing the risk of complications, and enhancing patient safety and quality of care (Putnam et al., 2021).

Statement of the Problem

Nursing schools provide students with the necessary knowledge, skills, and comprehensive clinical training in airway management and airway emergencies, including intubation, suctioning, and oxygen administration (Miranda et al., 2021; Rushton et al., 2020; Samosorn et al., 2020). These schools prepare students to work under the supervision of experienced nurses and physicians to manage airway emergencies in real-life situations (Salameh & Lasater, 2021) and provide safe and effective care to patients who require airway management (Miranda et al., 2021).

Nursing students need to have skills that enhance their competencies including EI and SE. EI is a basic to the nursing profession and education programs. It could be a significant element for success among nursing students (Budler et al., 2022; Snowden et al., 2015; Štiglic et al., 2018) and retention (Cleary et al., 2018). Utilizing emotional intelligence is highly necessary because it assists nurses in dealing with stressful situations, emotions, and relationships with the healthcare team, patients, and families (Aghajani Inche Kikanloo et al., 2019). It permits nursing students to confront challenges in clinical practice settings (Cleary et al., 2018) effectively, enhance their leadership and management skills and performance in clinical practice, and improve patient safety (Foster et al., 2017). Several studies have shown that emotional

intelligence has positively correlated with academic performance among undergraduate nursing students (ALmegewly et al., 2022; Budler et al., 2022; Benington et al., 2020; Di Fabio & Saklofske, 2021; Halimi et al., 2021). Additionally, Zaki et al. (2018) revealed that EI plays a critical part in developing effective CDM in the workplace, in which accurate and effective decisions assist nurses in delivering safe and appropriate care. High EI may help the nurse enhance self-control and SE (Smith, 2016). Also, it helps students to successfully interact and respond to the learning environment (Aparicio-Flores et al., 2021).

Education, especially nursing education, has faced a remarkable development in using technology in terms of using artificial intelligence (AI) and VR. In immersive VR (IVR), the students are provided with interactive experiences in an alternative reality where they interplay simulated objects that look real (Kamińska et al., 2019). Previous studies demonstrated that there was an improvement in remembering information among people who used VR headsets compared to those who did not use VR headphones (Samosorn et al., 2020).

By simulating realistic scenarios and providing feedback, VR training can enhance the participants' skills and confidence, as well as their ability to manage their emotions and interact with others in a professional and empathetic manner (Quail et al., 2016). One of the essential aspects of emergency care is airway management, which is essential to immediate survival and the possibility of a satisfactory recovery. Commonly, knowledge of airway management in highly controlled settings is necessary, however before the patient arrives at the hospital there is a clear variance in the success rates of airway management (Carney et al., 2021).

Furthermore, earlier evidence has shown that VR airway management training can enhance the skills and confidence of healthcare professionals (Kabi et al., 2021; Walker et al., 2013). By providing realistic, hands-on experience in a controlled and safe environment, VR training can

help healthcare professionals develop and refine their airway management techniques, such as intubation, ventilation, and emergency airway management (Chiang et al., 2022). VR training can also help to reduce the risk of complications associated with airway management procedures (Karamchandani et al., 2021). By allowing healthcare providers to practice in a virtual environment, they can identify and correct any mistakes or errors before performing the procedure on a real patient, reducing the risk of complications and adverse events (Haleem et al., 2021).

Studies have shown that learning modern simulation methods has increased learners' satisfaction and increased their ability to deal with patients (Putnam et al., 2021). It reflects the efficiency and satisfaction of the trainees to achieve the desired goals of training, which require accuracy and completeness (Kamińska et al., 2022). Additionally, technology may improve SE among learners (Pan, 2020). SE has been described as the motivational effect that enables a person to set goals and create a plan of action. It is the cognitive influence of highly qualified individuals who represent a higher ambition for the viewpoints (Hsiao, 2021). SE helps maintain the highest levels of self-esteem and improves individuals' feelings with a greater capability to confront stressors (Pérez-Fuentes et al., 2019).

Few studies were conducted in Arab countries that examined the effect of VR on nursing students (Bani Salameh et al., 2024). Unfortunately, there is a lack of research about VR simulation experiences in educational institutions in Palestine. Little attention is given to the effect of VR simulation on nursing students' performance and psychological reactions including SE and EI, which are considered significant competencies that influence nursing students' outcomes.

Significance of the Study

This study tries to integrate the practical and theoretical aspects of training using IVR to improve airway management, knowing the benefits resulting from it, and evaluating the resulting SE, in addition to evaluating the performance of students after learning using immersive virtual reality and determining the EI that they are going through.

VR application has been integrated into education on international levels and the effectiveness of using VR was proposed in enhancing skills and clinical competencies in nursing education (Chen et al., 2020; Cobbett & Snelgrove-Clarke, 2016; Farra et al., 2015; Fealy et al., 2019; Foronda et al., 2014; Foronda et al., 2017; Günay İsmailoğlu Elif & Zaybak, 2018; Negut et al., 2016; Padilha et al., 2019; Smith & Hamilton, 2015; Weiner et al., 2019).

This study is one of the first studies examined the effect of VR on performance, SE, and EI. Therefore, this study could provide baseline data and literature on VR simulation practices. Identification of this non-traditional technology could allow instructors, particularly in nursing fields to apply it as a learning method that provides alternative and advanced teaching strategies for nursing education to improve students' outcomes and their performance. Also, it could be necessary for healthcare professionals, instructors, and policymakers to assess the role of VR simulation in enhancing SE and EI accompanied by real practice, and to increase awareness of this technology among students, instructors, nurses, and the public.

Purpose of the Study

This study purposed to evaluate the effect of VR airway management as a learning strategy on performance, SE, and EI among nursing students in the West Bank/Palestine.

Objectives of the Study

This study included the following objectives:

- 1- To examine the effect of VR airway management as a learning strategy compared with traditional learning methods on nursing students' performance in Palestine.
- 2- To examine the effect of VR airway management as a learning strategy compared with traditional learning methods on nursing students' SE in Palestine
- 3- To examine the effect of VR airway management as a learning strategy compared with traditional learning methods on nursing students' EI in Palestine.

Questions of the Study

The following questions were driven to guide this study:

- 1- Is there an effect of VR airway management as a learning strategy on nursing students' performance in airway management in Palestine than those who will participate in traditional learning?
- 2- Is there an effect of VR airway management as a learning strategy on nursing students' SE in Palestine than those who will participate in traditional learning?
- 3- Is there an effect of VR airway management as a learning strategy on nursing students' EI in Palestine than those who will participate in traditional learning?

Hypotheses of the Study

These hypotheses are developed based on previous studies and include:

- H1- The nursing students who will engage in VR airway management as a learning strategy will have better performance in airway management than those who will participate in traditional learning.
- H2- The nursing students who will engage in VR airway management as a learning strategy will have more SE than those who will participate in traditional learning.

H3- The nursing students who will engage in VR airway management as a learning strategy will have higher EI than those who will participate in traditional learning.

Definitions of the Study Variables

The study had the following independent variables including virtual reality and airway management, and these dependent variables: performance, SE, and EI. Each variable had conceptual and operational definitions.

Conceptual Definitions

The following conceptual definitions were developed for the current study:

Virtual reality. It refers to the replication of reality through the use of immersive technologies, where users are enveloped within a simulated environment that lacks physical presence but effectively generates the perception of its presence (Standen et al., 2023). It is the totality of hardware and software systems aimed at creating a comprehensive, sensory illusion of being in another environment (Biocca & Delaney, 1995). Individuals using this technology feel a sense of engaging in activities that closely resemble real-time interactions.

Airway management. It is defined as a systematic assessment, strategic planning, and utilization of various medical techniques and tools to establish and maintain a secure and efficient conduit for the exchange of oxygen and removal of carbon dioxide. These procedures are recommended for patients who have a blocked airway, are experiencing respiratory failure, or require protection of their airway (Kottmann et al., 2022).

Performance. It refers to the extent of achieving goals or the likelihood of success (Krause, 2005). Concerning airway management, it refers to a series of techniques and treatments used to avoid and treat airway obstruction. As a result, the patient's lungs and the atmosphere have an open conduit for gas exchange (Bingham & Proctor, 2008).

Self-efficacy. It refers to an individual's opinion regarding having the knowledge and competency to carry out a specific activity or task (Bandura, 1977, 1997, 2006).

Emotional intelligence. It is defined as the flexibility of observing one's own and other's feelings and emotions, differentiating between them, and utilizing this information to guide one's thinking and actions (Salovey & Mayer, 1990). Also, it is the ability to recognize, express, and comprehend one's feelings and feelings of other people; it is the ability to manage and control one's feelings and feelings of other people (Kotsou et al., 2019). It consists of the ability to perceive, facilitate, understand, and manage emotions (Papadogiannis et al., 2009).

Operational Definitions

The following operational definitions were developed for this study:

Virtual Reality Airway Management. This experience is designed by the investigator based on American Heart Association (AHA) guidelines. The students can re-demonstrate the experience using software programs and equipment such as glasses and sticks.

Performance. American Heart Association Airway Management Skills Testing Checklist was utilized to assess performance. It includes seven items evaluating responsiveness, alerting the emergency response system, checking breathing, and pulse, inserting oropharyngeal or nasopharyngeal airway, delivering oxygen, and performing effective bag-mask ventilation for one minute. The scoring involves pass or fail (Appendix A).

Self-efficacy. A New General Self-Efficacy Scale (NGSE) that was created by Chen et al. (2001) was utilized to assess SE. It consisted of eight items, which were assessed utilizing a Likert scale ranging from 1 (poor agreement) to 5 (high agreement). The scoring of this tool was based on the mean, where a mean of less than three indicated a low level of SE and a mean of equal or more than three indicated a high level of SE (Appendix A).

Emotional intelligence. The Wong Law Emotional Intelligence Scale (WLEIS) was developed by Wong and Law (2002) to evaluate the level of EI. It consists of sixteen items which distributed into four subscales involving an evaluation of one's own emotions (SEA), an evaluation of others' emotions (OEA), the utilization of emotions (UOE), and the regulation of emotions (ROE). The responses were evaluated on a 7-point Likert-type scale ranging from 1 (strongly disagree) to 7 (strongly agree). The scoring system was based on the mean, where a mean of < 4 reflected low EI, and a mean of ≥ 4 indicated high EI (Appendix A).

Summary

Airway management is a crucial element in the provision of emergency medical treatment for conditions that pose a significant risk to life. Proficiency in airway control necessitates specialized medical training and utilization of specific equipment. Recently graduated nurses must possess a comprehensive understanding, appropriate dispositions, and requisite competencies to demonstrate proficiency in the field of clinical practice. Nevertheless, knowledge is deficient about the performance of nursing students in airway control during their clinical practice. VR has emerged as a significant tool in the training of airway management and crisis management skills inside a controlled and safe environment for patients. Hence, it is imperative to assess the impact of VR airway management training programs as an instructional approach to the performance, SE, and EI of nursing students in Palestine.

CHAPTER TWO

REVIEW OF LITERATURE

The literature pertinent to the study variables is reviewed in this chapter. It is divided into three categories: search strategy, previous literature, and conceptual framework of the study.

Search Strategy

For the search process, EBSCO, PubMed, and Science Direct as databases, and Google Scholar as an engine were used. The search terms included "immersive virtual reality", "virtual reality", learning strategy," "performance," "airway management," "self-efficacy," "nursing student," OR "nursing education, and "traditional learning".

This study included articles published between 2012 and Jan 2024 and in English, however, there were some exceptions for including older studies, such as those that dealt with measuring techniques, conceptual definitions, and the history of VR in nursing education. Some articles were not included because they did not particularly address nursing students, were published before 2012, and were not written in English. However, some missed data that was not located within the specified time constraints was covered by outdated references. Finally, the comprehensive literature review is composed of 115 articles. The search process is illustrated in Figure 1.

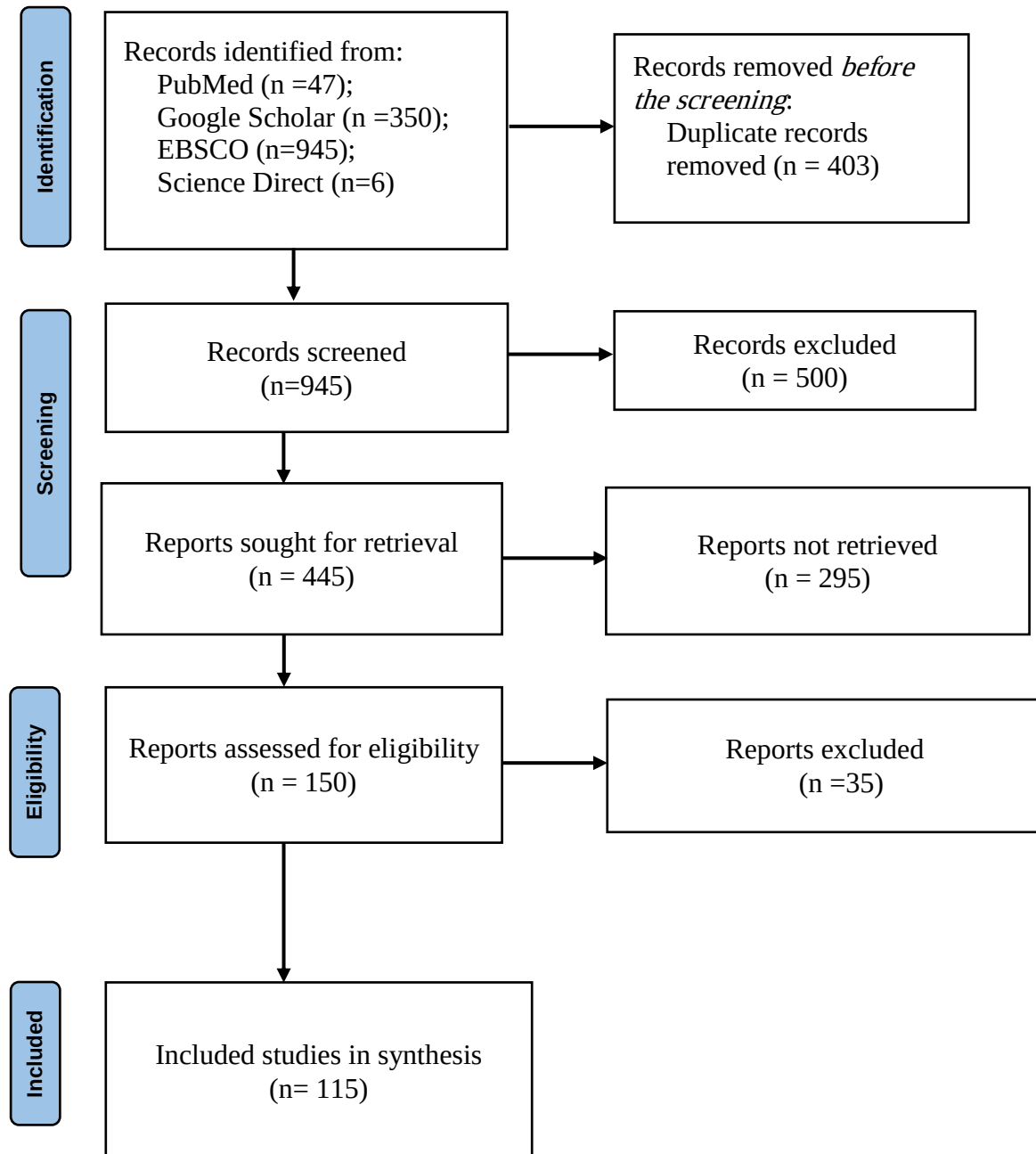


Figure 1: PRISMA flowchart

Previous Literature

This section presents the previous literature related to the study variables and it is divided into the following parts: history of VR technology, definition of VR, types of virtual definition, uses of VR, and effect of VR on performance, SE, and EI.

History of VR Technology

The beginning of VR was in the 1960s when Morton invented VR with the Telesphere Mask and Sensorama (Bown et al., 2017). The initial technologies immersed users in the video display, making them feel like part of it. Ivan Sutherland's Ultimate display used several input and output devices to immerse users in a computer-generated environment (Steinicke & Steinicke, 2016).

The Sensorama, which debuted in 1962, was the pioneering instance of a multi-sensory simulator. In a 1964 article, Popular Photography warned readers to be cautious of a groundbreaking technique known as Sensorama, which aimed to immerse the observer in the sensory experiences of the real world. The experience of seeing the color stereo video is enriched with binaural sound, fragrances, winds, and vibration. The original scene is faithfully recreated with exceptional accuracy. Currently, the system is approaching a level of replication of reality that surpasses any other system observed thus far (Gigante, 1993). The viewer can experience a motorcycle journey around New York, including artificially generated wind, the sounds, and the scents of the city. While Heilig's technology had all the characteristic features of a VR system, it lacked interactivity, where the path was predetermined and pre-recorded (Gigante, 1993) (Figure 2).



Figure 2: Sensorama groundbreaking technique

Ivan Sutherland is a trailblazer in the realm of computer graphics, making a greater contribution to its advancement. In 1965, Sutherland discussed "the Ultimate Display," which encompassed of interactive visuals and force-feedback devices. Additionally, he referred to the incorporation of audio, smell, and taste. In 1968, he elucidated a head-mounted display (HMD) that meticulously monitored the viewer's movements and promptly adjusted a graphical display to accurately mirror the viewer's updated position. Sutherland's technique employed a dual display setup that was observable through a set of semi-reflective mirrors. It presented the viewer with computer-generated visuals that were superimposed upon the real world, creating a stereoscopic visual experience (Sutherland, 1968) (Figure 3).

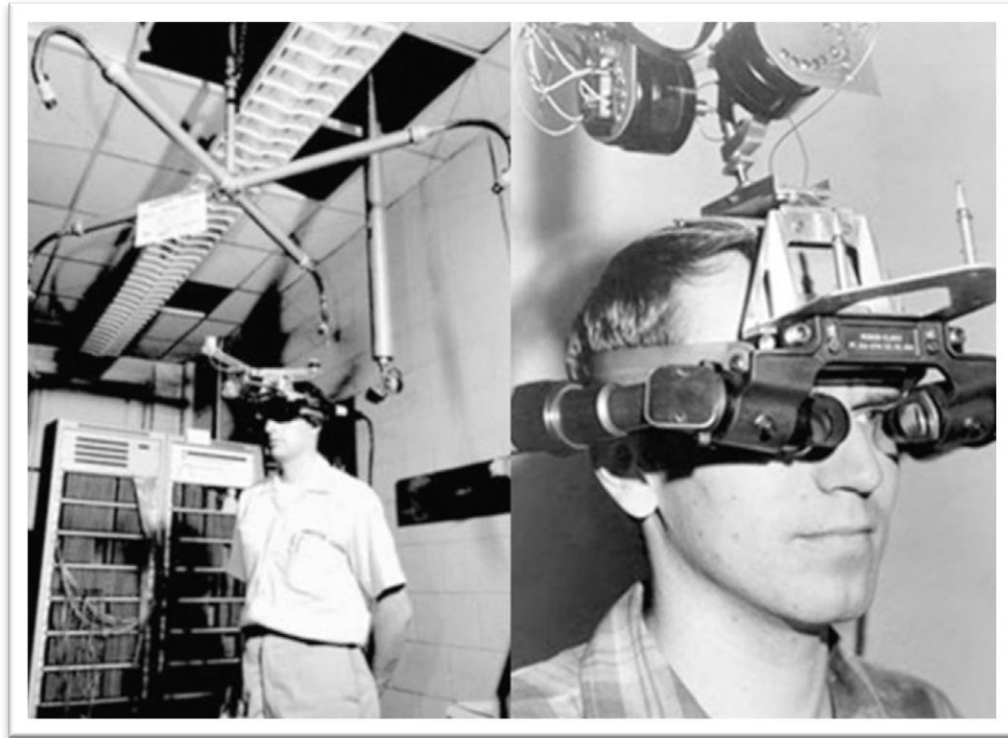


Figure 3: Sutherland's technique

The advancement of flight simulators has made substantial contributions to the progress of VR. The majority of the technology required for VR was primarily created for military flight simulators (Furness, 1986). Furness and his team created a sophisticated fighter cockpit known as the Visually Coupled Airborne Systems Simulator (VCASS) (Figure 4). In this setup, the fighter pilot would wear an HMD that enhanced their vision of the outside world by adding computer-generated images. The visuals encompassed friend-or-foe identification, targeting data, threat intelligence, and optimal flying path information. The fighter pilot is experiencing significant levels of stress, both cognitively and physically, while also needing to absorb and analyze large amounts of data. Furness tackled the primary concerns in VR, regardless the application is military-related or not. Overall, the work conducted in flight simulators has

contributed significantly to a deeper comprehension of the technical prerequisites that underlie VR (Furness, 1986).



Figure 4: Flight simulators

In 1984, Dr. Mike McGreevy and Jim Humphries of NASA Ames were the pioneers of the modern VR system known as Virtual Visual Environment Display (VIVED). They assessed the capabilities of the monochromatic HMD system for prospective astronauts (McGreevy et al., 1986). Subsequently, the Virtual Interactive Environment Workstation (VIEW) project created a versatile, multi-sensory, individual simulator and telepresence device. The configuration includes head and hand tracking, monochrome wide field-of-view stereo helmet-mounted displays, speech recognition, 3D audio output, and a tracked and instrumented glove (Figure 5). As a result of McGreevy and colleagues' study, the VPL research company emerged it is specialized in

producing the highly sought-after DataGlove and EyePhone which are widely recognized as the leading glove and HMD respectively (McGreevy et al., 1986).



Figure 5: Virtual interactive environment workstation (VIEW)

After the invention of the Sensorama and the conception of the Ultimate display, the early 2010s witnessed the beginning of the subsequent major explosion in the development of VR technology. During this period, VR was still thought of as a gimmick because of its high cost and the widespread consensus that it was not a technology that would ever become popular among the general public. This, however, began to change in 2012, when Palmer Luckey unveiled the prototype for the first Oculus headset that he had developed (Harley, 2020).

There is a rapid increase in relying on digital devices in acquiring knowledge and learning (Zawacki-Richter & Latchem, 2018). During the following two periods: between 1997-2006, when computers were used and connected to the Internet, and between 2007-2016, so-called digital learning began to spread via the Internet, researchers began to study the possibility of using virtual reality learning and integration of it in different life fields (Boulton et al., 2018; Muñoz Cristóbal et al., 2017).

