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The Effectiveness of Virtual Reality Simulation as a Learning Strategy on Acquisition of Ventrogluteal Injection Skill and Anxiety Level

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THESIS APPROVAL CERTIFICATE

The thesis study of Nursing Department graduate student Samar THABET IBRAHIM JALLAD with student number 20175251 titled **The Effectiveness of Virtual Reality Simulation as a Learning Strategy on Acquisition of Ventrogluteal Injection Skill and Anxiety Level** has been approved with unanimity / majority of votes by the jury and has been accepted as a Doctorate of Nursing Thesis.

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Hereby I declare that this thesis study is my own study, I had no unethical behavior in all stages from planning of the thesis until writing thereof, I obtained all the information in this thesis in academic and ethical rules, I provided reference to all of the information and comments which could not be obtained by this thesis study and took these references into the reference list and had no behavior of breeching patent rights and copyright infringement during the study and writing of this thesis.

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“Science may set limits to knowledge, but it should not set limits to imagination”

This thesis is dedicated to all those who supported me and inspired me to do this research and write before the work is over.

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Abbreviations and Symbols List

VR: Virtual Reality

VRS: Virtual Reality Simulation

IM: Intramuscular Injection

VG: Ventrogluteal Site

ADDIE: Analyse, Design, Development, Implementation, Evaluation

STAI: State-Trait Anxiety Inventory

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Turkish Summary

Bir Öğrenme Stratejisi Olarak Sanal Gerçeklik Simülasyonunun Ventrogluteal Enjeksiyon Becerisini Kazanmaya ve Kaygı Düzeyine Etkisi

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ÖZET

Amaç: Araştırma, hemşirelik eğitiminde ventrogluteal enjeksiyon becerisi ile ilgili sanal gerçeklik simülasyon yazılımı tasarlamak, geliştirmek ve öğrenme stratejisi olarak sanal gerçeklik simülasyonunun, ventrogluteal enjeksiyon becerisi kazanmaya ve kaygı düzeyine etkisini belirlemek amaıyla planlandı.

Gereç ve Yöntem: Araştırma, yarı-deneysel olarak tasarlandı. Araştırmanın çalışma evrenini 2019-2020 bahar yarıyılında Yakın Doğu Üniversitesi Hemşirelik Fakültesinde "Hemşirelik Esasları" dersine ilk kez kayıt yaptıran birinci sınıf öğrencileri (220 öğrenci), çalışma grubunu ise araştırmaya alınma kriterlerine uygun 66 öğrenci (kontrol grubu=33, deney grubu=33) oluşturdu. Araştırmada veri toplama aracı olarak "Kişisel Bilgi Formu", "İntramüsküler Ventrogluteal Enjeksiyon Beceri Kontrol Listesi" "Durumluk-Sürekli Kaygı Envanteri-STAI", "Kayıt Sayfası (Log Sheets)", " İntramüsküler Ventrogluteal Enjeksiyon Sanal Gerçeklik Simülasyonu" ve "Geliştirilmiş Kalça Enjeksiyon Modeli" kullanıldı. Veriler, ilgili kurumdan ve öğrencilerden izin alındıktan sonra uygulama öncesinde, sonrasında ve gönüllü bireylerde uygulama öncesinde olmak üzere üç aşamada toplandı ve SPSS paket programı kullanılarak analiz edildi.

Bulgular: Uygulama öncesi, sonrası ve gönüllü bireylerde uygulama öncesinde, psikomotor beceri puanı, durumluk ve sürekli kaygı açısından deney grubunun lehine istatistiksel olarak anlamlı fark saptanmıştır. Ayrıca, uygulama öncesi, sonrası ve gönüllü bireylerde uygulama öncesinde deney grubunun, beceriyi gerçekleştirme sürelerinin kontrol grubuna göre daha uzun olduğu belirlenmiştir.

Sonuç: Sonuçlar, sanal gerçeklik simülasyonunun, hemşirelik eğitiminde, intramüsküler enjeksiyon uygulaması gibi, işlem basamaklarının sıralanmasını gerektiren psikomotor becerilerin öğretiminde etkili bir yöntem olduğunu, geleneksel laboratuvar uygulamaları ile birlikte kullanılmasının, öğretme ve öğrenme sürecinin verimliliğini arttırdığını ve kaygı düzeyini azalttığını göstermektedir.

Anahtar Kelimeler: Sanal gerçeklik simülasyonu; Öğrenme stratejisi; Hemşirelik eğitimi; Intramüsküler enjeksiyon; Psikomotor beceri

The Effectiveness of Virtual Reality Simulation as a Learning Strategy on Acquisition of Ventrogluteal Injection Skill and Anxiety Level

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ABSTRACT

Aim: Aim of the study is to design and develop virtual reality simulation software related to ventrogluteal injection skills in nursing education and determine the effectiveness of virtual reality simulation as a learning strategy on the acquisition ventrogluteal injection skill and anxiety level.

Material and Method: The study was used a quasi-experimental design. The universe of the study consisted of the first-year students (220 students) who enrolled "Fundamentals of Nursing" course first time at the Near East University Faculty of Nursing in the summer semester in 2019-2020 academic years, and the study sample included 66 students who met inclusion criteria of the study (Control group=33, Experimental group=33). "Personal Information Form", "Intramuscular Ventrogluteal Injection Skill Checklist" "State-Trait Anxiety Inventory-STAI", "Log Sheets", "Intramuscular Ventrogluteal Injection Virtual Reality Simulation" and "Enhanced Injection Hip Model" were used as data collection tools in the research. Data were collected three times as at before practice, after practice, and before practice on a voluntary individual, after getting permission from relevant institutions and students. Data were analyzed by using the SPSS packet program.

Findings: There is a significant difference between both groups in pre-test and before practice on a voluntary individual in performance psychomotor skills scores, and in a pre-test in state anxiety level, and significantly long period time in a minute that mean was higher in the experimental group.

Conclusion: The results showed that virtual reality simulation is an effective method in nursing education, in the teaching of psychomotor skills that require sequencing of the procedure steps, such as intramuscular injection, and that its use with traditional laboratory practices increases the efficiency of the teaching and learning process and reduces the level of anxiety.

Key Words: Virtual reality simulation; Learning strategy; Nursing education; Intramuscular injection; Psychomotor skill

CHAPTER I

Introduction

Statement of the Problem

For at least two decades healthcare systems have altered with technological enhancements in especially diagnosis and care. Thus, a transformation of nursing education is necessary to prepare nursing students for develop and complex health care environments (Juraschek et al., 2019). In which, the essential aim of nursing education is to enhance the integrate of theoretical knowledge in clinical practice (Shin et al., 2015), through using modern various and innovation strategies that are appropriate for the evolution of technology by necessities of the digital age (Khraim et al., 2015). In which, learning environments are linked with students' behavior, academic achievements, satisfaction, and self-efficacy, and aims (Işık & Kaya, 2014).

Shortage of nursing faculty, student anxiety, a high number of students to nursing educators ratio, inadequate infrastructure and resources, lack of lab facilities, competitive and complex clinical settings, changes in roles from student to practitioner, and patient safety concerns of faculty(Cant & Cooper, 2014; Case & Huisman, 2015). In addition, inadequate time in the clinical lab and/or insufficient of clinical location experience including skillful performance may reduce possibilities for nursing students to master procedural skills that lead to reduce the readiness of students when performing procedures in clinical practice (Benner et al., 2010; IOM, 2011b); are the main challenges that caused nursing educators/faculties looking for alternative strategies to complement traditional ways on clinical practice experience to achieve all of the Y and Z generations' learning needs are frequently to multimedia environments and expect to integrate technology into their curricula, to narrow 'theory-practice gap' and provide safe and high-quality patient care (Işık & Kaya, 2014; Monaghan et al., 2015; NLN, 2016). Thus, translation of basic knowledge is as theory into practice skills, especially improvement of psychomotor skills, which remains the main concern for nurse educators and students.