Definition of Virtual Reality

Biocca and Delaney (1995) defined VR as the totality of the hardware and software systems that attempt to enhance the sensory illusion of attending to another environment. Also, VR refers to the creation of a simulated three-dimensional environment using computer simulation with a spatial presence that allows for accurate calculation and delivery of realistic 3D visuals as the user walks and offers a significant opportunity to acquire therapeutic skills (Ding & Li, 2022). According to Breault (2013), VR is defined as the process of utilizing computer technology to create an environment in which real or virtual images are placed within simulated scenarios, to replicate the genuine experiences associated with these scenarios. This environment exhibits realistic interactive characters that let users view a variety of computer-generated images and operate and interact with objects through a man-machine interface. Individuals possess the ability to navigate within a given location to effectively convey a sense of integration and active involvement in the process of experiencing various scenarios.

The learners are afforded the chance to engage in practice within a secure setting and acquire knowledge from errors without causing harm to actual patients (Cochrane, 2016; Jong et al., 2018). This is achieved by the utilization of five different virtual technologies (Chang et al., 2019). VR systems have three main characteristics: immersion, presence, and interactivity (Ryan,

2015). The VR has created simulation settings for real-world processes and circumstances (Dixken et al., 2019). It has been demonstrated that VR is an effective method for cutting down on training hours, minimizing the risk of making mistakes, and even enhancing the overall quality of products (Dixken et al., 2019). This technology can be presented as a low-cost option for learners' preparation and training by using specialized equipment that provides the stimulant for its implementation. VR supplies the users with a learning process that is immersive, charming, and innovative (Naranjo et al., 2018). On the contrary, the traditional method of learning is monotonous which leads to boredom and refusal (Naranjo et al., 2018).

Types of Virtual Reality

The two primary categories of VR technology include IVR and non-immersive VR (NIVR) (Wohlgenannt et al., 2020). In a NIVR, virtual information is typically presented to the viewer via screens situated all around them (Rahouti et al., 2021). Also, NIVR involves placing the user in a 3D scene that can be manipulated, but it is achieved using traditional graphics workstation tools such as a monitor, keyboard, and mouse (Robertson et al., 1993). Common examples of NIVR include driving and flight simulators where the user sits in a chair surrounded by screens, giving them the impression of being in the cockpit or driver's seat without actually being there (Figure 6).

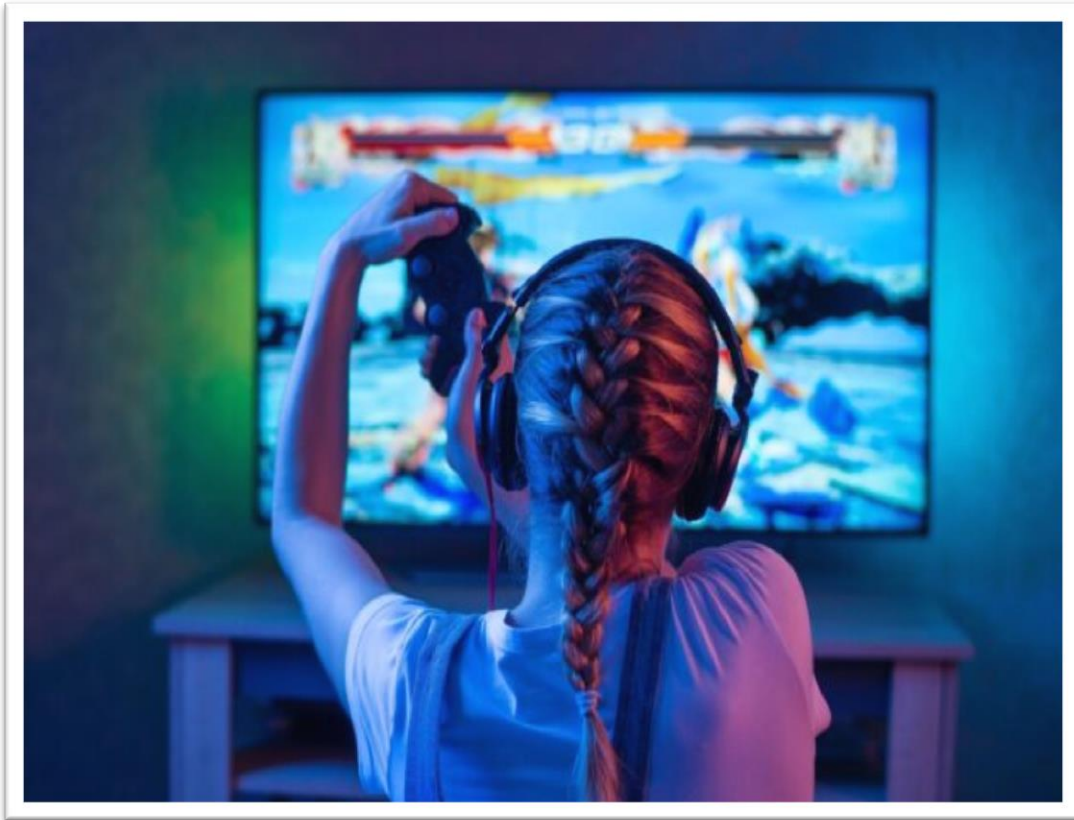


Figure 6: Non-immersive virtual reality

IVR includes using a head-mounted display (HMD) to monitor the user's head movement and adjust VR experience (Slater & Sanchez-Vives, 2014). The concept of "immersion" is discussed in the context of VR (Howard-Jones et al., 2014). Jennett et al. (2008) defined immersion in games as the state of being deeply engaged in the gameplay, resulting in a diminished perception of time and the physical world, and a strong sensation of presence within the virtual environment. The term "immersion" in VR typically refers to "spatial immersion," which means the sensation of being physically present in a virtual world (Guerra-Tamez, 2023). The user's perception is engendered by immersing them in a VR system that presents them with a highly captivating environment through the use of visuals, sound, or other stimuli. Spatial

immersion is the state in which a player experiences a simulated world that is visually compelling, appears authentic and realistic, and gives the player a strong sense of presence (Dwivedi et al., 2022) (Figure 7).



Figure 7: Immersive virtual reality

In a study conducted among 41 Chinese students from Tongji University in Shanghai concerning IVR and NIVR, the findings indicated that both technologies resulted in favorable learning experiences. However, IVR demonstrated superior performance in terms of sensory perception, realism, involvement, and intrinsic motivation, particularly in the enjoyment aspect. On the other hand, NIVR was found to be more accessible to the general public and potentially offered more advanced features and a sophisticated graphical user interface. Ultimately, both

technologies can effectively facilitate the learning of filmmaking when selected for appropriate educational purposes (Liu et al., 2023).

Uses of Virtual Reality

There are many uses for VR in different fields, including education and health care. This part summarizes these uses.

Virtual Reality in Education

The relationship between technology and education is deeply interconnected, with both playing crucial roles in the daily lives of individuals. Technology in education enhances the purpose, innovation, and forward-thinking nature of both learning and teaching (Organization for Economic Cooperation and Development [OECD], 2016). VR is increasingly being employed within the field of education as a pedagogical tool to augment the process of teaching and learning. Ahn and Cho (2015) revealed that the provision of virtual objects as experimental instruments for students to use immediately enhances their interest and focus, which would otherwise not be achievable.

Also, as a result of the widespread adoption of information technology, educators in contemporary education have recognized the indispensability of digital teaching materials, media, and equipment as crucial competencies and resources (Wu & Tai, 2016). Teachers on campus are increasingly including projectors, videos, and network communication as digital resources in their teaching practices. This shift towards employing these tools is evident in the prominence they have gained, alongside computing and reasoning, as well as operation and demonstration, in the educational setting (Wu & Tai, 2016). The promotion of creative thinking is a significant aspect of school education, leading to the emergence of diverse instructional practices that foster creativity. These instructional strategies or models are designed to foster and

enhance students' capacity for creative thinking by employing diverse and impactful methods and approaches in the realm of education and learning (Wu & Tai, 2016).

Multiple technological modalities can be employed to generate VR experiences with educational objectives. The predominant category comprises display devices, encompassing computers, phones, and tablets (Laine et al., 2024). These devices can access VR environments, such as the platform known as Second Life. Nevertheless, there exist more advanced technological solutions for VR, such as the HTC Vive Pro, Oculus Quest, Samsung Gear VR, and Google Cardboard (Parmaxi, 2023).

Additionally, there has been a significant evolution in VR technologies, transitioning from a technology that was first met with skepticism to one that is now being integrated into education and extensively utilized for instructional reasons (Walter et al., 2021). One of the primary notions contributing to the limited adoption of VR in educational settings is the prevailing belief that VR technology is primarily designed for recreational purposes. Nevertheless, recent research investigations have demonstrated the advantages correlated with utilization of VR within the realm of education, for example, Chang et al. (2019) demonstrated that integration of VR into educational practices has positive outcomes in terms of students' learning outcomes, academic achievements, levels of motivation, and overall satisfaction with the learning process. The utilization of VR in the field of education exhibits a multitude of facets. VR has the potential to eliminate temporal and spatial limitations that exist between learners, as well as between learners and their teachers. This technology offers the potential to create immersive virtual experiences that closely mimic real-world situations, allowing trainees to actively participate in purposefully designed experiments or scenarios tailored to their specific objectives (Dincelli & Yayla, 2022).

Using VR based on three-dimensionality, as well as an interactive 360-degree video, was found to be effective in educating students in the areas of spatial visualization, creative thinking, problem-solving, critical thinking, and empathy (Hernandez-de-Menendez et al., 2020; Kaminska et al., 2017). The use of digital technology can help many teachers and students with their educational challenges. Two such examples are blended learning (Amenduni & Ligorio, 2022) and online course delivery (Chang et al., 2022).

VR helps students gain and apply knowledge through meaningful experience. Active learning helps students understand the material (Hu-Au & Lee, 2017). It can transfer students to different environments, allowing them to learn and explore many topics safely and effectively. This is useful for showing underwater or space regions that cannot be visited (O'Connor & Domingo, 2017). Virtual environments created by computers can take the place of reality, where students can interact with a virtual environment by using sensors (Al-Ansi et al., 2023). The utilization of VR is a potentially advantageous strategy for the implementation of simulation-based training in the context of clinical procedures (Abbas et al., 2023). In contrast to conventional mannequin-based simulation training, VR-based training presents a range of distinctive attributes that enhance accessibility, enable the collection of dynamic behavioral data, and foster heightened immersion and realism (Maroukakis et al., 2024). This has prospects for instructing healthcare professionals in handling crucial "high acuity, low frequency" incidents that are challenging to replicate in actual clinical settings, enabling them to exercise judgment and learn from errors without jeopardizing patient safety (Bracq et al., 2019).

Previous evidence has shown that VR teaching can enhance student attentiveness and engagement (Christopoulos et al., 2018). VR education, for example, increases student involvement and interactivity (Alhalabi, 2016). VR headsets reduce visual and aural distractions,

helping pupils focus on educational information. It allows educators to communicate with pupils more individually, improving teacher-student relationships (Gadelha, 2018). Also, VR simulation is very effective in education and has effective outcomes on students' communication skills (Elliman et al., 2016). Previous studies revealed positive effects of VR on cognition and abilities (Farra et al., 2016), such as increasing the students' psychomotor abilities, especially their tracheostomy care abilities (Bayram & Biyik, 2019). Also, Valdis et al. (2015) conducted a study on 20 surgical trainees who were divided into two groups: the experimental group (underwent a 9-exercise VR curriculum on a robotic surgical simulator), and the control group that did not get any additional training. The findings revealed that implementing a VR simulation in curriculum enhanced the effectiveness and excellence of education in the field of robotic heart surgery.

The integration of simulation models in medical education such as mannequin training, VR, and interactive medical simulation software has emerged as a means to address the need for improving the acquisition of skills among healthcare trainees (Hao et al., 2002). The VR technological innovation enables students to actively participate in interactive training sessions conducted within a virtual environment. Moreover, this virtual environment can be modified to accurately simulate various patient scenarios (Pottle, 2019). Also, VR simulations offer medical personnel the chance to engage in the preoperative practice of procedures and surgical training, resulting in improved patient outcomes and a reduction in errors (Laspro et al., 2023). The utilization of VR technology in the context of medical practice and preparation has been found to yield positive effects on patient outcomes. This can be attributed to the enhanced level of preparedness exhibited by medical practitioners, who are equipped with a comprehensive

understanding of each patient's distinct circumstances before doing any operative procedures (Keri et al., 2015) (Figures 8-A and 8-B).



Figure 8-A: Virtual reality in medical education

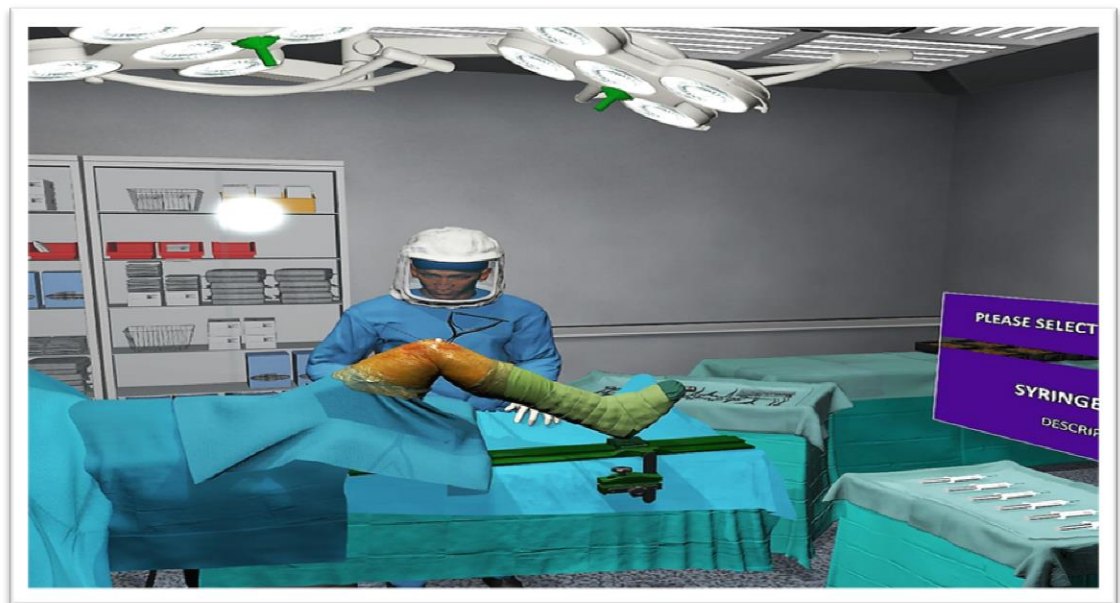


Figure 8-B: Virtual reality in medical education

Simulation has been more and more important in helping undergraduate medical imaging students acquire pre-clinical skills in recent years. Gunn et al. (2018) evaluated the influence of a cutting-edge VR educational setting on the enhancement of technical skills among first-year medical imaging students and evaluated their technical proficiency. Each student's learning experience involved in a standard laboratory simulation or VR simulation, focusing on two specific anatomical protocols. After that, the students engaged in role-plays and were evaluated based on their technical expertise. Each radiography procedure was documented with the corresponding learning environment, either laboratory or VR simulation, along with demographic information. The findings showed that students who were trained using VR simulation had a higher total score in role-play skills compared to those who used traditional laboratory simulation. Therefore, the VR simulation is a learning tool effectively aided the acquisition of technical skills, comparable to, or marginally superior to, traditional laboratory training.

VR technological innovation enables also nursing students to actively participate in interactive training sessions conducted within a virtual environment. The virtual environment could be customized to accurately simulate various patient scenarios (Pottle, 2019). It was claimed that VR not only provides secure learning environments for nursing students but also more realistic situations to break down barriers (Gupta et al., 2008). VR was first used to help nursing students learn the fundamentals of nursing (Liaw et al., 2014) (Figure 9). Also, many complex nursing scenarios, such as emergency and crisis management and critical care have been addressed using VR (Freina & Ott, 2015) (Figures 10–A and 10-B). The VR simulation improved cardiac surgery skills (Valdis et al., 2015) and IVR was used in emergencies requiring cardiopulmonary resuscitation (CPR) (Kilmon et al., 2010) (Figure 10-C). A previous study

conducted in Jordan indicated that VR simulation is an instructional approach that offers nursing students a secure and efficient learning environment (Bani Salameh., 2024). Also, VR was useful in education during pandemics like COVID-19 (Singh et al., 2020).



Figure 9: Immersive virtual reality in learning the fundamentals of nursing

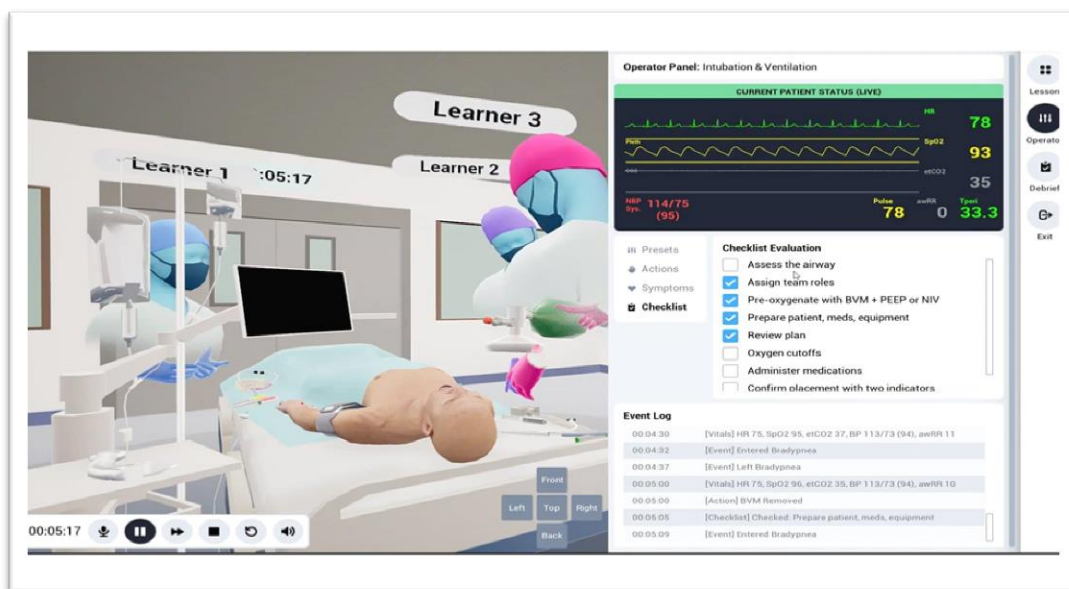


Figure 10-A: Immersive virtual reality in learning critical care situations



Figure 10-B: Immersive virtual reality in learning critical care situations



Figure 10-C: Immersive virtual reality in learning cardiopulmonary resuscitation

Nurses have a crucial role in managing mass casualty occurrences (MCI), yet they frequently experience a lack of readiness for these situations. Implementation options for training activities such as utilization of VR simulations provide nursing students with authentic and engaging learning experiences, hence improving their skills and competencies. Magi et al. (2023) executed a scoping review to examine the utilization of VR and augmented reality (AR) simulations for instructing nursing and paramedic students in the management of MCI. Out of the 162 records that were found, 27 full texts were examined and only six studies were selected. The investigations encompassed students who were allocated to various training modalities, such as IVR simulation, written teaching, and conventional lectures. VR, AR, and immersive simulation demonstrated improving practical skills and knowledge in managing MCI. Therefore, VR and AR have great potential in the field of disaster education and preparedness training. These technologies provide varying degrees of immersion and involvement, promoting active and experiential learning.

Blood transfusion (BT) is considered one of the nursing skills and nurse-led BT is a prevalent medical intervention, however, nursing students are frequently barred from engaging in and seeing BTs during their clinical rotations. In response to the limits of clinical placements, nursing educators have progressively embraced technology-driven simulation pedagogies, such as VR simulation, to enhance nursing students' education in clinical skills (Lee et al., 2023). A previous randomized controlled trial with single-blinding, consisting of two arms was conducted to examine the effect of VR simulation on knowledge and self-confidence in BT practice among nursing students. The sample consisted of 151 nursing students who were enrolled in a nursing undergraduate course at a university in Hong Kong. VR simulation movies were created based on evidence, encompassing two components; animated depiction of physiology of blood

formation and negative effects of BT and 360° nursing practice due to BT. The students were categorized into intervention or control groups through a random allocation process. The study demonstrated that both groups had progressive enhancements in both primary and secondary outcomes as time elapsed. Findings demonstrated that students who were exposed to VR simulation exhibited significantly higher scores of both basic technical (BT) knowledge and social skills and communication (SSCS) in comparison with those who did not obtain VR simulation post-intervention. Thus, using of VR simulations in BT teaching significantly improved the nursing students' knowledge and self-confidence in BT practice. Nurse educators can utilize VR simulation to augment the efficacy of BT in the nursing curriculum (Lee et al., 2023).

Another skill is the technique of nasogastric tube (NGT) feeding, Lo et al. (2022) conducted a study using a randomized controlled trial approach, which includes both pretest and posttest measurements. A total of 107 students from two institutions in central Taiwan were allocated randomly to 54 students in experimental group and 53 in control group. The experimental group acquired the technique of NGT feeding using IVR, while the control group observed a 15-minute 2D film. The students completed pre and posttest questions concerning their knowledge of NGT. Following the experiment, the participants were administered an additional questionnaire about their learning motives, cognitive load, and learning satisfaction. Both groups enhanced their educational achievements as nursing assistant students. The experimental group's students expressed greater satisfaction with IVR compared to the traditional learning method, Also, they stated that IVR stimulated their extrinsic learning motives and increased perception of task value (Lo et al., 2022).

Additionally, a non-equivalent control group pretest-posttest design was adopted by Kim and Kim (2021) among 137 nursing students with 69 in the experimental group that provided with VR experience and 68 in the control group. The VR experimental group demonstrated higher hospital environment knowledge, educational satisfaction, and academic achievement in comparison with control group. Findings indicated that VR-based learning is effective approach for enhancing hospital environment knowledge, educational satisfaction, and academic achievement in nursing education.

Despite the advantages and effectiveness of VR in education on enhancing high-quality skills and information acquisition, some instructors suppose that its adoption and implementation have been inadequate (Marks & Thomas, 2022). Also, the rates of adoption of VR technology in education depend largely on the educators' abilities to experience this technology in their educational process. This technology requires establishing a technical infrastructure suitable for this type of education. However, many universities still avoid using this type of education and investing in the infrastructure of this technology of education, especially if it does not have a pre-confirmed number of users (Kaminska et al., 2019).

Unfortunately, the use of VR technology can cause discomfort such as headaches and dizziness, especially when the headphones are placed by the user (Cassani et al., 2020). The high cost and complexity of adopting VR applications were shown to be obstacles for many schools or students (Chien et al., 2020). In addition, creating VR teaching materials is challenging for educators (Selzer et al., 2019). The limited availability of glasses and headphones due to their cost and the weakness of the Internet. All these factors can cause poverty in the educational process (Kaminska et al., 2019).

Virtual Reality in Healthcare

This section explains the various domains within the healthcare sector where VR technology is being utilized, specifically focusing on the integration of VR in the field of medicine and training medical professionals, in addition to the management of stress and pain, psychological counseling, cognitive rehabilitation techniques, and physiotherapy (Pillai & Mathew, 2019). VR has been utilized in the diagnosis and treatment of various health issues, including surgeries and surgical procedures, dentistry, autism-related challenges, and enhancing mental health (Pillai & Mathew, 2019). Also, VR emerges as a viable alternative to the challenges characterized by either prohibitive costs or insurmountable barriers in many scenarios in healthcare. One important area related to health care includes educating medical professionals, identifying diseases, and providing appropriate medical interventions (Pillai & Mathew, 2019) (Figures 11-A and 11-B).



Figure 11-A: Using virtual reality in performing surgeries



Figure 11-B: Using virtual reality in performing surgeries

Virtual reality therapy (VRT) is a relatively new technology that is frequently utilized in the fields of occupational therapy and psychiatric therapy. It is accomplished through the utilization of specially programmed computers, visual immersion equipment, and artificially manufactured surroundings to facilitate the creation of an artificial experience for the patient (Riva et al., 2016). Additionally, VRT has shown effective outcomes in cognitive and physical rehabilitation (Figure 12) including the treatment of post-stroke rehabilitation (Figure 13), pain management (Figure 14), and the treatment of psychological illnesses involving phobias (Figures 15-A and 15-B), post-traumatic stress disorders (PTSD) (Figures 16-A and 16-B), obsessive-compulsive disorders (OCD) (Figure 17), anxiety, depression (Figure 18), attention deficit hyperactivity disorder (ADHD) (Figure 19), cerebral palsy (CP) (Figure 20), and autism spectrum disorder (ASD) (Figure 21) (Bashiri et al., 2017; Chen et al., 2014; El-Qirem et al.,

2023; Iruthayarajah et al., 2017; Kouhbanani et al., 2021; Luo et al., 2019; Maskey et al., 2019; Singh et al., 2020; Zhao et al., 2022).



Figure 12: Virtual reality for rehabilitation



Figure 13: Virtual reality for post-stroke rehabilitation



Figure 14: Virtual reality for pain relief

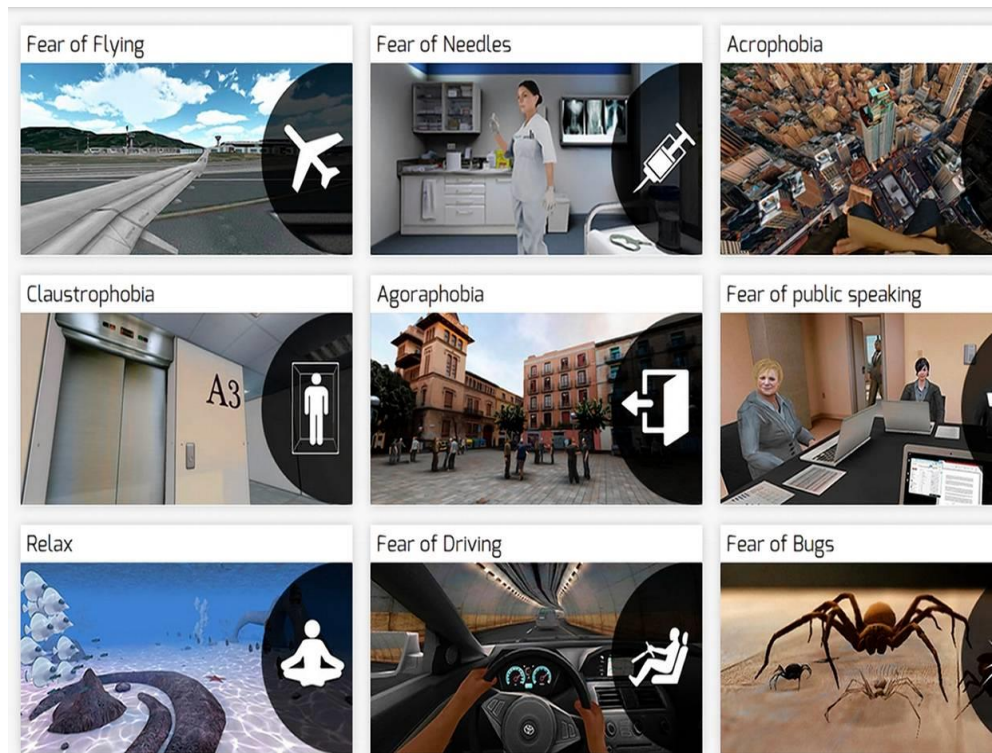


Figure 15-A: Virtual reality for treatment of phobia

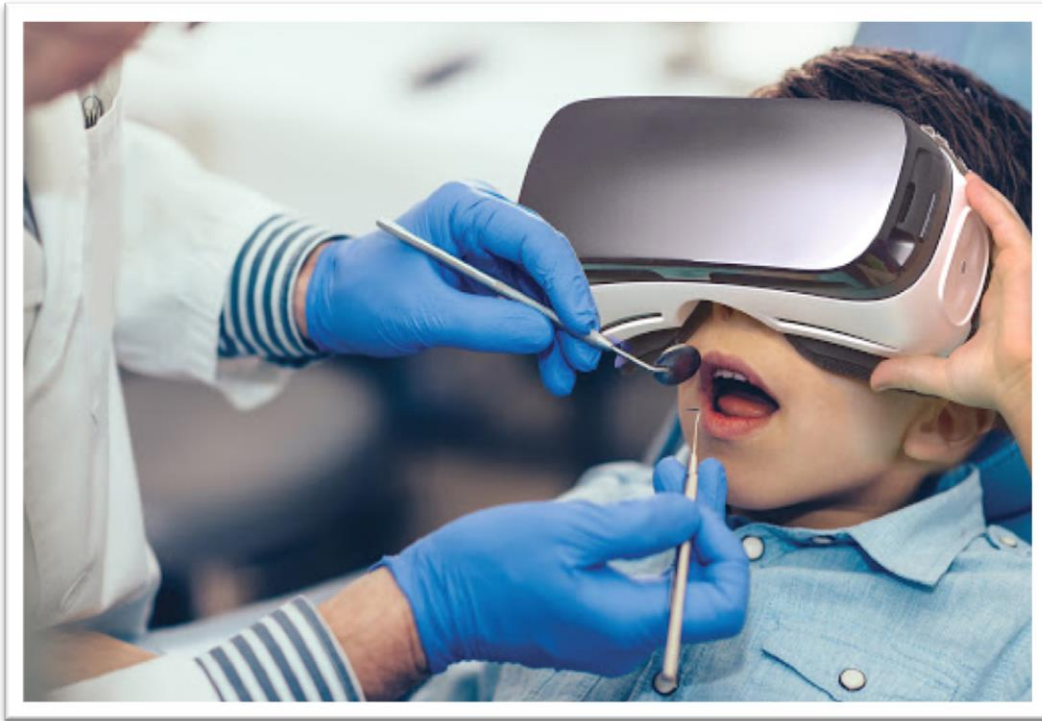


Figure 15-B: Virtual reality for treatment of dental phobia



Figure 16-A: Virtual reality for treatment of post-traumatic stress disorder (PTSD)

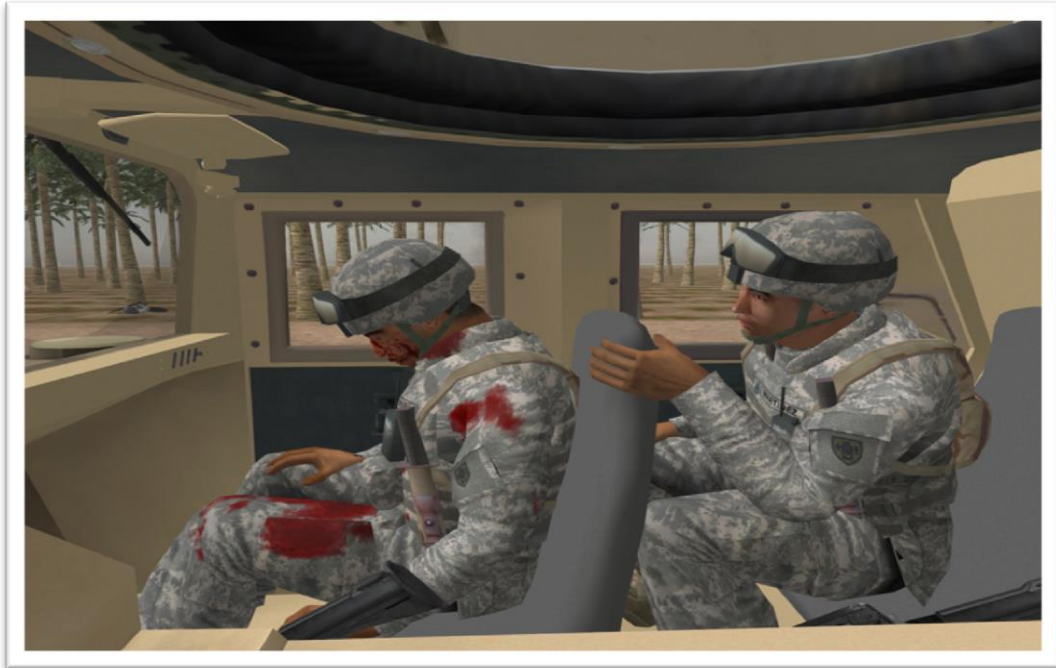


Figure 16-B: Virtual reality for treatment of post-traumatic stress disorder (PTSD)



Figure 17: Virtual reality for treatment of obsessive-compulsive disorder (OCD)

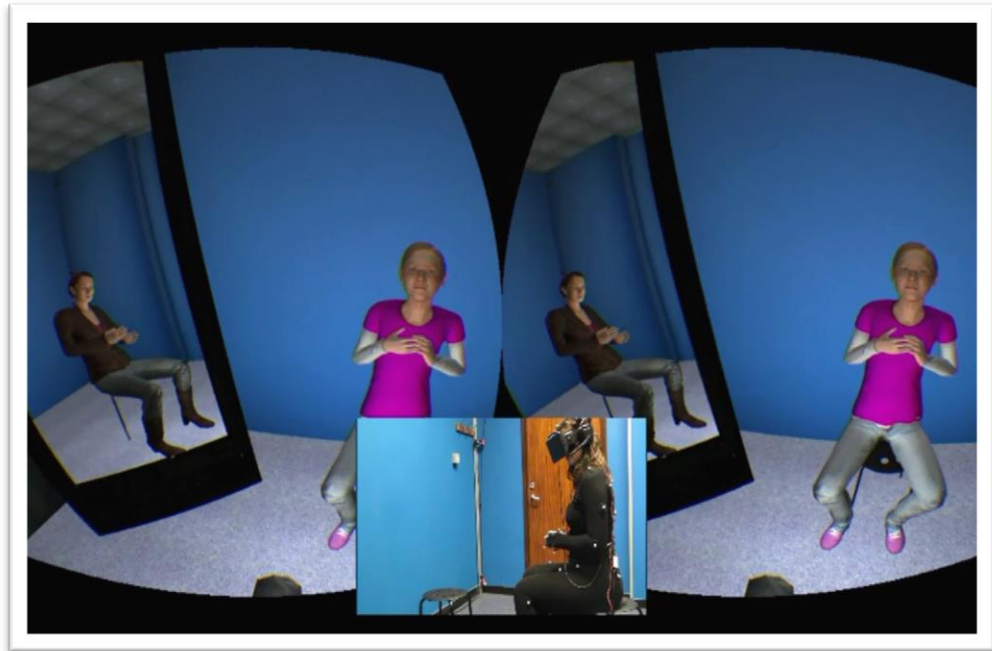


Figure 18: Virtual reality for treatment of depression



Figure 19: Virtual reality for treatment of attention deficit hyperactivity disorder (ADHD)



Figure 20: Virtual reality for treatment of cerebral palsy (CP)



Figure 21: Virtual reality for treatment of autism spectrum disorder (ASD)

Many studies were conducted to examine the effect of VR on health problems, for example, a literature review study was carried out to focus on the effects of VR in the rehabilitation treatment of children with ADHD. This review included 20 pertinent studies that utilized VR technology to diagnose, treat, assess, and train children with ADHD. The findings demonstrated that the utilization of VR technology, through the simulation and provision of a virtual environment, was effective in delivering optimal rehabilitation for children diagnosed with ADHD. This technology is effective in facilitating diagnosis, training, monitoring, assessment, and therapy for this cohort group (Bashiri et al., 2017).

Concerning CP, Leal et al. (2020) performed a study to evaluate the performance of achieving a duty in a virtual environment an addition to the ability to transfer the duty performed in a realistic situation in children aged 6-15 years. The 56 Brazilian participants were classified into treatment group (children with CP =28) and control group (children with no CP =28). The virtual computer program consisted of a motor duty that includes concrete and abstract interaction. The concrete connection with physical contact; the participants touched the computer screen to finish the duty. The abstract connection with no physical contact; the participants achieved a hand motion in front of the Kinect device. Findings revealed that participants in both groups had improvement in duty performance and kept gained information. The treatment group had worse performance in comparison with the control group. Also, the treatment group had better improvement in the performance of the abstract connection compared to concrete connection. On the contrary, the control group had better performance in concrete abstract. Thus, motor skills carried out by the treatment group by a connection with a virtual environment (abstract connection) provided the best performance in comparison with a connection with realistic features (concrete connection). Also, Chen et al. (2014) conducted a systematic review

of the utilization of VR as the intervention technique among children with CP to enhance the functions of the upper extremity (UE). Findings demonstrated that VR is an effective tool for enhancing UE function in children with CP (Chen et al., 2014).

Regarding post-stroke rehabilitation, Maqsood et al. (2023) performed a randomized controlled trial to determine the effect of VRT on rehabilitation results in patients with stroke including motor functions, quality of life, and activities of daily living. A total of 100 Pakistani patients with stroke were divided into two groups (VRT and traditional therapy groups). The evaluations were conducted pre-intervention and 12 months after intervention. The two groups demonstrated significant improvement in both groups ($p < 0.001$). In the follow-up stage, the VR therapy group showed greater performance compared with the control group in motor functions, quality of life, and activities of daily living ($p < 0.05$). The results suggested that the integration of VRT into rehabilitation therapy improved the aforementioned variables.

Also, a systematic review was conducted by Hao et al. (2023) to examine the effects of VR stroke rehabilitation one month after stroke on the functions of patients. The findings of 17 randomized control trials (RCTs) revealed that VR is a feasible technique and showed effects in functions compared with conventional rehabilitation among patients with stroke. Moreover, another systematic review was performed by Demeco et al. (2023) to examine the IVR in stroke rehabilitation. The review included 12 RCTs including patients post-acute and chronic stroke. The results revealed that IVR had more benefits compared with conventional rehabilitation. Also, there were enhancements in the dexterity of the upper limb, gait performance, and dynamic balance, which affected patient independence. Thus, IVR is considered an adaptable rehabilitation tool in post-stroke, improved patients' adherence to treatment, and increased functioning levels and quality of life among patients with stroke.

El-Kafy et al. (2021) performed an RCT study to assess the impact of VRT on the improvement of the functions of the upper limb among Saudi patients with chronic stroke 6-24 after stroke occurrence (N= 40). The patients were distributed by random method into control and treatment groups. The treatment group received a program of one-hour traditional functional training and one hour of VRT, while the control group provided a program of two hours of a traditional training. The program was carried out for three times weekly for three months. Findings revealed significant differences in the Action Research Arm Test (ARAT), Wolf Motor Function Test (WMFT), WMFT-Time (time needed to complete the test), and Hand Grip Strength (HGS) three months post-treatment. Also, the treatment group endorsed greater improvement in ARAT, WMFT, and WMFT-Time scores post-treatment in comparison with the control group. Also, there was no significant difference in HGS between both groups post-treatment.

Another RCT study was conducted by Pedreira da Fonseca et al. (2017) to assess the effect of VRT on gait balance and incidence of falls post-stroke in comparison with conventional physiotherapy among Brazilian patients. The patients were randomly assigned into treatment group (n=14) and control group (n=13). Both groups received 20 intervention sessions. The findings revealed an improvement in gait balance and a decreased incidence of falls in the two groups. Also, there were no significant differences between the two groups. Additionally, a comprehensive review and meta-analysis were performed to examine the efficacy of VR therapies in enhancing balance among patients with chronic stroke (≥ 6 months). The study's findings indicated that VR interventions yielded notable enhancements when compared to conventional rehabilitation methods (Iruthayarajah et al., 2017).

Regarding PTSD, a literature review was conducted to evaluate the influence of Virtual Reality Exposure Therapy (VRET) on the treatment of adults who experienced anxiety disorders and depression. The findings proposed that VRET was effective in the treatment of individuals with anxiety disorders. Also, VRET could work as a health-promoting strategy to minimize anxiety disorders, phobias, and depressive symptoms (Hawajri et al., 2023). Also, Beck et al. (2007) carried out a study to investigate the effectiveness of VRET in the healing process among individuals suffering from symptoms of PTSD following a severe vehicle accident. A total of ten sessions of VRET were performed for six persons who were diagnosed with either full or severe sub-syndromal PTSD. These sessions were carried out with the assistance of software that was designed to generate real-time driving scenarios. The findings revealed that re-experiencing, avoidance, and emotional numbing were among the post-traumatic stress disorder symptoms that were significantly reduced (Hawajri et al., 2023).

Several studies demonstrated the effectiveness of VR-based cognitive behavioral therapy (CBT) in treating specific phobias (SPs), for example, a systematic review was conducted by Maples-Keller et al. (2017) to evaluate the effect of VR for the treatment of SP. The review included RCTs with sufficient sample sizes and demonstrated substantial treatment effects, both within and within the treatment groups. Certain individuals have integrated behavioral avoidance testing into the presence of the feared stimuli itself, resulting in significant behavioral modification. Moreover, the statistics indicated that the improvements achieved during treatment remained stable for several years after the treatment was finished. The studies demonstrated the effectiveness of virtual reality exposure (VRE) for SPs is highly encouraging, especially for patients who have concerns about settings that may not be secure, economical, or practical to carry out in real life.

The VRET has been utilized for treating various fears and phobias, for example, Gujjar et al. (2017) examined the safety and efficacy of utilizing VRET for treating dental phobia. A sample of 10 participants who had not visited the dentist during the last 12 months due to dental phobia were randomly selected. Safety was assessed by identifying any unfavorable events or symptom aggravation and efficacy was assessed by comparing the minimizing in the scores of dental anxiety that measured sixteen times during 14 weeks and at six months' follow-up. Heart rate during VRET and experience post-VRET were evaluated. The findings revealed no unfavorable events or symptom aggravation occurred. Also, there was a greater reduction in scores of dental anxiety and no increase in the average heart rate during VRET. The majority of the participants were not diagnosing teeth phobia after six months.

Also, Raghav et al. (2016) conducted a single-blindness, randomized controlled intervention with two parallel arms. The participants were categorized into either VRET or in-person therapy (IP) in a 1:1 ratio. Thirty individuals between the ages of 18 and 50 who met the criteria for dental phobia according to the Phobia Checklist were randomly assigned to groups using block randomization with allocation concealment. The findings demonstrated the utilization of innovative non-invasive VRET, which could potentially serve as an alternative treatment for dental anxiety and phobia.

Concerning using VRT in treating stress and anxiety, El-Qirem et al. (2023) performed a study to assess the effect of VR on stress and anxiety among undergraduate university students in Jordan. One group pre-posttest was adopted and 90 students were recruited. The intervention consisted of a therapeutic experience known as River Relaxation VR, which was accessed via Stream VR. The participants underwent a total of eight sessions, each lasting 15 minutes. These sessions were conducted twice a week over one month in the virtual reality laboratory. The

results indicated the significance of incorporating VRT as a successful strategy to reduce stress and anxiety and improve physiological indicators in college students.

Another quasi-experimental approach was employed to evaluate the effect of IVR on reducing anxiety in nursing students (N= 33) enrolled in two recognized registered nurse programs in the U.S.A. VR simulation was used to create an apprehensive patient scenario. The short-form State Anxiety Inventory was used to measure the anxiety levels of the students. The dashboard of simulation's analytics was also utilized to appraise their communication skills. The results revealed that IVR reduced the students' anxiety levels (Traister, 2023). Additionally, Jo et al. (2021) investigated the impact of VR forest movies on physiological stress levels, heart rate variability (HRV), and electroencephalogram (EEG) measurements as indicators of control of Korean college students (N=60). The participants were exposed to both two-dimensional (2D) and VR videos. The results reflected positive effects on the physiological stress levels. Also, VR technology has been employed in the field of pediatrics as a means of distraction and as a preparatory aid for children undergoing hospital procedures (Evans & Moonesinghe, 2020).

Many studies were conducted regarding VR and autism, for example, Zhao et al. (2022) used six training environments to assess the impact of virtual reality technology on perception, imitation, and social interaction in 44 Chinese children experience autism aged 3-5 years. The findings demonstrated that social stories introduced in virtual animation form make it simpler to capture and hold children's attention. Additionally, the immersive image made children more responsive to visual stimulation, which is good for their cognitive development. Finally, the results demonstrated that social stories helped children generalize social skills like realization of facial expression, a happy voice tone, and bodily language into daily interactions with others.

Therefore, the VR environment has the usefulness of safety, controllability, and frequent functioning.

A study conducted by Kouhbanani et al. (2021) with 43 Iranian autistic children aged 6–12 years, focused on parents' use of a smartphone application to send 3D images and videos to their children through VR glasses to enhance children's perceptual, spatial, processing, and visual memory abilities, ultimately helping them to perform everyday activities. The findings showed improvements in emotional cognition, performance, social authority, deductive thinking, and improved social communication, and that children were better prepared to engage in social interactions, communicate with others, meet new people, form friendship groups, and consult friends.

Moreover, Maskey et al. (2019) conducted a study in the United Kingdom to examine the effect of using an IVR environment in conjunction with cognitive behavior as a treatment approach for children with autism aged 8–14 years and dealing with SPs. A total of thirty-two participants were randomly assigned to treatment group or control group. The intervention protocol consisted of an initial session dedicated to introducing CBT approaches, followed by four sessions of VR exposure therapy. The Blue Room virtual reality environment (VRE) with audio and visual video was used to perform hierarchical scenes of exposure to feared stimuli. These sessions were administered by clinical therapists who were based in the local area. The delivery of brief VR exposure combined with CBT is both possible and appropriate within child therapeutic services. Furthermore, this intervention has demonstrated an improvement in reducing phobia for the study participants.