In response to these challenges, and to promise the quality and safety of nursing education, the World Health Organization and the National Council of State Boards of Nursing provided recommended the use of simulation-based activities like virtual reality simulation in health-related fields as an active teaching/learning strategy in a clinically realistic environment to improve the safety of patients (IOM, 2011b; NCSBN, 2006; WHO, 2010).

Purpose of the Study

The study aims to design and develop virtual reality simulation software related to ventrogluteal injection skills in nursing education and to determine the effectiveness of virtual reality simulation as a learning strategy on an acquisition of ventrogluteal injection skills and anxiety level.

Hypotheses

For the study, the following hypotheses will be sought.

Hypothesis 1_0: There is no difference between the groups in terms of skill level in the laboratory section of ventrogluteal injection training with Model and Virtual Reality.

Hypothesis 1_1: There is a difference between the groups in terms of skill level in the laboratory section of ventrogluteal injection training with Model and Virtual Reality.

Hypothesis 2_0: There is no difference between the groups in terms of anxiety level in the laboratory section of ventrogluteal injection training with Model and Virtual Reality.

Hypothesis 2_1: There is a difference between the groups in terms of anxiety level in the laboratory section of ventrogluteal injection training with Model and Virtual Reality.

Hypothesis 3_0: There is no difference between the groups in terms of skill level on a voluntary individual of ventrogluteal injection training with Model and Virtual Reality.

Hypothesis 3_1: There is a difference between the groups in terms of skill level on a voluntary individual of ventrogluteal injection training with Model and Virtual Reality.

Hypothesis 4_0: There is no difference between the groups in terms of anxiety level on a voluntary individual of ventrogluteal injection training with Model and Virtual Reality.

Hypothesis 4_1: There is a difference between the groups in terms of anxiety level on a voluntary individual of ventrogluteal injection training with Model and Virtual Reality.

Significance of the Study

The acquisition of clinical psychomotor skills is an central part of an undergraduate nursing program which inextricably linked with cognitive and motor skills, that involves the application of theoretical knowledge to psychomotor skills, and integration of clinical ability, performance, essential knowledge, and attitude in the nursing situation which taught in traditionally or in simulated clinical practice (Liou & Cheng, 2014).

In nursing education, nursing students should be ready to know, understand, remember and competently perform various procedures, to reduce the risk of harm when they learn and practice on an actual patient (Freitag et al., 2015).

One of these procedural skills is an intramuscular injection (IM) that considered an essential place in injection applications (Kilic et al., 2014), it is one of the essential skills causing many complications, that lead to increase fear and anxiety among nursing students, and incompetence to perform critical skills competently and confidently in a particular practical setting (Gonzalez & Kardong-Edgren, 2017; Tugrul & Denat, 2014).

Students should be know the advantages and disadvantages of the injection site as ventrogluteal (VG) site is the safest, define the anatomic marking points, and perform IM injection practice via selecting the correct injection technique to avoid complications (Freitag et al., 2015; Gülnar & Özveren, 2016); through repetitive practice with feedback to support motor skill learning and retention (Gonzalez & Kardong-Edgren, 2017; Oermann, 2015). On the other hand, inadequate practice time affects the chances for students of receiving clinical experience with an actual patient, and contributes to occurring nursing skill errors that risk the safety of patients (Gonzalez & Kardong-Edgren, 2017). Consequently, the nursing education programs have the responsibility to prepare qualified and competent graduates to manage the patients' medication effectively (Zare et al., 2013).

Simulation is becoming a valuable tool and essential part of nursing education increasingly common; it helps optimize the teaching process, provides students with truthful opportunities to acquire skills learning in theory, for allows students to hold a diversity of practical opportunities to duplicate clinical scenarios and make instant reflections and decisions (Cant & Cooper, 2017; Flott & Linden, 2016). Virtual reality (VR) is one of the most methods of simulation becomes an effective supplemental tool for instruction (Shin et al., 2015; Smith & Hamilton,

2015) that based on computer technology to form an co-operating three-dimensional (3D) world in which handlers have a sense of immersion (Lioce et al., 2020).