Virtual Reality Simulation and Airway Management Training

Nursing students learn about airway anatomy and physiology, the indications for airway management, and the different methods of airway management (Rushton et al., 2020; Samosorn et al., 2020). They also learn about the potential complications associated with airway management and methods of preventing and managing them (Cook, 2018). However, few methods are available for instructing nursing students in the management of difficult airways. VR is considered a solution to instruct nursing students in the particular skills associated with airway management (Samosorn et al., 2020). Also, VR is crucial for offering a risk-free opportunity to get practical experience in managing these essential situations (Putnam et al., 2021). VR simulation is a reliable and secure approach for teaching bronchoscopy abilities (Casso et al., 2019).

A previous study utilized a quasi-experimental one-group pretest-posttest design to evaluate the fidelity, realism, potential adverse effects, and effectiveness of VR intervention for airway management. The participants included 21 undergraduate nursing students and 10 faculty members. The study demonstrated that the VR airway laboratory is an effective method for instructing nursing students on the challenging task of managing difficult airways. Also, they reported high presence and acceptance, no feeling of cybersickness, and significant improvement in airway management knowledge ($p < 0.001$) (Samosorn et al., 2020).

Although pediatric airway crises can have severe and catastrophic outcomes, VR simulation facilitates the methods of proper management of these crises (Putnam et al., 2021). An earlier study was performed to assess the initial understanding of managing pediatric airway emergencies among medical students, residents, instructors, and advanced nurses' practitioners. The study involved forty-one participants. The participants took a brief pre-test, then, they

engaged in two successive interventions; interactive videos on pediatric airway management and VR trainer. Participants were randomly assigned to either handle anaphylaxis or aspiration of foreign body. Upon completion of intervention, the students were assessed for a post-test knowledge exam and a survey regarding their understanding of the films and VR trainer. Generally, both initiatives were positively received. The positive perceptions encompassed the qualities of authenticity, engagement, and a dynamic educational setting. Critical remarks were centered around the video's speed and the steep learning curve of the VR trainer. Participants expressed a desire for attending future training on pediatric airway situations using videos and VR trainers, and with/without using traditional instructional lectures. The interventions resulted in significant enhancements in most areas of knowledge. Notably, the scores for questions related to pediatric anatomy, allergy, Heimlich technique, and removal of foreign body exhibited the most significant improvement (Putnam et al., 2021).

Another study was conducted to determine whether individual self-practice of the Airways, Breathing, Circulation, Disability, and Exposure (ABCDE) approach using an IVR and interactive VR application yielded significant learning outcomes in comparison with those using traditional equipment (TP) among the medical and nursing students in the first year. An equivalent group randomized controlled experiment was adopted. This interventional study was associated with a standard educational program carried out over two months. Every student engaged in a 15-minute introductory session on the ABCDE approach, followed by a 20-minute individual practice session. In the individual practice session, the students either used IVR and interactive VR with hand controllers and haptic feedback (Individual VR), or they used a blood pressure gauge, ear-thermometer, and oximeter (Individual TP). The main measure of success was the count of students who accurately recorded all eight predetermined observations in the

ABCDE technique in ordered sequence during a practical exam on a sophisticated simulator manikin. This test had a time constraint of five minutes and was conducted immediately post self-practice session. The predetermined threshold for non-inferiority was set at 13 percentage points. The study demonstrated that the utilization of individual VR in practicing ABCDE technique was non-inferior to TP (Berg & Steinsbekk, 2020).

Another study created a 3D experiment scene using VR, animation, human-computer interaction, and other technologies. This scene aimed to replicate virtual rescue scenarios for patients with craniofacial injuries. The scenarios included emergency reception, first-aid cooperation, massive hemorrhage rescue cooperation, and tracheotomy cooperation in emergencies where the airway is suddenly blocked. Additionally, exercise modules and assessment modules were implemented. Within the VR simulation platform, students employed the holistic nursing theory and the plan-do-check-act (PDCA) cycle methodology to systematically observe, assess, and provide treatment for patients with craniofacial injuries. An initial assessment of the platform was conducted during the training of 62 dental nurses. The virtual simulation training platform for in-hospital first aid of craniofacial injury patients offers an immersive learning experience, allowing students to get an intuitive understanding of rescue techniques and enhance their overall first-aid skills (Xiao-yue et al., 2023).

Virtual Reality and Performance

The impact of VR Simulation Problem-Based Learning (VRS-PBL) has been confirmed as a beneficial approach that enhances knowledge, clinical proficiency, and self-confidence (Lee & Son, 2023). A Jordanian study was performed to assess the nursing students' satisfaction, confidence, and performance in clinical environments. A total of 102 students registered in community and pediatric nursing courses were selected to participate in the study. The sample

was randomly allocated to intervention ($n = 52$) and control ($n = 50$) groups. The intervention group received VR experiences about home visiting, community bag, growth, and development monitoring, administering intramuscular, subcutaneous, and intradermal injections, and the control group received traditional learning using videos and manikin. Findings illustrated that students in the intervention group reported higher satisfaction, confidence, and performance compared to control group after conducting the intervention. Therefore, the integration of VR simulation into traditional nursing clinical courses can be used to enhance nursing students' satisfaction, confidence, and performance (Bani Salameh et al., 2024).

Another study was carried out by Lee and Son (2023) to examine the influence of VRS-PBL on neurological assessment performance among undergraduate nursing students. A convenience sampling method was used to recruit 76 participants who were divided into control and intervention groups. The control group was provided with traditional lectures and demonstrations on neurological assessment before their practical training. While, the intervention group engaged in VRS-PBL sessions once a week for two weeks, where each session lasted 60 minutes. The findings demonstrated a notable increase in academic SE ($p < 0.01$) and neurological examination performance ($p < 0.001$) among students in the experimental group compared to the control group.

Also, Lee and Baek (2023) conducted an interventional study to determine the effectiveness of a VR nursing education program for postoperative patient care using an information processing model. A VR simulation nursing education program connected to clinical practice was executed over four weeks. South Korean nursing students were split into two groups; 22 students in the experimental group who used VR simulation and clinical practice, and 22 in the control group who received ordinary clinical practice. Findings showed that the VR

simulation nursing education program effectively enhanced nursing students' performance confidence and CDM skills. The VR simulation program can offer fundamental information for future simulation curriculum development and enhance nursing students' clinical competence by boosting their performance confidence and CDM skills.

Shujuan et al. (2022) conducted an interventional study to evaluate the impact of VR disaster preparedness program on nursing students' disaster readiness, confidence, and performance. A two-arm randomized controlled study was utilized and 49 students were assigned to the intervention group that received VR disaster program and 52 were assigned to the control group that received traditional learning. Data were gathered at the beginning and after the intervention. The findings revealed that students in the VR group had higher improvement in disaster preparedness, confidence, and performance. Thus, VR offers a cost-efficient simulation method in nursing education that can help address the gap in disaster training and increasing need for disaster preparedness.

Additionally, Yu and Yang (2022) used a quasi-experimental design utilizing a pre-posttest approach to identify the effects of the VR infection control simulation (VRICS) program on knowledge about personal protective equipment (PPE), performance of infection control, and SE for nursing students. The students in the third and fourth years were assigned into two groups; 25 students in the experimental group who took part in a VRICS program and 25 in the control group who did not receive any education. The VRICS program included a briefing, hands-on practice of putting on and taking off PPE, sessions of VR simulation, and a debriefing session. The sessions of VR simulation consisted of donning and inspecting PPE in the dressing room before entering the isolation unit, evaluating suctioning care, nasopharyngeal suctioning, and assessing patients with COVID-19 in the isolation unit. The time for implementing the

whole program was 180 minutes. Findings demonstrated that the VR simulation training program for pediatric patients with COVID-19 improved skills training and theoretical understanding in respiratory care and preparation for infectious illnesses.

Virtual Reality and Self-Efficacy

SE is attributed to decisions that individuals make about their abilities to achieve actions essential to attain specific outcomes (Bandura, 1994). These important beliefs can work as strong predictors of behaviors, affect, motivation, and cognition (Bandura, 1977). It was found that students who experienced high SE had more capability to engage in challenging duties, persevere longer when encountering difficulties, and reach higher levels (Mills et al., 2007). SE is considered a predictor of success compared with previous knowledge, achievements, or skills (Bandura, 1994), therefore, it is a predictor of academic success in nursing education (Silvestri et al., 2013). Students' SE level is a crucial aspect in evaluating their success and advancement. It can enhance their performance, social relationships, career options, and more (Ahlawat, et al., 2022). SE is necessary for student nurses in clinical practices, where those with poor SE may not fulfill necessary tasks for their patients (Cant & Cooper, 2017; Franklin & Lee, 2014). It is important to determine the professional identity among nursing students, for example, Mei et al. (2022) revealed that there was a correlation between SE and professional identity among Chinese first-year nursing students (FNSs) and SE is a potentially significant determinant in the development of professional identity in FNSs.

Albagawi et al. (2019) conducted a study to evaluate the degree of clinical competence and SE among Saudi fourth-year nursing students and to examine how these factors relate to the students' demographic features. The study participants were selected using a convenience sampling method. The students demonstrated a high degree of both clinical competency and SE.

The students demonstrated elevated levels of clinical competence and SE, which are essential for nursing students to effectively fulfill their standard duties and responsibilities in clinical settings. Also, a significant relationship was demonstrated between the levels of clinical competence and SE. These results revealed that students possessed the clinical aptitude to arrange and execute the required courses of action.

Building SE is a significant aspect of nursing education as it influences the success of nursing students in their future careers as healthcare providers. Nurse educators have a crucial role in evaluating self-efficacy and establishing a supportive atmosphere for its growth (Pitre et al., 2022). A cross-sectional survey was carried out on 214 Emirati undergraduate nursing students to determine the levels of self-efficacy among participants. The results indicated that 56% of students exhibited a high level of self-efficacy, 35.51% showed a moderate level, and 8.41% had a low level. The students with strong self-efficacy exhibited confidence, and perceived capability and tenacity (Pitre et al., 2022).

Another study examined the SE levels of Indian nursing students. The GSE scale was utilized to collect data from 380 nursing students who completed an online Google form. The data indicated that 56.32% of students exhibited high SE, whereas 43.68% demonstrated poor self-efficacy. Gender, educational years, family income, place of residence, and fathers' occupation and self-efficacy were significantly associated (Ahlawat, et al., 2022).

Simulation is an innovative instructional method frequently employed in nursing education. Simulation-based nursing education enhances the clinical skills of nursing students (Al Gharibi et al., 2021). It is necessary to develop creative ways to improve the transfer of learning for nursing students. Undergraduate nursing education is increasingly utilizing IVR simulations due to their ability to replicate the dynamic nature of clinical settings for students

(Chiang et al., 2022). Additionally, these simulations allow educators to facilitate the integration of theory and practice, as well as the development of multiple skills. Furthermore, they offer a cost-effective solution for programs to support the readiness of students for clinical practice. The using of VR simulations in medical settings allows for the development of skills without jeopardizing patient safety (Chiang et al., 2022). Also, VR permits instructors, educators, and learners in any educational environment to create and provide difficult information attractively. VR engages learners through dynamic teaching and learning methods, transforming student teachers into active participants who generate new ideas and solutions (Nissim & Weissblueth, 2017). The previous studies that examined self-efficacy among nursing students for clinical procedures using digital simulation environments reported increasing in self-confidence (Cant & Cooper, 2017; Franklin & Lee, 2014).

Also, Song and Kim (2023) executed a study to examine the effects of VRS-PBL on the skills of critical thinking and problem-solving, in addition to SE among nursing students about the nursing care of women during induction of labor. A non-equivalent control group design was adopted and 52 nursing students were divided into 24 in the intervention group and 28 in the control group. The intervention group received a PBL lecture during the first week, after that they were involved in self-directed learning utilizing VR simulation. During the second week, lectures about emergency nursing care induction of labor, and medication administration were provided. The control group received PBL during the first week and lectures during the second week. Findings revealed significant differences pre and post-intervention between the two groups in problem-solving ($p < 0.001$) and SE ($p < 0.001$). On the other hand, no significant difference was demonstrated in critical thinking between the two groups.

Another study was conducted by Shah et al. (2022) to investigate the experiences of first- and second-year nursing students utilizing Simulation Learning Systems with VR (SLS with VR) over 7 weeks. Additionally, the study sought to evaluate any changes in the students' self-efficacy levels before and after the study. A systematic examination of students' feedback demonstrated that they felt more involved and invested in VR experiences. Additionally, the combination of SLS with VR allowed them to engage in realistic roleplaying scenarios in clinical settings. Students' ratings of self-efficacy measures, including their comprehension of content, capacity to make clinical judgments, provision of patient care, collaboration in teams, and maintenance of safety and quality in clinical scenarios, showed a statistically significant improvement.

Nursing students frequently experience fear, worry, and a sense of helplessness when participating in mental health rotations, which hinders their ability to achieve the learning goals set for the mental health nursing practicum. Hence, it is vital to have inventive approaches that provide ample practice opportunities to foster their competence development (Kim et al., 2024). An earlier study examined the effects of VR-based Mental Health Nursing Practice Simulation (MHNPS) on the proficiency of nursing students in mental disease-related knowledge, communication SE, critical thinking, and clinical confidence for patients with mental disorders. A total of 50 nursing students who had completed at least one mental health theory course but had not started their mental health clinical practicum were enrolled. A one-group pretest-posttest repeated measures experimental design was adopted. The VR simulation comprised six modules encompassing delusion, hallucination, mania, and depression in elderly depression in adolescents associated with suicidal ideation, and OCD. Pre and post-simulation questionnaires were distributed using the specified hyperlinks. The study demonstrated that there were immediate and

enduring enhancements in mental disease-related knowledge, communication SE, critical thinking, and clinical confidence in mental health nursing after MHNPS (Kim et al., 2024).

Nursing students can utilize VR simulation to safely gain clinical experience with high-risk neonatal in situations where access to neonatal critical care facilities is restricted (Yu et al., 2021). A previous study investigated the impact of VR simulation program on Korean senior nursing students' knowledge, performance, SE, and satisfaction. A non-equivalent pre-posttest group design was utilized. The students were separated into two groups with 25 students in each group. An experimental group received VR simulation in addition to routine neonatal intensive care, and a control group only received routine neonatal critical care. The approach consisted of three distinct scenarios: fundamental care, skin care and nourishment administration, and environment management aimed at averting infant infection. The simulation utilized a head-mounted display equipped with hand-tracking technologies to provide users with vivid VR experiences. The findings demonstrated that the VR simulation can augment the nursing students' practical experience within secure virtual environments and improve their SE in performing tasks and their overall happiness with the learning process (Yu et al., 2021).

Al-Gharibi et al. (2021) conducted a quasi-experimental design with one-group repeated measures to assess the influence of repeated simulation experience on SE among undergraduate nursing students in Oman. A sample of 126 students registered in Nursing Care for Childbearing Families and Nursing Care for Child-rearing Families courses was selected via convenience sampling. The results indicated a decrease in SE after the initial simulation, but a notable enhancement in students' SE after participating in repeated simulations.

VR simulations have been demonstrated to be a highly effective method for developing interprofessional nurse-physician communication and SE (Liaw et al., 2023). A previous study

utilized a mixed-methods approach, incorporating a one-group pretest-posttest design and focus group talks. Thirty-two 32 Singaporean nursing students engaged in a 2-hour AI-assisted VR simulation. The participants' communication knowledge and SE were assessed by pre-tests and post-tests. Survey questionnaires were distributed to the students to assess their encounters with the VR environment and the AI doctor. A total of five focus group conversations were carried out to obtain a more profound understanding of their learning experiences. The participants exhibited substantial enhancements in their understanding of communication and their SE in interprofessional communication following the learning experience. The study provided a positive assessment of the AI-enabled VR simulation in terms of its acceptability, feasibility, and usability. This indicates that the AI-enabled VR simulation has the potential to enhance nursing students' acquisition of interprofessional communication skills and SE (Liaw et al., 2023).

Game-based VR simulations can leverage the benefits of remote education while effectively engaging trainees and enhancing training effectiveness. This study devised a game-based VR simulation to examine the nervous system and gauge the impact of the program on the learning attitudes of nursing students. A design of one-group pretest-posttest was employed to assess the learning attitudes toward self-directed learning, academic SE, learning experience, and learning presence for 41 senior nursing students. The program had a statistically significant impact on self-directed learning ($p < 0.05$) and learning presence ($p < 0.01$). However, there were no significant differences in academic SE ($p > 0.05$) and learning flow ($p > 0.05$). The virtual gaming simulation can serve as a viable substitute for field training, for example in cases of restricting field training, like the ongoing COVID-19 epidemic (Kim et al., 2023).

Another randomized pre/post-test experimental design was employed. A total of seventy-seven nursing students were registered in a mandatory critical-care course at a prominent

university in the Midwest for this study. A comparison was made between the two instructional approaches. The traditional method is comprised of a self-learning study module, a concise lecture and presentation by an instructor, and practical practice utilizing a plastic manikin and actual ECG equipment with 12 leads in the laboratory. Another approach was presenting the identical material through an interactive multimedia CD-ROM that incorporated VR and was complemented by a self-learning study module. Findings demonstrated significant variations in pre-intervention scores among the two groups, and there were also no differences between the groups in terms of cognitive improvements, students' satisfaction with the learning technique, or feeling of SE in completing the skill. Overall findings revealed that the two cohorts expressed contentment with their teaching approach and had comparable proficiency in accurately executing the skill on a real, virtual patient (Jeffries et al., 2003).

Virtual Reality and Emotional Intelligence

The cultivation of EI has become a focal point in recent years. This surge in attention toward EI training can be attributed to the rapid advancements in technology. A concerted effort is being made to enhance emotional abilities through various means such as programs, methods, software, mobile applications, games, and virtual and augmented reality (Murwonugroho & Ardianto, 2019). There is a significant emphasis on incorporating factors about emotion recognition, emotional self-awareness, control, management, confidence and criticism, and a general inclination towards personal growth inside many technological platforms. Moreover, within the realm of VR and AR, the advancement of traits and facets that enhance one's personality and positively influence human behavior will serve as crucial motivators for their advancement (Von Itzstein et al., 2019).

EI encompasses the capacity to identify, articulate, and comprehend both personal and interpersonal emotions, and the aptitude to regulate and govern these emotions (Drigas & Papoutsis, 2018). Moreover, it involves the demonstration of empathy, self-awareness, and social skills, ultimately leading to the development of elevated levels of self-actualization and self-transcendence. These advanced stages enable individuals to fully realize their potential and serve as a source of inspiration for others in their pursuit of self-fulfillment (Drigas & Papoutsis, 2018). It can influence the participant's ability to communicate effectively with patients and colleagues, manage stress, and make ethical decisions (Mayer, 2004). The EI level of nursing students reflects their capacity to manage their emotions, have self-awareness, exhibit empathy, express motivation, and demonstrate social skills. This has a significant influence on their ability to cope during their education and training to provide better nursing care (Almansour, 2023). Also, it plays an essential part in the success and high work performance of nursing students (Budler et al., 2022).

Contemporary nursing students will become the upcoming generation of nursing practitioners. The ability to establish and sustain a therapeutic nurse-patient interaction is the fundamental aspect of a proficient nurse. To fulfill these requirements, the nurse must possess a comprehensive comprehension of their own emotions, as well as an understanding of others' emotions, and the ability to effectively express emotions suitably. Nurse leaders have emphasized that emotional intelligence is a crucial attribute for nurses to effectively communicate and interact with both their clients and other healthcare professionals. The EI influence on the standard of care has been significant (Nair & Lee, 2016).

Nursing students, as crucial participants in the healthcare sector, have the significant responsibility of providing care for individuals and supporting the community (Vasli et al.,

2023). EI significantly impacts the quality of learning and the practical application of acquired knowledge. A cross-sectional study was conducted involving 322 Saudi nursing students who were conveniently selected. The findings indicated that the majority of the students had moderate to high EI levels. EI levels varied significantly based on factors such as students' age, sex, level of studying, marital status, mother's educational level, physical and psychological health status, and grade point average (Almansour, 2023). Another study was performed using a descriptive correlational design among Saudi nursing students (N = 204) indicating that nursing students demonstrated excellent academic performance and exhibited a significant degree of emotional intelligence (ALmegewly et al., 2022).

Moawed et al. (2017) examined the emotional intelligence skills of Saudi and Egyptian nursing students. The comparative study design was utilized and 400 students were recruited utilizing a convenience method of sampling. The findings revealed that the Saudi students had higher overall scores in emotional intelligence in comparison to Egyptian students. Thus, the nursing curriculum should foster the development of students' emotional intelligence skills, which are essential for effectively interacting with patients across various clinical environments.

Empathy is widely regarded as a fundamental aspect of high-quality healthcare and an essential component of nursing education. VR environments can promote a higher empathy level compared with videos or traditional media methods (Herrera et al., 2018). VR fosters heightened empathy and enhances attitudes and actions to benefit patients (Gillespie et al., 2021). It was found that computer role-playing games (CRPGs) are favorable methods to improve clinical empathy (Ma et al., 2021). Ma et al. (2021) conducted a study among 69 undergraduate nursing students at two colleges in the U.S. to evaluate the effectiveness and practicability of CRPGs on the participants' empathy focusing on immersiveness and views. The 2×2 (VR versus non-VR

× patient's family's views versus healthcare providers' views) between-subjects experiment. The findings revealed that playing the game in VR versus non-VR resulted in greater empathy and spatial presence. Additionally, playing from the healthcare providers versus the patient's family's views obtained higher empathy. A moderated mediation effect was seen, indicating that the allocation of users' recognition had a substantial role in mediating the impact of immersiveness on empathy in the condition where the patient's family's perspective was considered. These results demonstrated the practicability of employing a role-playing game for nursing education.

Also, VR is a promising intervention in fostering empathy toward older individuals, for example, Quay and Ramakrishnan (2023) utilized a one-group, pretest-posttest design to investigate the impact of storytelling and empathy intervention to promote empathy toward older individuals utilizing IVR among nursing students. The sample consisted of 121 prelicensure nursing students who were in their second year of education. The results showed an appreciable increase in self-perceived empathy after intervention.

Moreover, Dyer et al. (2018) used technology to teach medical and other health students to be empathetic with elderly people utilizing VR software that permits them to simulate patients with age-associated illnesses and to provide students with information related to the elderly people's health. The study used IVR experiences for training the students in elderly services. Those students experienced age-related changes like macular degeneration and hearing loss from elderly viewpoints. Librarians and instructors shared to merge the experience into the curriculum, and students went to the library at their appropriate time to accomplish the VR assignment. Findings exhibited that VR increased students' comprehension of age-associated health difficulties and enhanced their empathy for elderly people suffering from vision loss and hearing difficulties or Alzheimer's disease.\

Furthermore, the potential effects of digital media on empathy's affective and perspective-taking components in patients with chronic pain were assessed. Chronic pain impacts approximately 20% of individuals in developed nations (Tong et al., 2020). An empirical study utilized a mixed methods technique to compare the outcomes associated with empathy pre-and post-testing on 19 participants. The study's findings indicated that the VR game successfully enhanced both implicit and explicit empathy, as well as its emotional and perspective-taking components. The mean of the empathy scale's pretest did not show a statistically significant difference ($p > 0.05$), however, there were variations in the subscale pre and post-test. The kindness subscale exhibited a statistically significant increase in the posttest in comparison to the pretest. Also, a difference was shown in the scores of the Willingness to Help Scale before and after games (Tong et al., 2020).

Summary of the Previous Literature

There have been many studies conducted globally on the uses of VR in education and healthcare. Additionally, there are few studies were conducted in Arab countries about VR, however, no published studies have been conducted in Palestine focusing on VR. Also, little research about the study variables including performance, self-efficacy, and emotional intelligence among nursing students in Arab nations was conducted, unfortunately, no studies were performed in Palestine considering the aforementioned variables.

Most of the studies about the uses of VR implemented a meta-analysis, systematic review, and interventional studies. These studies concluded that VR was effective in medical and nursing education and different healthcare situations such as psychological problems, autism, critical care, emergencies, and others. Also, earlier studies found that VR simulation programs were effective in improving the aforementioned study variables among nursing students.

However, limited studies have been conducted on the utilization of IVR as an instructional instrument for learners in the context of diagnosing and managing airway crises. Also, there are studies about the EI levels in nursing students, but many intervention studies examined the effect of VR on emotions instead of EI. Therefore, it is essential to highlight the pivotal role instructors play in guaranteeing the efficacy of using VR, especially in learning clinical procedures and training programs about airway management.

Conceptual Framework of the Study

Many models and theories have been applied in VR education, these theories include Roger's innovation theory, cognitive load theory, and experiential learning. Roger's innovation theory has been adapted to include the utilization of technology breakthroughs in education (Straub, 2009). The theory of Rogers' diffusion of innovations is highly suitable for studying the acceptance of technology in higher educational settings (Medlin, 2001; Parisot, 1995). Similar to the time when VR gained significant attention in the 1990s, the present assertions and forecasts for virtual reality are exceedingly audacious and frequently influenced by personal biases. Roger Everett's Diffusion of Innovation theory, which is widely accepted in academia, provides a comprehensive framework for evaluating the various elements that influence the widespread adoption of VR technology. The various characteristics of VR technology, the discourse surrounding it, and the decision-making process of individuals all have an impact, either favorable or bad, on the rate at which it is adopted. When it comes to VR, these distinct characteristics often conflict with one another. The platform possesses a significant comparative advantage over other technologies, while it incurs a substantial investment and disrupts typical media habits (Daghir, 2017).

Rogers (2003) defined adopter categories as "the categorizations of individuals within a social system based on their level of innovativeness" (p. 22). This category encompasses those who are considered innovators, early adopters, early majority, late majority, and laggards. Innovativeness refers to the extent to which an individual or other adopter is more prompt in adopting new ideas compared to other members of a system (Rogers, 2003). Users in every category exhibit comparable levels of innovation. Rogers comprehended the planned and primary innovation-decision behavior using innovativeness.

He categorizes individuals based on their inclination to embrace new ideas or technologies as follows: *Innovators* were inclined to embrace novel concepts. Therefore, individuals should be ready to handle unremunerated and ineffective innovations, as well as a certain degree of ambiguity regarding the invention. *Early Adopters* are constrained by the constraints of the social system to a greater extent than innovators. Rogers (2003) posited that early adopters, due to their propensity for occupying leadership positions within the social system, are sought out by other members for guidance or information concerning the innovation. *Early Majority*: while the early majority can interact with other social system members, they cannot lead like early adopters. However, their interpersonal networks remain vital to invention diffusion. *The late Majority* is similar to the early majority and constitutes around one-third of the individuals within a social system who choose to delay their adoption of the innovation until their peers have already done so. Despite their skepticism over the effectiveness of the innovation, economic imperatives and social influence may compel them to embrace it. Finally, *Laggards* adhere to tradition and are less receptive to change compared to the late majority. Their social connections primarily consist of individuals who belong to the same category as

them, as these connections are predominantly limited to a specific geographical area. The distribution of adopters is depicted in Figure 22.

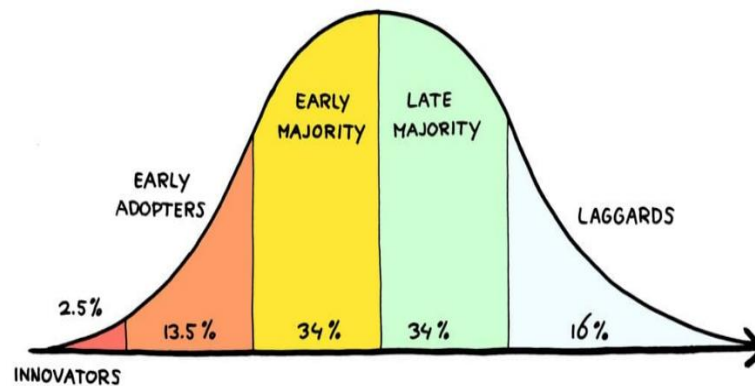


Figure 22: Distribution of adopters (Rogers, 2003)

Cognitive load theory, a well-established concept, enhances learners' working memory capacity by managing cognitive load while they are studying. Education is adopting VR, a technology that provides an immersive and captivating experience. The IVR environment could potentially overwhelm learners' cognitive capacities, leading to difficulties in understanding and retaining information. To ensure successful VR learning, cognitive load needs to be optimized (Marougkas et al., 2023). Cognitive load theory categorizes cognitive stress into intrinsic, external, and germane types. Extraneous cognitive burden arises from inappropriate or poorly designed learning resources, whereas intrinsic cognitive load stems from the complexity of the learning material. Relevant cognitive load refers to the amount of mental work required to link new information with existing knowledge. Effective management of cognitive load in virtual reality learning settings necessitates suitable feedback. Feedback assists students in evaluating their cognitive load and adjusting their learning strategies. It can help students select regions to concentrate on, so enhancing their relevant cognitive load and enhancing learning results. Optimizing cognitive load in VR learning settings is crucial for enhancing learning effectiveness and engagement. Designers can enhance learning outcomes, processing, retention, and

preparedness for real-world challenges by comprehending cognitive load and creating VR experiences that maximize it (Maroukcas et al., 2023). VR technology in education can transform how students learn and interact with intricate concepts and ideas. Integrating VR into education allows teachers to provide students with interactive learning experiences that enhance their comprehension and lead to more profound and efficient learning results (Maroukcas et al., 2023).

Also, Experiential learning theory, as a distinct methodology, asserts that the optimal approach to learning entails a cyclical process encompassing concrete experience, reflective observation, abstract conceptualization, and active exploration. According to Kolb (1984), the initial hypothesis posited that learners must actively participate in all four of these processes to effectively assimilate new knowledge and abilities.

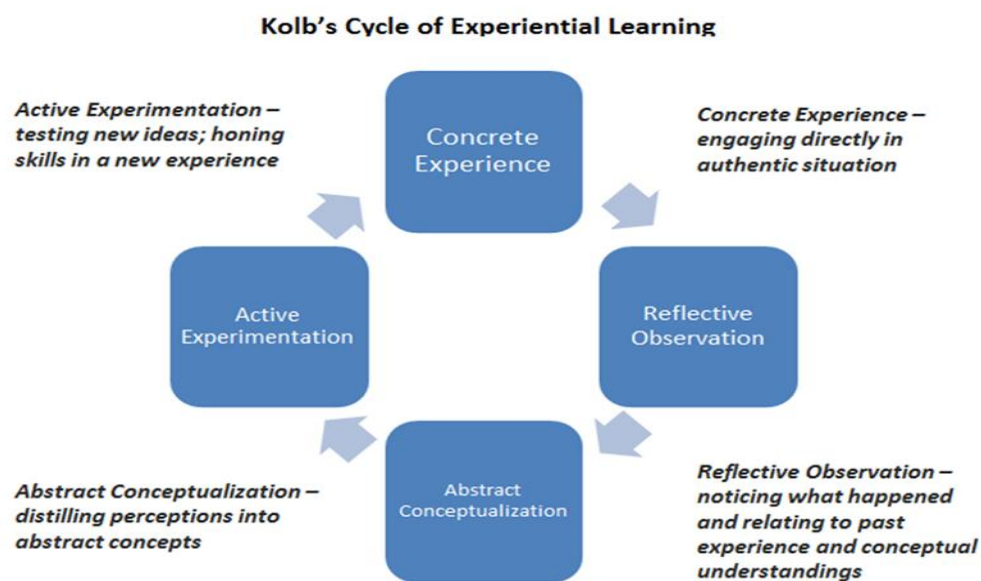


Figure 23: Kolb's cycle of experiential learning (Kolb's, 1984)

According to Kolb (1984), experiential learning places emphasis on practical, interactive learning encounters that include learners in the process of deriving significance from their

experiences. Moreover, experiential learning places emphasis on the learner's emotions, cognitive capacities, and environmental attributes within the framework of observations and relationships. Among other learning theories, this particular theory is seen as highly suitable for VR learning settings due to its emphasis on fostering learner autonomy inside the artificial world. The individual can engage with the artificial world to acquire novel knowledge, leading to the formation of fresh experiences and memories. The primary objective of experiential learning is to foster profound comprehension and enduring retention of information and skills by facilitating the building of knowledge through firsthand experience (Maroukhas et al., 2023).

The utilization of VR technology offers a distinctive means of enhancing experience learning within the realm of education. VR technology enables students to engage in immersive and interactive environments that replicate real-world experiential scenarios. This enables students to actively participate in educational endeavors and to investigate, test, and contemplate their encounters in a manner that fosters profound learning and comprehension (Maroukhas et al., 2023). Experiential learning has the potential to enhance perceived educational outcomes, captivate students' attention, and foster a greater sense of satisfaction. Additionally, it improves understanding of the subject matter, fosters a feeling of being fully engaged and present, boosts motivation and involvement, facilitates the growth of advanced cognitive abilities like problem-solving and critical thinking, and enhances students' capacity to apply abstract ideas in practical scenarios (Pande et al., 2021). In summary, the utilization of VR technology has the potential to enhance experiential learning within the realm of education through the provision of immersive and interactive settings that facilitate hands-on and active learning encounters (Maroukhas et al., 2023).

However, the researcher developed a model that interrelated all study variables together. This model is developed after the analytical review of previous studies on the study topic. It consists of a set of independent variables including VR and traditional learning of airway management, and dependent variables represented in performance, self-efficacy, and emotional intelligence. The previous evidence (Marougkas et al., 2023) showed that there was an effect of VR versus traditional learning of airway management on nursing students' performance, self-efficacy, and emotional intelligence as shown in Figure 24.

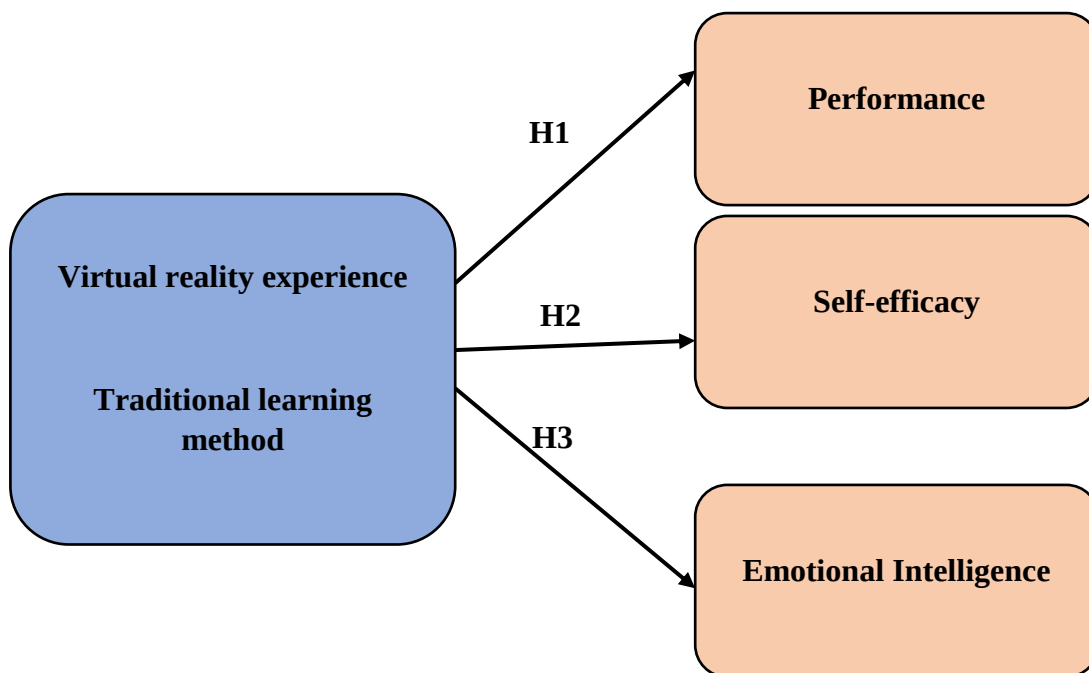


Figure 24: Conceptual model of the study

CHAPTER THREE

METHODOLOGY

This chapter discusses the following components including research strategy and design, setting, study measures, population and study sample, ethical issues, field study and intervention, and data analysis.

Study Design

This study adopted a pre–post-test control group design to evaluate the effect of VR airway management as a learning strategy on performance, SE, and EI among nursing students. This design included two groups (control and experimental) who were selected randomly. The experimental group received VR training sessions on airway management, while, the control group received traditional learning methods. This study was achieved during the time from October 2023 to December 2023.

Setting

The research was carried out at the Arab American University at Palestine (AAUP), an academic institution located near Zababdeh hamlet in the northern area of the West Bank. AAUP was established in 2000 and provides services for more than 9500 students in all specialties. The university provides undergraduate programs in several fields, including nursing, allied sciences, medicine, and information technology. Furthermore, the university utilizes sophisticated technology and instructional approaches for both Palestinian and international students.

The study was applied in the VR lab of the AAUP, which was recently built at the university. This lab contains 10 computers (Windows 10 Pro Education 64-bit (10.0, Build

19045) (19041.vb_release.191206-1406)), 15 Oculus Quest 2 glasses (HP Reverb G2, Pico Neo 3 Pro, Oculus Quest 2), and two cameras (360 degrees) (Figure 25).

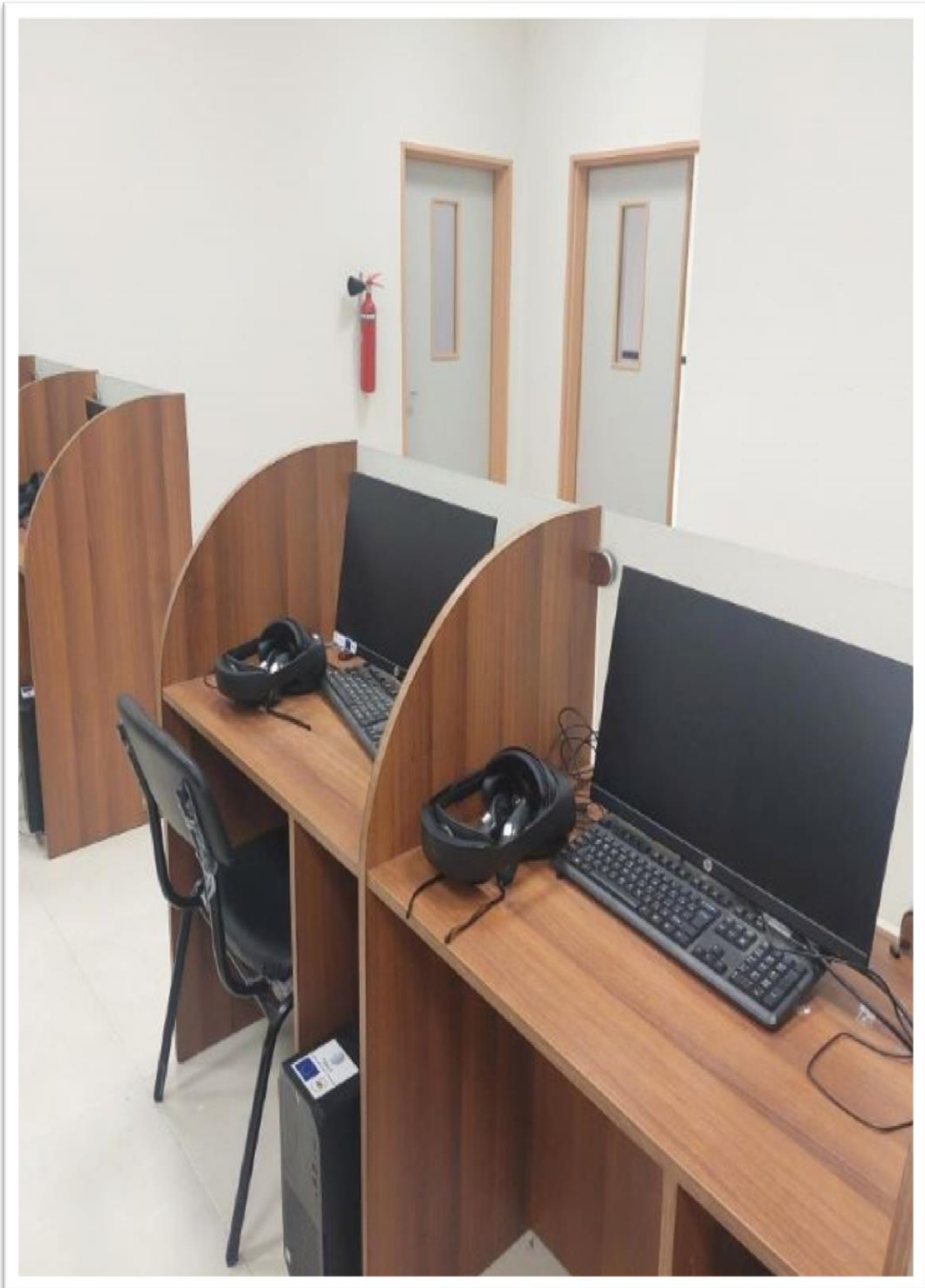


Figure 25: Virtual reality lab and equipment

Population, Sampling, and Sample

The target population of this study included all nursing students in the third year. There were an estimated 650 nursing students registered in the third year of the fall semester during the academic year 2022/2023.

A simple random sampling technique was utilized to recruit the desired number of students. The G*power program was adopted to calculate sample size with an alpha of 0.05, moderate effect size of 0.5, and a power of 0.90 with an independent t-test. A sample of 172 students was required to carry out this study; an additional 18 participants were added to avoid withdrawal and dropout. Those participants were randomly distributed into experimental or control groups.

The participants in the present study were recruited by employing third-year students' institutional data, where a list of candidates was compiled, followed by even numbers were selected. Then, the investigator proceeded to allocate each eligible student in a randomized manner to either the experimental or control arm, where each student was asked to pull a number containing the type of group from the basket. This approach ensured the prevention of any potential selection bias. The sample frame of this study is explained in Figure 26.

The inclusion criteria of the participants involved nursing students who were: a) registered in the third university year, b) not experiencing severe mental or cognitive problems (because VR may cause dizziness and drowsiness), and c) willing to engage in the study. The students who participated in any training programs like advanced cardiac life support (ACLS) were excluded.

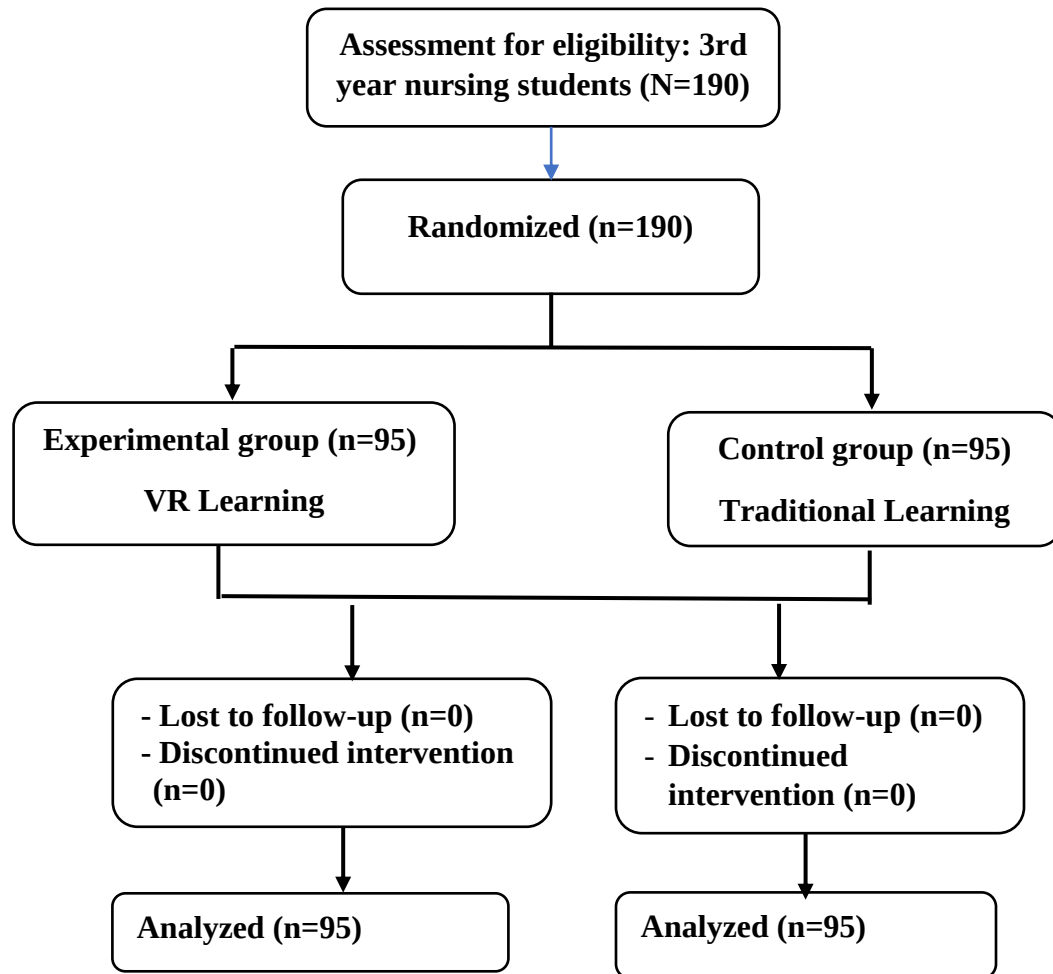


Figure 26: Sample frame of the study

Study Measurements

In this study, a structured self-reporting questionnaire and observation method were utilized to collect data. The questionnaire included demographic data, the New General Self-Efficacy Scale (NGSE), and the Wong Law Emotional Intelligence Scale (Appendix A). Additionally, an airway management skill testing checklist was utilized to evaluate students' performance (Appendix A).

- **Demographic data.** It included age, gender, general point average (GPA), experience in healthcare settings, and duration of experience.
 - ✓ **Age.** Nursing students' age in years.
 - ✓ **Gender.** It was classified as either male or female.
 - ✓ **General point average (GPA).** It is related to the average grade point average. It is categorized as poor, moderate, good, excellent, and very good.
 - ✓ **Experience in healthcare settings.** It refers to having previous nursing experience in healthcare contexts.
 - ✓ **Duration of experience.** It is related to the number of years that nursing students work.
- **New General Self-Efficacy Scale (NGSE).** It was used to measure SE (Chen et al., 2001). It comprises eight elements, each element was assessed on a Likert scale ranging from 1 (low agreement) to 5 (great agreement) (Chen et al., 2001). The scoring was based on the mean as follows: ≤ 3 reflected a low SE level and > 3 indicated a high SE level. This scale has acceptable validity and reliability with a Cronbach's alpha of 0.86 (Scherbaum et al., 2006). The Arabic version of this scale was utilized to conduct this study, which had good validity and reliability with Cronbach's alpha ranging from 0.91 to 0.95 (Amer et al., 2023; Crandall et al., 2016). The Cronbach's alpha of NGSE in this study was 0.942.
- **Wong Law Emotional Intelligence Scale.** This scale was created by Wong and Law (2002) to measure EI. It consists of 16 items distributed on four subscales, which measure four aspects of EI: an appraisal of one's emotions (SEA), appraisal of others' emotions (OEA), use of emotion (UOE), and regulation of emotion (ROE). Each item is scored using a Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). The mean was used for scoring as follows: $4 \leq$ reflected low EI and > 4 indicated high EI. The original tool is valid and reliable,

where Cronbach's alpha was 0.94 (Pacheco et al., 2019). The Arabic version of this tool was utilized to carry out this study (El Ghoudani et al., 2018), which is valid (El Ghoudani et al., 2018) and reliable with Cronbach's alpha of 0.67 (Naeem & Muijtjens, 2015). The Cronbach's alpha of WLEIS in this study was 0.827.

- **Airway Management Skills Checklist.** It was devolved by the AHA and comprised of seven items measuring airway management performance by assessing these skills: checking responsiveness, activating the emergency response system, checking breathing, checking pulse, inserting oropharyngeal or nasopharyngeal airway, administering oxygen, and performing effective bag-mask ventilation for 1 minute. The scoring result was pass or fail; if all procedure steps were successfully achieved, the student considered "pass", further, the student considered fail and should receive remediation.

Intervention and Data Collection Procedures

At the beginning, the study announcement was posted on the third-year students' board in addition to electronic contact links in collaboration with the nursing faculty administrator to facilitate students' recruitment. Then, the investigator provided students who agreed to engage in the study with the required information and criteria.

Before their participation, the students were informed of the objectives and implementation of the procedure. The consent forms were signed by the participants who agreed to participate in this study and met the eligibility criteria. Students received printed information about the date and time of the study. Then, the students were randomly assigned to experimental or control group. Once the students were divided into two groups, these two groups were assembled.

Intervention for the Control Group

On the first day, the participants in the control group were asked to fill out the questionnaire that included demographic data and SE and EI scales. Then, the control group received traditional learning about airway management, which was conducted by the investigator. The traditional learning was conducted as follows: students were divided into groups, in which each group consisted of 9 to 10 students. Then, two sessions were provided for each group in two days. The duration of each session ranged from 160 to 180 minutes. These sessions included audiovisual materials, group discussion, presentation of a video demonstration, and hands-on practice using a designated manikin for airway management (Table 1). Subsequently, the students underwent training and proceeded to apply the procedure (Figure 27).

Table 1: Traditional learning program

Time & Duration	Session	Contents	Teaching strategies (methods and materials)
First day 160-180 minutes	The first session	Airway management • Definition • Purposes of procedure • Methods • Steps of procedure	• Lecture • Videos • Discussion
Second day 160-180 minutes	The second session	Application on procedure	• Demonstration • Re-demonstration on mankind • Group work



Figure 27: Traditional learning methods for control group

Intervention for the Experimental Group

Regarding the experimental group, the investigator met the VR instructor at the nursing faculty, whose role as a technician was restricted to preparing the laboratory, running and controlling the experiment, and training students to use the VR experience. Then, the students were given an illustration of the intervention (airway management experience), including its objectives, content, duration, and experience by the researcher.

This experience was developed according to the AHA's guidelines (Figure 28). It was designed by the investigator and structured by a VR technician who followed the investigator's experience steps. These steps were arranged as follows: initiating a series of checks to assess responsiveness, calling for immediate assistance from surrounding individuals, activating the emergency response system, and getting the automated external defibrillator (AED). Then,

perform a visual examination of the chest for any signs of movement and assess the pulse for 5-10 seconds, placing an oropharyngeal airway, and administering effective bag-mask ventilation for 1 minute. After that, provide appropriate oxygenation by delivering a ventilation rate of once every 6 seconds, ensuring the correct ventilation speed within one second, and delivering an adequate ventilation volume of approximately half a bag. Also, the experience was provided with written instructions before performing any steps, in addition to audio alarms that activate when a wrong step is taken and ask the student to go back from the beginning to repeat the steps.



Figure 28: Experience steps

Also, this experience was assessed for validity using the content validity index (CVI), which assesses the degree of matching of experience with the study objectives and AHA guidelines (Appendix C). The CVI was judged by three experts in advanced life support who were provided with a brief description of the study purposes and the experience, in addition to the CVI form for scoring the questions related to experience. Experience software and CVI form were sent to the experts by e-mail. The CVI consists of a scale composed of four choices for

every question, which was rated as follows: 1 = no relevance, 2 = somewhat relevant, 3 = has relevance but needs to be changed slightly, and 4 = has relevance. After returning the responses, the CVI was calculated and was 1, which reflecting the validity of airway management experience. The students in the experimental group were categorized into ten groups, where every group consisted of 9 to 10 students. Approximately three to three and half-hour orientation sessions were provided to the students by a VR instructor about VR involving components, advantages, actions, and utilizing virtual reality technology, specifically VR glasses and a stick, within the confines of a VR laboratory (Figure 29).

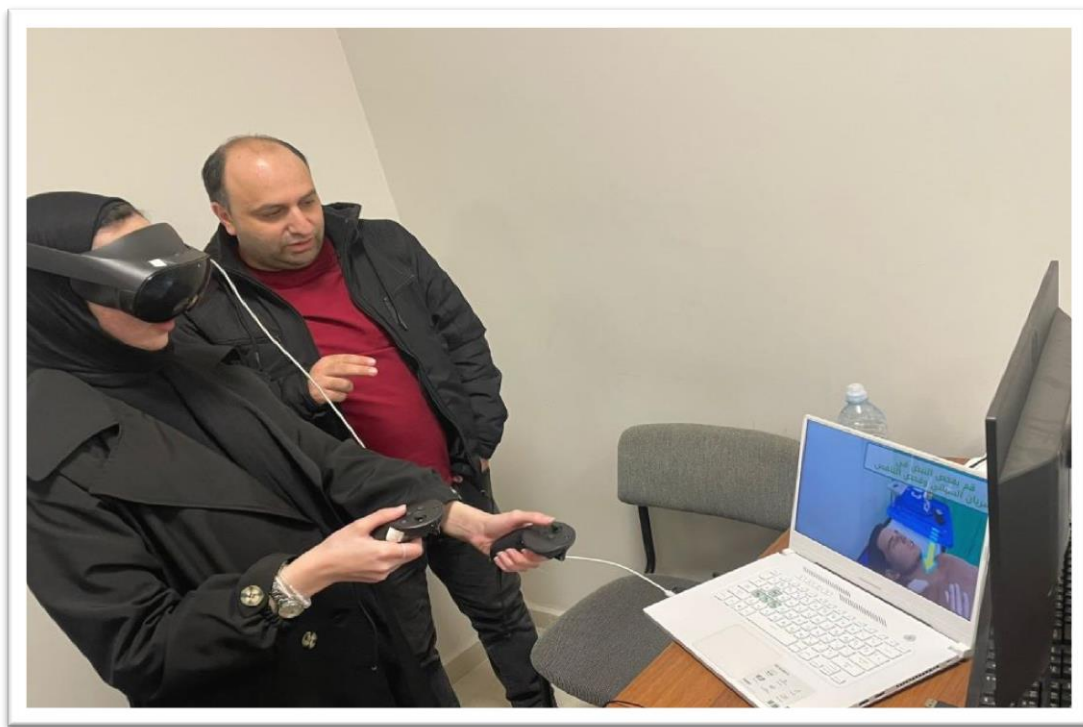


Figure 29: Orientation sessions provided to students by virtual reality instructor

The intervention was achieved in the following steps: before the session, participants in this group were requested to fill out the same questionnaire that was administered to the control group. After that, students were required to wear the HMD and utilize the stick. Then, they

enacted the VR intervention sessions as explained in Figures 30-A, 30-B, 30-C, and 30-D. At the beginning of each VR experience session, there was a screen presenting the definition, purposes of procedure, and methods of airway management. Then the student engaged in airway management experience. The required duration of each session was estimated at 15-20 minutes, therefore, each nursing student in the experimental group is required between 8-9 sessions to be competent. Additionally, the students were divided into groups, in which each group accommodated between 9 and 10 students. Table 2 illustrates the VR learning program.

The intervention and collecting data were completed over two months from October to December 2023.

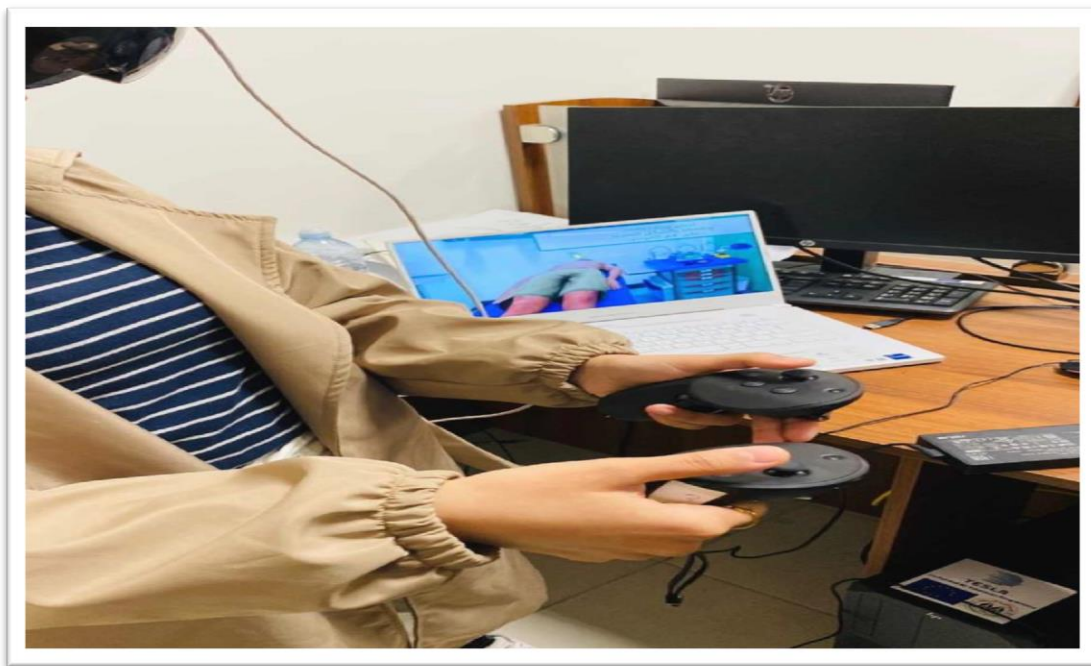


Figure 30-A: Application of virtual reality experience



Figure 30-B: Application of virtual reality experience



Figure 30-C: Application of virtual reality experience

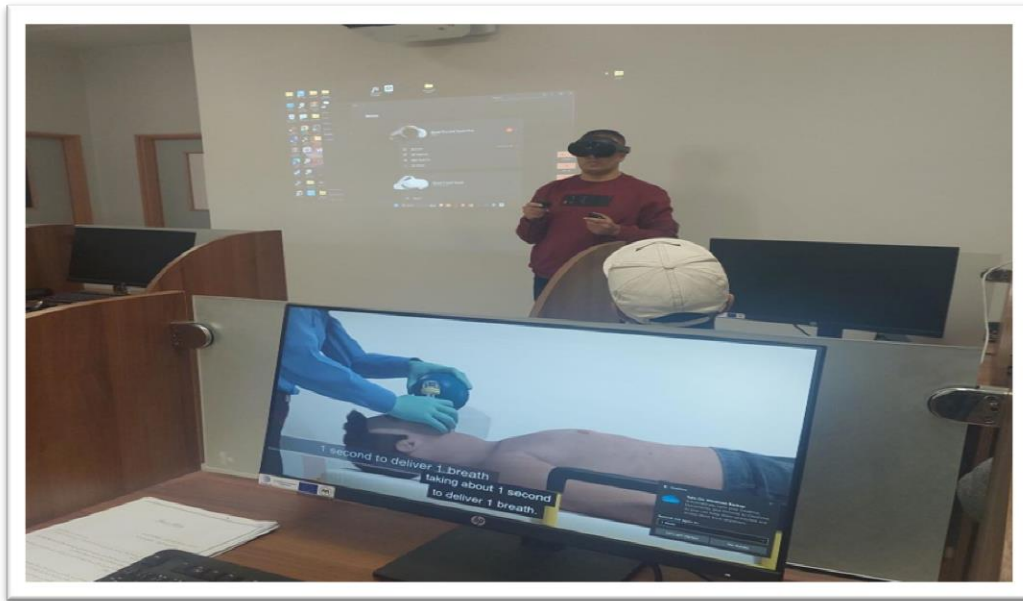


Figure 30-D: Application of virtual reality experience

Table 2: Virtual reality learning program

Time & Duration	Session	Contents	Teaching strategies (methods and materials)
First day (3-3.5 hours)	The first session	Orientation sessions were provided to the students by a VR instructor about VR involving components, advantages, actions, and utilizing virtual reality technology, specifically VR glasses and a stick, within the confines of a VR laboratory	• VR simulation • Discussion
Second and third day (140-180 minutes)	Eight to nine sessions for each student, each session (experience) was estimated 15-20 minutes	Application on procedure	• VR simulation

After that, the participants in both groups were asked to complete the same questionnaires at the end of all sessions. Additionally, the students' airway management performance was assessed while practicing on the Laerdal Airway Management Trainer. Their performance was evaluated using the AHA checklist for airway management skills by the investigator.

Structured debriefing was conducted for control and experimental groups, where students were instructed to reflect on their behaviors (Nascimento et al., 2020). This technique aids in providing feedback and rectifying inappropriate conduct (Coutinho et al., 2014). Therefore, once the students finished the experiences (Traditional and VR), a debriefing session was conducted by the investigator in a private to obtain students' self-evaluation and reflection. This debriefing session was guided by the instructor using the oral reflective ten-question from the NLN scenarios and lasted for sixty minutes. The students in the experimental group endorsed that the experience was interesting and the instructions and alarms in the experience helped them to recognize and apply the procedure. Also, this technology helped them to deal with a patient in an unrealistic environment, which enhanced their self-confidence and controlled their emotions. Also, the students in the control group revealed that they needed to repeat the procedure many times to apply it correctly.

To control contamination between experimental and control groups, this study was performed in two phases.

- Phase I: The control group engaged in traditional learning for three hours on airway management that was given by the investigator and training was demonstrated using a Laerdal airway management trainer. After completion of the traditional learning, the investigator who is an Advanced Life Support (ALCS) instructor assessed the students of

the control group individually in the performance of airway management skills and filled out the checklist.

- Phase II: The experimental group received VR airway management training. After the completion of the VR training, the students in the experimental group were assessed individually in carrying out the airway management skill, and a performance evaluation checklist was filled out by the investigator who is an ACLS instructor.
- For ethical considerations, the control group was participated in VR after completing this study.
- To control the extraneous variables, the investigator ensured the following:
 - ✓ Airway management skill performance was assessed immediately after finishing the VR experience.
 - ✓ The investigator clarified to the students the study's aim, and their performance in this interventional research will not influence their academic success in other courses.

Ethical Considerations

Approval to carry out this study was attained from the Institutional Review Board (IRB) at Arab American University in Palestine (Appendix D). Written informed consent was gained from the study participants (Appendix E). Study objectives and protocol were discussed with the agreed and eligible students. The participation was voluntary, where the students can withdraw during any time of the study with no benefits or risks. Confidentiality was kept in all phases of the study. Also, the study's data were kept in the file on the computer which was not backed up.

Data Analysis

The SPSS version 26 software was adopted to enter and analyze the study data. Descriptive statistics were used to analyze the sociodemographic characteristics of the study

participants, where mean (M) and standard deviation (SD) were used for continuous variables, and numbers and percentages (%) for categorical variables. Chi-square (X^2), paired t-test, and independent t-test were used to assess differences between groups. Additionally, Levene's test of equality of error variances was used to examine homogeneity. Findings were considered significant at p-value of ≤ 0.05 .

At pretest, the homogenous characteristics of the sample was evaluated between the control and experimental groups utilizing t-tests and chi-squares. Additionally, the equality of error variances test of Levene's test was applied. Concerning demographic characteristics, the results showed that the Chi-squares demonstrated no differences between the groups concerning gender ($X^2_{(190)} = 0.180, p > 0.05$), GPA ($X^2_{(190)} = 0.161, p > 0.05$), and experience in healthcare settings ($X^2_{(190)} = 0.491, p > 0.05$). Also, the t-test showed no significant differences in the mean of age ($t_{(190)} = 0.513, p > 0.05$) and duration of experience ($t_{(190)} = 0.822, p > 0.05$) (Table 2).

The independent sample t-tests examined differences in SE and EI between the two groups and a paired test was adopted to examine the differences in dependent variables in the same groups pre and post-intervention. The histograms and the normalcy assumptions were tested and found to be met. The homogeneity of variances between the two groups was tested using Levene's test to verify the second premise. There was no significant violation of the assumption of equal variance, and no significant group variances in SE and EI, according to the results of Levene's tests ($F = 1.414, p > 0.05$; $F = 2.487, p > 0.05$), respectively. The third premise of mutual exclusivity was satisfied since there were no appreciable differences between the two groups ($t = 0.138, p > 0.05$; $t = 0.353, p > 0.05$), respectively (Table 3).

Table 3: Comparison between study variables among control and experimental groups at pre-intervention (N= 190, Control=95, Experimental=95)

Characteristic	Categories	Control group n (%)	Experimental group n (%)	Chi-square	p-value
Gender	Male	38 (40.0)	40 (42.1)	0.180	0.678
	Female	57 (60.0)	55 (57.9)		
GPA	Excellent	16 (16.8)	16 (16.8)	0.161	0.688
	Very good	40 (42.2)	41 (43.2)		
	Good	37 (38.9)	36 (37.9)		
	Medium	2 (2.1)	2 (2.1)		
Experience	Yes	61 (64.2)	63 (66.3)	0.491	0.483
	No	34 (35.8)	32 (33.7)		
		Mean (SD)	Mean (SD)	t-test	p-value
Age		20.70 (0.93)	20.64 (0.76)	0.513	0.609
Duration of experience		1.45 (0.50)	1.38 (0.52)	0.822	0.413
Self-efficacy		3.07 (0.10)	3.06 (0.11)	0.353	0.724
Emotional intelligence		3.65 (0.30)	3.64 (0.29)	0.138	0.890

M: Mean; SD: Standard Deviation; N/n: number; %: percentage; GPA: General Point Average

* p: significant at the ≤ 0.05 level

Summary

This study utilized a pre-post-test control group design. A cohort of third-year nursing students from AAUP was selected and subsequently divided into control and experimental groups through a random sampling method. Both groups completed the questionnaire including demographic data, SE, and EI scales. Additionally, an assessment was conducted to evaluate the performance of AHA airway control techniques. A comprehensive three-hour session was conducted, encompassing a lecture, demonstration, and further re-demonstrations, focusing on the management of the AHA airway. Also, the experimental group underwent a three-hour

training session on airway management utilizing VR technology, specifically following the guidelines provided by the AHA. Subsequently, both groups completed the same set of questionnaires.

The data were entered and analyzed utilizing SPSS version 26. To investigate the differences between the control and experimental groups and to assess the study hypotheses, both chi-square and independent t-tests were used. The homogeneity of the two groups was assessed by utilizing Levene's test of equality of error variances, chi-square analysis, and t-test. The analysis considered statistically significant at $p \leq 0.05$.

CHAPTER FOUR

RESULTS

This chapter illustrates the findings of this study that based on the research hypotheses. It includes a description of the sample's characteristics and study variables. The effect of the interventions on the control and experimental group's emotional intelligence, self-efficacy, and performance in airway management.

Study Sample's Characteristics

The current study involved 190 students registered in the third year. All students completed the study. Findings showed that the average age of the participants was 20.67 years (SD = 0.84). More than half of the participants were females (58.9%) and 43.7% of the students obtained a very good GPA. Furthermore, a majority of them (65.3%) had experience in healthcare settings. The average duration of their experience was a mean of 1.42 (SD=0.50) as indicated in Table 4.

Table 4: Demographic characteristics of the study participants (N=190)

Characteristic	Categories	n	%
Gender	Male	78	41.1
	Female	112	58.9
GPA	Excellent	32	16.9
	Very good	81	42.6
	Good	73	38.4
	Medium	4	2.1
Experience in healthcare settings	Yes	124	65.3
	No	66	34.7
	Mean (SD)		
Age	20.67 (0.84)		
Duration of experience	1.42 (0.50)		

N/n: number; %: percentage; M: Mean; SD: Standard Deviation; GPA: General Point Average

Levels of Self-Efficacy and Emotional Intelligence among the Control and Experimental Groups Pre-intervention

As illustrated in Table 5, the total mean of SE among the control group at pre-intervention was 3.07 (SD=0.10), indicating a high SE level. Also, the mean scores of all items on the SE scale ranged from 3.03 to 3.10, reflecting high levels. The item “When facing difficult tasks, I am certain that I will accomplish them” had the highest mean, and the items “I will be able to achieve most of the goals that I set for myself” and “Even when things are tough, I can perform quite well” had the lowest means.

Table 5: Level of self-efficacy among the control group at pre-intervention (n=95)

Items	Mean	SD
I will be able to achieve most of the goals that I set for myself.	3.03	0.17
When facing difficult tasks, I am certain that I will accomplish them.	3.10	0.42
In general, I think that I can obtain outcomes that are important to me.	3.07	0.39
I believe I can succeed at most any endeavor to which I set my mind.	3.07	0.33
I will be able to successfully overcome many challenges.	3.08	0.27
I am confident that I can perform effectively on many different tasks.	3.08	0.27
Compared to other people, I can do most tasks very well.	3.07	0.33
Even when things are tough, I can perform quite well.	3.03	0.39
Total self-efficacy scale	3.07	0.10

N: number; SD: Standard Deviation

Table 6 explains that the total mean of SE among the experimental group at pre-intervention was 3.06 (SD= 0.10), indicating a high SE level. Moreover, the means of all items on the SE scale ranged from 3.02 (SD=0.20) to 3.10 (SD= 0.30), reflecting high levels. The item “I am confident that I can perform effectively on many different tasks” had the highest mean and the item “Even when things are tough, I can perform quite well” had the lowest mean.

Table 6: Level of self-efficacy among the experimental group at pre-intervention (n=95)

Items	Mean	SD
I will be able to achieve most of the goals that I set for myself.	3.04	0.20
When facing difficult tasks, I am certain that I will accomplish them.	3.09	0.41
In general, I think that I can obtain outcomes that are important to me.	3.06	0.35
I believe I can succeed at most any endeavor to which I set my mind.	3.05	0.30
I will be able to successfully overcome many challenges.	3.07	0.33
I am confident that I can perform effectively on many different tasks.	3.10	0.30
Compared to other people, I can do most tasks very well.	3.06	0.27
Even when things are tough, I can perform quite well.	3.02	0.20
Total self-efficacy scale	3.06	0.10

N: number; SD: Standard Deviation

As shown in Table 7, the total mean of EI among the control group at pre-intervention was 3.65 (SD= 0.30), reflecting a low level of EI. Also, all items on the EI scale had means ranging from 3.48 (SD=0.79) to 3.80 (SD=0.40), reflecting low levels. The highest mean was for the item “I would always encourage myself to try my best” and the item “I can always calm down quickly when I am very angry” had the lowest mean.

Table 7: Level of emotional intelligence among the control group at pre-intervention (n=95)

Items	Mean	SD
I have a good sense of why I have a certain feeling most of the time.	3.62	0.53
I have a good understanding of my own emotions.	3.70	0.58
I really understand what I feel.	3.64	0.63
I always know whether or not I am happy.	3.68	0.49
I always know my friends' emotions from their behavior.	3.68	0.53
I am a good observer of others' emotions.	3.60	0.72
I am sensitive to the feelings and emotions of others.	3.56	0.61
I have a good understanding of the emotions of people around me.	3.60	0.55
I always set goals for myself and then try my best to achieve them.	3.73	0.48
I always tell myself I am a competent person.	3.78	0.42
I am a self-motivated person.	3.74	0.54
I would always encourage myself to try my best.	3.80	0.40
I am able to control my temper and handle difficulties rationally.	3.56	0.75
I am quite capable of controlling my own emotions.	3.60	0.59
I can always calm down quickly when I am very angry.	3.48	0.79
I have good control of my own emotions.	3.52	0.73
Total emotional intelligence scale	3.65	0.30

N: number; SD: Standard Deviation

Table 8 shows that the total mean of EI among the experimental group at pre-intervention was 3.64 (SD= 0.29), indicating a low level of EI. Additionally, the means of all items on the EI scale ranged from 3.47 (SD=0.78) to 3.82 (SD=0.38), indicating low levels. The item “I would always encourage myself to try my best” had the highest mean and the item “I can always calm down quickly when I am very angry” had the lowest mean.

Table 8: Level of emotional intelligence among the experimental group at pre-intervention (n=95)

Items	Mean	SD
I have a good sense of why I have a certain feeling most of the time.	3.60	0.53
I have a good understanding of my own emotions.	3.67	0.55
I really understand what I feel.	3.67	0.62
I always know whether or not I am happy.	3.65	0.48
I always know my friends' emotions from their behavior.	3.67	0.53
I am a good observer of others' emotions.	3.63	0.62
I am sensitive to the feelings and emotions of others.	3.54	0.59
I have a good understanding of the emotions of people around me.	3.61	0.55
I always set goals for myself and then try my best to achieve them.	3.70	0.50
I always tell myself I am a competent person.	3.74	0.44
I am a self-motivated person.	3.72	0.49
I would always encourage myself to try my best.	3.82	0.38
I am able to control my temper and handle difficulties rationally.	3.59	0.66
I am quite capable of controlling my own emotions.	3.62	0.54
I can always calm down quickly when I am very angry.	3.47	0.78
I have good control of my own emotions.	3.50	0.72
Total emotional intelligence scale	3.64	0.29

N: number; SD: Standard Deviation

Levels of Performance, Self-Efficacy, and Emotional Intelligence among the Control and Experimental Groups Post-intervention

Furthermore, Table 9 shows that the percentage of students in the experimental group who passed in airway management procedure after the intervention was 88.4% compared with 33.7% in the control group. This result indicated that the experimental group had higher performance in airway management than the control group.

Table 9: Students' performance at post-intervention among control and experimental groups (Control group n=95, Experimental group n=95)

Group	Pass n (%)	Fail n (%)
Control	32 (33.7)	63 (66.3)
Experimental	84 (88.4)	11 (11.6)

n: number; %: Percentage

As shown in Table 10, the total mean of SE among the control group at post-intervention was 4.05 (SD = 0.14), indicating a high SE level. Also, the means of all items on the SE scale were increased and ranged from 4.0 (SD = 0.41) to 4.06 (SD = 0.24), reflecting high levels. The items "When facing difficult tasks, I am certain that I will accomplish them," and "I am confident that I can perform effectively on many different tasks" had the highest means, and the item "I believe I can succeed at most any endeavor to which I set my mind" had the lowest mean.

Table 10: Level of self-efficacy among the control group at post-intervention (n=95)

Items	Mean	SD
I will be able to achieve most of the goals that I set for myself.	4.05	0.33
When facing difficult tasks, I am certain that I will accomplish them.	4.06	0.31
In general, I think that I can obtain outcomes that are important to me.	4.04	0.32
I believe I can succeed at most any endeavor to which I set my mind.	4.00	0.41
I will be able to successfully overcome many challenges.	4.05	0.22
I am confident that I can perform effectively on many different tasks.	4.06	0.24
Compared to other people, I can do most tasks very well.	4.04	0.43
Even when things are tough, I can perform quite well.	4.05	0.22
Total self-efficacy scale	4.05	0.14

SD: Standard Deviation

Table 11 reveals that the total mean of SE among the experimental group at post-intervention was 4.24 (SD = 0.28), indicating a high SE level. Also, the means of all items on the SE scale were increased and ranged from 4.20 (SD=0.40) to 4.28 (SD=0.57), reflecting high levels. The item “I will be able to successfully overcome many challenges” had the highest mean, and the item “I will be able to achieve most of the goals that I set for myself” had the lowest mean.

Table 11: Level of self-efficacy among the experimental group at post-intervention (n=95)

Items	Mean	SD
I will be able to achieve most of the goals that I set for myself.	4.20	0.40
When facing difficult tasks, I am certain that I will accomplish them.	4.23	0.51
In general, I think that I can obtain outcomes that are important to me.	4.26	0.56
I believe I can succeed at most any endeavor to which I set my mind.	4.22	0.48
I will be able to successfully overcome many challenges.	4.28	0.57
I am confident that I can perform effectively on many different tasks.	4.27	0.49
Compared to other people, I can do most tasks very well.	4.23	0.59
Even when things are tough, I can perform quite well.	4.27	0.49
Total self-efficacy scale	4.24	0.28

N: number; SD: Standard Deviation

As clarified in Table 12, the total mean of EI among the control group at post-intervention was 4.19 (SD = 0.13), indicating a high EI level. Moreover, the means of all items on the EI scale were improved and ranged from 4.15 (SD = 0.42) to 4.23 (SD = 0.42), reflecting high levels. The item “I have a good sense of why I have a certain feeling most of the time” had the highest mean and the item “I am able to control my temper and handle difficulties rationally” had the lowest mean.

Table 12: Level of emotional intelligence among the control group at post-intervention (n=95)

Items	Mean	SD
I have a good sense of why I have a certain feeling most of the time.	4.23	0.42
I have a good understanding of my own emotions.	4.20	0.40
I really understand what I feel.	4.21	0.40
I always know whether or not I am happy.	4.16	0.42
I always know my friends' emotions from their behavior.	4.20	0.40
I am a good observer of others' emotions.	4.17	0.38
I am sensitive to the feelings and emotions of others.	4.20	0.40
I have a good understanding of the emotions of people around me.	4.17	0.38
I always set goals for myself and then try my best to achieve them.	4.18	0.39
I always tell myself I am a competent person.	4.18	0.39
I am a self-motivated person.	4.17	0.45
I would always encourage myself to try my best.	4.22	0.42
I am able to control my temper and handle difficulties rationally.	4.15	0.42
I am quite capable of controlling my own emotions.	4.20	0.40
I can always calm down quickly when I am very angry.	4.19	0.39
I have good control of my own emotions.	4.20	0.40
Total emotional intelligence scale	4.19	0.13

N: number; SD: Standard Deviation

Table 13 shows that the total mean of EI among the experimental group at post-intervention was 5.48 (SD = 0.39), indicating a high EI level. Also, the means of all items on the EI scale were improved and ranged from 5.16 (SD=0.97) to 5.74 (SD=0.69), reflecting high levels. The item “I have a good understanding of the emotions of people around me.” had the highest mean and the item “I have a good sense of why I have a certain feeling most of the time.” had the lowest mean.

Table 13: Level of emotional intelligence among the experimental group at post-intervention (n=95)

Items	Mean	SD
I have a good sense of why I have a certain feeling most of the time.	5.16	0.97
I have a good understanding of my own emotions.	5.49	0.69
I really understand what I feel.	5.59	0.68
I always know whether or not I am happy.	5.60	0.70
I always know my friends' emotions from their behavior.	5.67	0.55
I am a good observer of others' emotions.	5.68	0.74
I am sensitive to the feelings and emotions of others.	5.47	0.68
I have a good understanding of the emotions of people around me.	5.74	0.69
I always set goals for myself and then try my best to achieve them.	5.30	0.77
I always tell myself I am a competent person.	5.54	0.79
I am a self-motivated person.	5.47	0.63
I would always encourage myself to try my best.	5.62	0.66
I am able to control my temper and handle difficulties rationally.	5.31	0.85
I am quite capable of controlling my own emotions.	5.34	1.08
I can always calm down quickly when I am very angry.	5.38	0.94
I have good control of my own emotions.	5.25	0.99
Total emotional intelligence scale	5.48	0.39

N: number; SD: Standard Deviation

Effect of VR Airway Management Vs. Traditional Learning on Performance among the Control and Experimental Groups

The findings indicated a statistically significant difference between the two groups in performance of airway management at post-intervention (Chi-square=81.16, $p < 0.001$) (Table 14). This finding proposed the effectiveness of VR learning methods compared with traditional

learning methods in improving performance in airway management, which accepted hypothesis one.

Table 14: Comparison between the control and experimental groups in performance at post-intervention: Chi-square test

Phase and group	Performance			
	n	n (%) of pass	Test statistics	
			Chi-square	p-value
Post-intervention:				
Control group	95	32 (33.7)	81.16	0.000**
Experimental group	95	84 (88.4)		

n: number; %: percentage;

p-value: *significant at ≤ 0.05 ; ** Significant at ≤ 0.01

Effect of VR Airway Management Vs. Traditional Learning on Self-Efficacy among the Control and Experimental Groups

As shown in Table 15, the findings revealed a significant difference in SE between the control group before and after the intervention ($t_{(93)} = -58.952$, $p < 0.001$). This finding proposed the effectiveness of the traditional learning methods in improving SE among the control group.

Table 15: Comparison between the control group in self-efficacy at pre-post intervention: paired t-test

Phase	Self-efficacy				
	n	M (SD)	95% CI	Test statistics	
				t-test	p-value
Pre-intervention	95	3.07 (0.10)	-1.01- -0.952	-58.952	0.000*
Post-intervention	95	4.05 (0.14)			

M: Mean; SD: Standard Deviation

P-value: *significant at ≤ 0.05 ; ** Significant at ≤ 0.01

CI: Confidence Interval

Table 16 shows a significant difference in SE between the experimental group before and after the intervention ($t_{(93)} = -38.456$, $p < 0.001$). This result suggested that the VR learning method was effective in improving SE.

Table 16: Comparison between the experimental group in self-efficacy at pre-post intervention: paired t-test

Phase	Self-efficacy				
	n	M (SD)	95% CI	Test statistics	
				t-test	p-value
Pre-intervention	95	3.06(0.10)	-1.24- -1.12	-38.456	0.000**
Post-intervention	95	4.24 (0.28)			

M: Mean; SD: Standard Deviation

P-value: *significant at ≤ 0.05 ; ** Significant at ≤ 0.01

CI: Confidence Interval

As shown in Table 17, the findings revealed no statistically significant difference in SE between the control and experimental groups in pre-intervention ($t_{(188)} = 0.353$, $p > 0.05$). On the other hand, a statistically significant difference was found between the control and experimental groups in SE in post-intervention ($t_{(188)} = -5.871$, $p < 0.001$). These findings indicated the VR learning method was more effective in enhancing SE than the traditional learning methods, which accepted hypothesis two.

Table 17: Comparison between the control and experimental groups in self-efficacy at pre-post intervention: independent t-test

Phase and group	Self-efficacy				
	n	M (SD)	95% CI	Test statistics	
				t-test	p-value
Pre-intervention:					
Control group	95	3.07 (0.10)	- 0.024- -0.034	0.353	0.724
Experimental group	95	3.06 (0.11)			
Post-intervention:					
Control group	95	4.05 (0.14)	-0.254- -0.126	-5.871	0.000**
Experimental group	95	4.24 (0.28)			

M: Mean; SD: Standard Deviation

P-value: *significant at ≤ 0.05 ; ** Significant at ≤ 0.01

CI: Confidence Interval

Effect of VR Airway Management Vs. Traditional Learning on Emotional Intelligence among the Control and Experimental Groups

As illustrated in Table 18, findings revealed that a significant difference was demonstrated in EI between the control group before and after the intervention ($t_{(93)} = -14.230$, $p < 0.001$). This result suggested the effectiveness of the traditional learning methods in enhancing EI in the control group.

Table 18: Comparison between the control group in emotional intelligence at pre-post intervention: paired t-test

Phase	Emotional intelligence				
	n	M (SD)	95% CI	Test statistics	
				t-test	p-value
Pre-intervention	95	3.65 (0.30)	- 0.619- - 0.467	-14.230	0.000**
Post-intervention	95	4.19 (0.13)			

M: Mean; SD: Standard Deviation

P-value: *significant at ≤ 0.05 ; ** Significant at ≤ 0.01

CI: Confidence Interval

Table 19 shows that there was a significant difference in EI between the experimental group before and after the intervention ($t_{(93)} = -32.540$, $p < 0.001$). This finding proposed the effectiveness of the VR learning method in improving EI among the experimental group.

Table 19: Comparison between the experimental group in emotional intelligence at pre-post intervention: paired t-test

Phase	Emotional intelligence				
	n	M (SD)	95% CI	Test statistics	
				t-test	p-value
Pre-intervention	95	3.64 (0.30)	- 1.950- -1.726	-32.540	0.000**
Post-intervention	95	5.48 (0.39)			

M: Mean; SD: Standard Deviation

P-value: *significant at ≤ 0.05 ; ** Significant at ≤ 0.01

CI: Confidence Interval

Table 20 illustrates that there was no statistically significant difference in EI between the two groups in pre-intervention ($t_{(188)} = 0.188$, $p > 0.05$). Conversely, there was a significant difference between the control and experimental groups in EI in post-intervention ($t_{(188)} = -$

30.253, $p < 0.001$). These findings indicated the VR learning method was more effective in improving EI than the traditional learning methods, which accepted hypothesis three.

Table 20: Comparison between the control and experimental groups in emotional intelligence at pre-post intervention: independent t-test

Phase and group	Emotional intelligence				
	n	M (SD)	95% CI	Test statistics	
				t-test	p-value
Pre-intervention:					
Control group	95	3.65 (0.30)	- 0.078- 0.090	0.188	0.890
Experimental group	95	3.64 (0.29)			
Post-intervention:					
Control group	95	4.19 (0.13)	-1.373- -1.204	-30.253	0.000**
Experimental group	95	5.48 (0.39)			

M: Mean; SD: Standard Deviation

P-value: *significant at ≤ 0.05 ; ** Significant at ≤ 0.01

CI: Confidence Interval

Summary

The results revealed that the nursing students in the control and experimental groups had high SE and low EI before the intervention (VR and traditional learning methods). After interventions, both control and experimental groups had high SE and EI. Also, the experimental group recorded higher performance in comparison with control group.

Significant differences were demonstrated in performance, SE, and EI in airway management between control and experimental groups post-intervention ($p < 0.05$). The findings proved the effectiveness of VR learning method in enhancing performance, SE, and EI rather than traditional learning methods.

CHAPTER FIVE

DISCUSSION

This chapter presents a discussion of results, implications, strengths and limitations, conclusion, and recommendations focused on the results of this study.

Discussion of the Results

Effect of IVR Airway Management on Nursing Students' Performance

The findings of this study accepted the third hypothesis stated “The nursing students who will engage in VR airway management as a learning strategy will have better performance in airway management than those who will participate in traditional learning”. Findings supported the effect of VR as an intervention in promoting students’ performance in airway management. Findings of this study aligned with the results of Lee and Son’s (2023) study which demonstrated that VRS-PBL is a valuable method in enhancing knowledge acquisition, clinical aptitude and performance, and self-confidence. Furthermore, Bani Salameh et al. (2024) showed a positive effect of VR on improvement of nursing students’ performance. Lee and Baek (2023) demonstrated that VR simulation significantly improved nursing students' performance and their ability to make clinical decisions. Also, Shujuan et al. (2022) demonstrated that the participants who participated in the VR group exhibited greater enhancements in crisis preparedness, confidence, and performance. Yu and Yang (2022) revealed that implementation of a VR simulation training program resulted in enhanced skills in respiratory treatment and a theoretical understanding of infectious disease preparedness.

Hence, this study proposes that the identification of optimal learning and training methodologies using highly advanced technology such as VR can enhance the performance of nursing students and equip them with the necessary skills to be proficient and capable nurses

within healthcare environments. VR technology facilitates the demonstration of clinical experiences and practicing these experiences in a safe environment. Also, all guides and instructions are provided inside the experience, thus it is easy for students to re-demonstrate the experience many times until mastering it.

Effect of IVR Airway Management on Nursing Students' Self-Efficacy

Findings from this study accepted the second hypothesis stated “The nursing students who will engage in VR airway management as a learning strategy will have more SE than those who will participate in traditional learning”. SE was higher in experimental group compared to control group post-intervention. This study proposes that VR improved SE for nursing students more than traditional learning. Findings of the present study are supported the results from previous studies (Cant & Cooper, 2017; Franklin & Lee, 2014)

Also, Song and Kim (2023) demonstrated notable disparities in problem-solving abilities and SE between the two groups before and after the intervention. Furthermore, Shah et al. (2022) demonstrated a statistically significant enhancement in students' SE ratings a cross various domain, such as content comprehension, clinical judgment, patient care provision, team collaboration, and safety and quality maintenance in clinical scenarios. In addition, Kim et al. (2024) showed that there were both rapid and long-lasting improvements in nursing knowledge associated with mental disorders, SE in communication, critical thinking skills, and clinical confidence in mental health nursing following MHNPS. Yu et al. (2021) demonstrated that the utilization of a VR simulation program has the potential to enhance the practical experience of nursing students in secure virtual environments, which can lead to improvements in their SE in task performance and overall satisfaction with the learning process. Furthermore, Al-Gharibi et al. (2021) showed a notable improvement in students' SE after their engagement in iterative VR

simulations. Liaw et al. (2023) revealed that VR simulation was effective in fostering SE. On the contrary, the findings of the study contradicted the results reported by Kim et al. (2023), who demonstrated no statistically significant disparity was observed in academic SE and learning flow. Furthermore, Jeffries et al. (2003) demonstrated no statistically significant differences was demonstrated in pretest scores between the two groups (Traditional and VR intervention) in SE in skill completion.

One plausible rationale for the present study findings is that the participants underwent their initial clinical exposure to VR as an instructional approach, thereby perceiving it as a novel encounter. Consequently, this novel experience may have contributed to their heightened SE. This study examines the impact of teaching tactics and instructors' talents on students' SE about training. Therefore, educators must enhance their pedagogical approaches, disseminate their expertise in alignment with educational goals, and offer assistance and motivation to their students (Costa et al., 2020). VR has been found to enhance students' abilities, comprehension, and critical thinking skills, as well as their readiness for practical application and SE (Costa et al., 2020). Students with a high level of SE are more likely to be motivated in the learning process. VR simulations provide students with a heightened sense of SE, enabling them to engage with diverse realities inside a secure and regulated setting (Costa et al., 2020). Moreover, students cultivate a heightened feeling of SE within safe and realistic clinical environments, so enhancing their confidence in implementing practical nursing protocols while mitigating the potential hazards associated with patient care (Costa et al., 2020).

Effect of IVR Airway Management on Nursing Students' Emotional Intelligence

The study's intervention yielded a notable enhancement in EI among nursing students, thereby confirming the initial hypothesis that "the nursing students who will engage in VR

airway management as a learning strategy will have higher EI than those who will participate in traditional learning”. This study provides evidence on the effectiveness of VR on EI for nursing students. Specifically, the participants in experimental group exhibited higher levels of EI in comparison to control group, which had a lower level of EI. The outcomes of the present investigation provide additional evidence that aligns with previous studies, for example, Quay and Ramakrishnan (2023) demonstrated a significant rise in empathy among nursing students following VR intervention in comparison to pre-intervention. In addition, VR games effectively improve empathy, in addition to emotional and viewpoint-taking facets. Ma et al. (2021) demonstrated that engaging in the game using VR as opposed to non-VR led to increased levels of empathy and spatial presence. Additionally, Gillespie et al. (2021) found that VR promoted empathy and improved attitudes and behaviors for the betterment of patients. Herrera et al. (2018) demonstrated that VR environments have the potential to enhance empathy to a greater extent when compared to movies or conventional media approaches.

This result could be illustrated as the development of EI has emerged as a central area of focus in contemporary times. The increased focus on cultivating EI can be ascribed to the swift progress in technology (Murwonugroho & Ardianto, 2019). Another potential explanation may be related to VR intervention that provided students with the impression that they were in a realistic and safe environment, which affected their feelings and resulted in high EI. This experience provided students with real stimuli and sounds that reflect reality, therefore, students practiced experience in the absence of stress and fear till they performed the skill accurately. Technology has also a significant impact on students’ perception and comprehension of educational materials through games (Carstens et al., 2021). Also, the students can practice and

manage different clinical situations and cases that students find difficulty to deal with and finding in realistic clinical settings.

Strengths and Limitations of the Study

The present study exhibits notable strengths in terms of its provision of significant findings and its contribution to the existing body of literature by including Arab nursing students. Furthermore, the university offers a nursing VR simulation laboratory as a part of its resource offerings. This study represents the first experimental investigation conducted in Palestine seeking to assess the effectiveness of VR on the performance, SE, EI of airway management in nursing students. Furthermore, the investigation was conducted on two separate groups (experimental and control) that were assigned utilizing random allocation. Furthermore, the instruments with acceptable validity and reliability were utilized to assess study variables.

Regardless of the strengths of this study, it is imperative to accept several limitations. This study was executed at a single location and involved a similar group of participants. However, it was restricted to students in the third year who were pursuing a Bachelor of Science in Nursing degree at one of the private universities.

Implications for Study

This study evaluated the effect of VR on airway management on performance, SE, and EI among undergraduate nursing students in Palestine. It provides significant findings about the effect of VR airway management on the aforementioned variables. These findings could be applied in nursing education, practice, policy, and future research.

Implications for Nursing Education

This study provides evidence in favor of incorporating VR into the nursing curriculum. By integrating theory and practice, students will be able to establish connections. It is imperative

to emphasize that providing educators with training on VR scenarios is essential for ensuring effectiveness. However, the training of educators is challenging and requires a significant amount of time. The acquisition of competence necessitates consistent engagement in the preparation and execution of VR scenarios through repeated practice. Furthermore, nurse educators must integrate VR into their teaching. Implementing this will enhance the quality and outcomes of their courses.

Furthermore, the implementation of standardized VR scenarios will promote fairness among students, guaranteeing equal opportunities for knowledge acquisition, assessment, and exposure before their immersion in real-life environments.

Implications for Nursing Practice

Integrating VR into nursing courses would augment the clinical proficiency of graduate nurses and significantly boost patient safety. VR learning provides students with the opportunity to engage in clinical encounters that are infrequently experienced in real-world settings. This will enhance and broaden the learners' experiences, so enhancing their preparedness to effectively handle a diverse range of cases encountered in their professional activity.

Implications for Policy

The results of this study offer valuable insights for policymakers in formulating policies about the obligations and functions of nursing students in patient care within healthcare environments. Furthermore, the implementation of VR simulation training for staff and educators is recommended. The primary rationale for the utilization of simulations in nursing administration lies in the reduction of patient hazards, which may be attributed to enhancing nursing graduates' experiences.

The proficient skills for nursing graduates will reflect positively on patients' health consequences and outcomes, therefore, policy-makers and nursing managers should enact VR simulations upon developing their strategies as possible. The nursing directors can benefit from VR simulations to enhance patients' safety; VR can give opportunities for intern nursing graduate students to accomplish the nursing skills in an environment free from hazards or fear to improve safety culture and quality of care.

Implications for Future Research

Future research should be focused on increasing sample size, and the VR experience could be replicated on other nursing students from different faculties in the region. It is also preferable to conduct other studies on VR education in Palestinian universities and compare their results with the results of this study. Additionally, a mixed methods study could be carried out to examine the experiences of the participants with VR experience in addition to the effect of VR.

Conclusion

VR-based learning can be an important element for preparation of nursing students for a successful transmission to clinical practice settings. The effect of VR simulation on performance, SE, and EI concerning airway management was examined among nursing students in Palestine. This study established that VR simulation as a learning strategy learning enhanced students' performance, SE, and EI in comparison with traditional learning. VR is a learning strategy that provides a nursing student with a safe and effectual learning environment. VR experiences can be integrated as a supplemental to traditional education, therefore, the study reinforce incorporating VR into nursing courses in order to minimize the requirement for clinical practice areas available for the clinical training.

Recommendations

These recommendations are proposed based on the significant results of this study:

- Incorporate VR into the nursing curriculum as a teaching method, with a designated proportion, alongside traditional learning.
- Integrate VR technology into nursing courses, such as Fundamentals of Nursing, can facilitate development of essential nursing skills and competencies like SE, EI, and decision-making.
- Enhance using VR airway management experience in training instructors, undergraduate students, and nurses in clinical care settings to promote learning skills.
- Conduct future studies to ensure the applicability of these findings, it is highly advisable to undertake more studies that replicate the VR airway management experience in various situations and fields.
- Perform further studies to explore the impact of VR airway management training programs on other factors, including acquisition of knowledge, critical thinking, and decision-making among nursing students.
- Conduct future research to examine the transferability of the effect of VR simulation experience into actual clinical settings. Also, qualitative studies could be conducted to evaluate the students' experiences with VR.

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APPENDIX A

English Version of the Questionnaire

The Effect of Immersive Virtual Reality Airway Management as A Learning Strategy on Performance, Self-Efficacy, and Emotional Intelligence among Nursing Students in the West Bank/ Palestine

1- Demographic data

- Gender: ☐ Male ☐ Female
- Age:
- General point average (GPA): ☐ Excellent ☐ Very good ☐ Good
☐ Medium ☐ Weak
- Experience in healthcare settings: ☐ Yes ☐ No
- Duration of Experience:.....

2- Wong Law Emotional Intelligence Scale

Instructions:

Below is a short 16-item measure of emotional intelligence. Complete this questionnaire, and state how much you agree or disagree with each of the statements. Where:

1= Strongly disagree 2 - Disagree 3 –Slightly disagree 4 - Neither agree nor disagree
 5- Slightly agree 6- Agree 7- Strongly agree

No.	Item	Strongly disagree	Disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Agree	Strongly agree
1.	I have a good sense of why I have a certain feeling most of time.							
2.	I have good understanding of my own emotions.							
3.	I really understand what I feel.							
4.	I always know whether or not I am happy.							

No.	Item	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
5.	I always know my friends' emotions from their behavior.					
6.	I am a good observer of others' emotions.					
7.	I am sensitive to the feeling and emotions of others.					
8.	I have a good understanding of the emotions of people around me.					
9.	I always set goals for myself and then try my best to achieve them.					
10.	I always tell myself I am a competent person.					
11.	I am a self-motivated person.					
12.	I would always encourage myself to try my best.					
13.	I am able to control my temper and handle difficulties' rationally.					
14.	I am quite capable of controlling my own emotions.					
15.	I can always calm down quickly when I am very angry.					
16.	I have good control of my own emotions.					

3- New General Self-Efficacy scale (NGSE)

Instructions:

Below is a short 8-item self-efficacy scale. Complete this questionnaire, and state how much you agree or disagree with each of the statements. Where:

1- Strongly Disagree 2- Disagree 3- Neither agree nor disagree 4- Agree

5- Strongly Agree

No	Item	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1.	I will be able to achieve most of the goals that I set for myself.					
2.	When facing difficult tasks, I am certain that I will accomplish them.					
3.	In general, I think that I can obtain outcomes that are important to me.					
4.	I believe I can succeed at most any endeavor to which I set my mind.					
5.	I will be able to successfully overcome many challenges.					
6.	I am confident that I can perform effectively on many different tasks.					
7.	Compared to other people, I can do most tasks very well.					
8.	Even when things are tough, I can perform quite well.					

4- Airway Management Skills Testing Checklist

Airway Management Skills Testing Checklist



Student Name _____ Date of Test _____

Critical Performance Steps	✓ if done correctly
BLS Assessment and Interventions	
Checks for responsiveness • Taps and shouts, "Are you OK?"	
Activates the emergency response system • Shouts for nearby help/Activates the emergency response system and gets the AED or • Directs second rescuer to activate the emergency response system and get the AED	
Checks breathing • Scans chest for movement (5-10 seconds)	
Checks pulse (5-10 seconds) Breathing and pulse check can be done simultaneously Notes that pulse is present and does not initiate chest compressions or attach AED	
Inserts oropharyngeal or nasopharyngeal airway	
Administers oxygen	
Performs effective bag-mask ventilation for 1 minute • Gives proper ventilation rate (once every 5-6 seconds) • Gives proper ventilation speed (over 1 second) • Gives proper ventilation volume (~half a bag)	

STOP TEST

Instructor Notes

- Place a ✓ in the box next to each step the student completes successfully.
- If the student does not complete all steps successfully (as indicated by at least 1 blank check box), the student must receive remediation. Make a note here of which skills require remediation (refer to Instructor Manual for information about remediation).

Test Results Check **PASS** or **NR** to indicate pass or needs remediation: **PASS** ☐ **NR** ☐

Instructor Initials _____ Instructor Number _____ Date _____

APPENDIX B

Arabic Version of the Questionnaire

دراسة حول: "تأثير إدارة مجرى الهواء بالواقع الافتراضي كاستراتيجية تعلم على الأداء والكفاءة الذاتية والذكاء العاطفي لدى طلاب التمريض في الضفة الغربية / فلسطين"

1- المعلومات الشخصية والاجتماعية

- الجنس: ☐ ذكر ☐ أنثى
- العمر: -----
- التحصيل الأكاديمي: ☐ ممتاز ☐ جيد جدا ☐ جيد ☐ متوسط ☐ ضعيف
- هل لديك خبرة في العمل في أماكن الرعاية الصحية: ☐ نعم ☐ لا
- مدة الخبرة.....

2- مقياس لونغ لو للذكاء العاطفي

التعليمات:

فيما يلي مقياس قصير مكون من 16 عنصراً للذكاء العاطفي، أكمل هذا الاستبيان، وحدد مدى موافقتك أو عدم موافقتك على كل من العبارات. حيث ان:

- 1= أرفض بشدة 2- أرفض 3- أرفض قليلاً 4- لا أرفض ولا أوافق
5- أوافق قليلاً 6- أوافق 7- أوافق بشدة

العبارة	أرفض بشدة	أرفض	أرفض قليلاً	لا أوافق ولا أرفض	أوافق قليلاً	أوافق	أوافق بشدة
1- لدي فكرة جيدة عن سبب شعوري بمشاعر معينة معظم الوقت							
2- لدي فهم جيد لمشاعري							
3- أنا أفهم حقاً ما أشعر به							
4- أعرف دائماً ما إذا كنت سعيداً أم لا							
5- أعرف دائماً مشاعر أصدقائي من سلوكهم							

العبارة	أرفض بشده	أرفض	أرفض قليلا	لا أوافق ولا أرفض	أوافق قليلا	أوافق	أوافق بشده
6- أنا مراقب جيد لمشاعر الآخرين							
7- أنا حساس لمشاعر وعواطف الآخرين							
8- لدي فهم جيد لمشاعر الناس حولي							
9- أنا دائما أضع الأهداف لنفسي ثم أبذل قصارى جهدي لتحقيقها							
10- أقول لنفسي دائما إنني شخص كفء							
11- أنا شخص ذو دوافع ذاتية							
12- أشجع نفسي دائما على بذل قصارى جهدي							
13- أنا قادر على التحكم في أعصابي حتى أتمكن من التعامل مع الصعوبات العقلانية							
14- أنا قادر تماما على التحكم في مشاعري							
15- يمكنني دائما أن أهدأ بسرعة عندما أكون غاضبا جدا							
16- لدي سيطرة جيدة على مشاعري							

3- مقياس كفاءة الذات العام الجديد

التعليمات:

فيما يلي مقياس قصير مكون من 8 عناصر لتقييم كفاءة الذات، أكمل هذا الاستبيان، وحدد مدى موافقتك أو عدم موافقتك على كل من العبارات. حيث ان:

1-ارفض بشدة 2- أرفض 3-لا أرفض ولا أوافق 4- أوافق 5- أوافق بشدة

العبارة	أرفض بشده	أرفض	لا أرفض ولا أوافق	أوافق	أوافق بشده
1 سأكون قادراً على تحقيق معظم الأهداف التي حددتها لنفسي					
2 عند مواجهة مهام صعبة، أنا متأكد من أنني سأنجزها					
3 بشكل عام، أعتقد أنه يمكنني الحصول على نتائج مهمة بالنسبة لي					
العبارة	أرفض	أرفض	لا أرفض	أوافق	أوافق

بشدة	ولا أوافق	بشده	
			4 أعتقد أنني أستطيع أن أنجح على الأكثر في أي مسعى أضعه في ذهني
			5 سأكون قادراً على التغلب بنجاح على العديد من التحديات
			6 أنا واثق من أنني أستطيع الأداء بفعالية في العديد من المهام المختلفة
			7 بالمقارنة مع الأشخاص الآخرين، يمكنني القيام بمعظم المهام بشكل جيد للغاية
			8 حتى عندما تكون الأمور صعبة، يمكنني أن أؤدي أداءً جيداً

4- قائمة فحص مهارات إدارة مجرى الهواء

Airway Management Skills Testing Checklist



Student Name _____ Date of Test _____

Critical Performance Steps	✓ if done correctly
BLS Assessment and Interventions	
Checks for responsiveness • Taps and shouts, "Are you OK?"	
Activates the emergency response system • Shouts for nearby help/Activates the emergency response system and gets the AED or • Directs second rescuer to activate the emergency response system and get the AED	
Checks breathing • Scans chest for movement (5-10 seconds)	
Checks pulse (5-10 seconds) Breathing and pulse check can be done simultaneously Notes that pulse is present and does not initiate chest compressions or attach AED	
Inserts oropharyngeal or nasopharyngeal airway	
Administers oxygen	
Performs effective bag-mask ventilation for 1 minute • Gives proper ventilation rate (once every 5-6 seconds) • Gives proper ventilation speed (over 1 second) • Gives proper ventilation volume (~half a bag)	

STOP TEST

Instructor Notes

- Place a ✓ in the box next to each step the student completes successfully.
- If the student does not complete all steps successfully (as indicated by at least 1 blank check box), the student must receive remediation. Make a note here of which skills require remediation (refer to Instructor Manual for information about remediation).

Test Results Check **PASS** or **NR** to indicate pass or needs remediation:

PASS ☐ NR ☐

Instructor Initials _____ Instructor Number _____ Date _____

APPENDIX C**Content Validity Index (CVI) for Virtual Reality Airway Management Experience****Letter Seeking Permission to Validate Virtual Reality Airway Management Experience****Dear Experts**

I am a Ph.D. student at Arab American University at Palatine. I would like to conduct a dissertation entitled "The Effect of Immersive Virtual Reality Airway Management as A Learning Strategy on Performance, Self-Efficacy, and Emotional Intelligence among Nursing Students in the West Bank/ Palestine". The purpose of this study is to evaluate the effect of virtual reality airway management as a learning strategy on emotional intelligence, self-efficacy, and performance among nursing students in the West Bank/Palestine.

Based on AHA guidelines in airway management, I built a virtual reality airway management experience with assistance of virtual reality designer. I would like to assess the content validity index (CVI) for the intervention program using a 4-point rating scale, whereas "1 = not relevant; 2= unable to assess relevance without item revision or the item is in need of such revision that it would no longer be relevant; 3= relevant but needs minor alteration; 4= very relevant and succinct.

If this is possible, please indicate so by replying to me through e-mail:

Sincerely,

Hisham Zahran

Ph.D. Student

Items	1	2	3	4
The experience shows clear learning objectives.				
The experience follows AHA guidelines.				
Content organization is clear, consistent, and appropriate.				
The experience can attract users' attention.				
The experience has new and interesting information.				
The experience has various cultural elements.				
The experience is relevant to the target group.				
The experience has appropriate and editable instructions				
The experience contains vocabularies that are suitable for learners.				
The experience has teaching aids that help the teaching activity.				
The experience can be used in various situations.				
The experience allows learners to demonstrate airway management safely and frequently.				

APPENDIX D

Informed Consent

Arab American University
Scientific Research Oversight
Ethical Review Committee



الجامعة العربية الأمريكية
 عمادة البحث العلمي
 لجنة أخلاقيات البحث العلمي

INFORMED CONSENT

AAUP-IRB Code No.:

AAUP-IRB Date:

I, ... (*Name of Participant / optional*) hereby agree to take part in the clinical research (clinical study/questionnaire study/drug trial) specified below:

Title of Study: The Effect of Immersive Virtual Reality Airway Management as A Learning Strategy on Performance, Self-Efficacy, and Emotional Intelligence among Nursing Students in the West Bank/ Palestine
 , Fulfillment of PhD degree, in Nursing, in AAUP.

The nature and purpose of which has been explained to me by Hisham Zahran, and interpreted by Hisham Zahran to the best of his/her ability in English.

I have been told about the nature of the research in terms of methodology, possible adverse effects and complications (as per Participant Information Sheet).

After knowing and understanding all the possible advantages and disadvantages of this research, I voluntarily consent of my own free will to participate in the clinical research specified above.

I understand that I can withdraw from this research at any time without assigning any reason whatsoever.

Date:

Signature:

(Participant)

IN THE PRESENCE OF:

Name:

Designation:

Signature:

(Witness for Signature of Participant)

I confirm that I have explained to the patient the nature and purpose of the above-mentioned research.

Date:

Signature: Hisham Zahran

(Attending investigation)

APPENDIX E

Institutional Review Board (IRB) at Arab American University

Arab American University- Palestine Deanship of Scientific Research IRB committee Tel: 04-241-8888, ext 1196 E-mail: rb.aau@aaup.edu		الجامعة العربية الأمريكية - فلسطين عمادة البحث العلمي لجنة الممارسات البحث العلمي تليفون: 04-241-8888 ext 1196 البريد الإلكتروني: rb.aau@aaup.edu
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IRB Approval Letter

Study Title: The Effect of Immersive Virtual Reality Airway Management as A Learning Strategy on Performance, Self-Efficacy, and Emotional Intelligence among Nursing Students in the West Bank/ Palestine

Submitted by: Hisham Zaher A.alfatah Zhran

Date received: 18th April 2023

Date reviewed: 24th May 2023

Date approved: 26th May 2023

Your Study titled "The Effect of Immersive Virtual Reality Airway Management as A Learning Strategy on Performance, Self-Efficacy, and Emotional Intelligence among Nursing Students in the West Bank/ Palestine" With archived number 2023/A/88/N was reviewed by the Arab American University IRB committee and was approved on 26th May 2023.

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




General Conditions:

1. Valid for 6 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 الممارسات البحث العلمي في الجامعة العربية الأمريكية
 IRB at Arab American University

الملخص

الخلفية: تعد إدارة مجرى من الكفاءات الأساسية التي يجب أن يتمتع بها طلاب التمريض. هناك نقص في الدراسات التي تبحث تأثير إدارة مجرى الهواء بالواقع الافتراضي في الدول العربية بما فيها فلسطين. وبالتالي، هدفت هذه الدراسة إلى تقييم تأثير إدارة مجرى الهواء بالواقع الافتراضي كاستراتيجية تعليمية على الذكاء العاطفي والكفاءة الذاتية والأداء بين طلاب التمريض في الضفة الغربية/فلسطين.

الطريقة: تم استخدام تصميم المجموعة الضابطة قبل وبعد الاختبار وتم اختيار 190 مشاركاً عشوائياً من الجامعة العربية الأمريكية في فلسطين وتقسيمهم إلى مجموعة تجريبية (العدد=95) ومجموعة ضابطة (العدد=95). تلقت المجموعة التجريبية إدارة مجرى الهواء بالواقع الافتراضي وتلقت المجموعة الضابطة التعلم التقليدي. وتضمن استبيان منظم للتقارير الذاتية مقياس الكفاءة الذاتية العام الجديد، ومقياس الذكاء العاطفي لقانون وونغ، وتم استخدام طريقة الملاحظة لجمع البيانات. بالإضافة إلى ذلك، تم استخدام قائمة مرجعية لاختبار مهارات إدارة مجرى الهواء لتقييم أداء الطلاب.

النتائج: بعد التدخل، نجح 88.4% من المجموعة التجريبية في إدارة مجرى الهواء، بينما نجح 33.7% من المجموعة الضابطة. كما أن متوسط درجات الكفاءة الذاتية للمجموعتين الضابطة والتجريبية كان 4.05 (الانحراف المعياري = 0.14) ، و 4.24 (الانحراف المعياري = 0.28) ؛ على التوالي، مما يشير إلى كفاءة ذاتية عالية. وكان متوسط درجات الذكاء العاطفي للمجموعتين الضابطة والتجريبية 4.19 (الانحراف المعياري = 0.13)، و 5.48 (الانحراف المعياري = 0.39) ، على التوالي، مما يشير إلى ارتفاع الذكاء العاطفي. كما كان هناك فروق بين المجموعتين الضابطة والتجريبية بعد التدخل في الأداء والكفاءة الذاتية والذكاء العاطفي (القيمة الاحتمالية > 0.01) مما يشير إلى أن المجموعة التجريبية حصلت على متوسط درجات أعلى في المتغيرات المذكورة مقارنة مع المجموعة الضابطة.

الاستنتاجات: أكدت النتائج أن محاكاة الواقع الافتراضي أدت إلى تحسين أداء الطلاب والكفاءة الذاتية والذكاء العاطفي مقارنة بالتعلم التقليدي. يمكن أن تكون تجارب الواقع الافتراضي مكملية للتعلم التقليدي؛ وبالتالي تدعم هذه الدراسة دمج الواقع الافتراضي في مساقات التمريض لتقليل الحاجة إلى أماكن التدريب العملي للمسابقات السريرية.

الكلمات المفتاحية: إدارة مجرى الهواء؛ الذكاء العاطفي؛ أداء؛ الكفاءة الذاتية؛ الواقع الافتراضي