VRS encourages nurse educators to study educational innovations to enhance the education of future health providers (Padilha et al., 2019), which encourages the learner’s involvement, self-confidence, and satisfaction, it decreasing nursing learner's anxiety before patient-care procedures, via allowing them to practice their skills safely in a controlled learning environment avoiding actual real dangers(Cant & Cooper, 2017; Ismailoglu & Zaybak, 2018; Jeffries, 2014). In addition. It assists to transfer knowledge from classroom to clinical setting. In addition, accessible to practice opportunities at lowest cost (Tschannen et al., 2012).

Foronda and colleagues (2014) addressed in their study that 98% of nursing students considered VRS familiar solution for defeating organizational and situational difficulties associated with practical skills and incorporated within teaching and learning methods through providing virtual scenarios in a simulated safe and accessible learning environment.

Chang, (2018), Rourke, (2020), and S. J. Smith et al., (2016), indicated in their studies that VRS allows repetitive exposure to educational content such as clinical skills and critical events that improve patient safety, and promote cognitive, and enhance skill mastery among nursing students, which lead to higher expectations in clinical performance of nurses (Lee & Hahn, 2011).

In the light of these explanations, this study can help nurse educators by providing evidence to maintenance educational and curricular changes that support in the transformation of nursing education.

CHAPTER II

Literature Review

Theoretical Framework

Meleis explains the significance of concept exploration through using a strategy for developing a concept of newly set and prior it becomes an accepted fragment of the nursing discipline, which may have been known in the daily involvement of nurses as the concept of virtual reality education that is integrated into nursing experiences, normalized its properties and existence by limiting the concept's growth and meanings (Meleis, 2011).

Learning via virtual reality simulation in practice is viewed as one strategy of outining the gap between theory (concepts, features, limitation,…, etc.) and practice (performing skills, and experience in clinical settings) (Monaghan et al., 2015) that has several advantages as preventing the probably disastrous consequences of errors occurring in clinical settings (Lewis et al., 2012).

Traditionally, higher education was instructive, providing form of theory-based lectures, with structured clinical hours undertaken in the clinical environment (Tierney et al., 2018). Whereas, traditional practice happens within physical laboratories, using mannequins, human actors, and task instructors to duplicate procedural tasks and clinical scenarios (Weller et al., 2012).

While, the transfer into the digital age has seen a move into blended learning methods which have become progressively common since the mid-2000s, and occurs on mixed structure, a constructive, and consisted of several strategies of teaching as audio-visual elements, online learning, self-directed learning modules, lectures and/or workshops, and critical-thinking exercises (Güzer & Caner, 2014). Thus, virtual reality simulation plays a vital role within nursing education, with a diversity of software applications a supplement to face-to-face training, and 'serious games' being used as a replacement for it (Donovan et al., 2018).

Description of Virtual Reality Simulation

Today's, to meet Y and Z generations' learning needs who are merging technology into their curricula and using multimedia environments (Lee et al., 2016; Somyürek, 2014), simulation-based education (SBE) is becoming a learner-oriented experiential approach that integrates cognitive, psychomotor, and affective domains in a safe and less threatening environment by using case studies, role play, task trainers, high fidelity simulators based simulation (Cato, 2012).

One of the emerging forms of simulation that now the third most common educational technology is virtual reality simulation (VRS) that has penetrated several fields such as media, communication, travel, education, games, medical and nursing education (Parsons et al., 2017; Tiffany & Forneris, 2018). There are different terms include virtual simulation, virtual reality, and augmented reality that refer to provide partially and/or completely immersive experiences through the use of a headset (Foronda et al., 2020).

A virtual world was defined as ‘‘a computer-based simulated environment created with two-/ three-dimensional [3D] graphical images of physical space’’ (Shen & Eder, 2009). Society for Simulation in Healthcare, (2016) defined virtual reality (VR) as “a computer-generated three-dimensional environment that gives an immersion effect”(Owen, 2016). In addition, virtual reality provides the sense of being anywhere by providing our sense organs with various data (Edeer & Sarikaya, 2015). In addition, Decker et al. (2008) describe virtual reality merges a computer-generated environment with palpable, auditory, and visual sensory stimuli through complex influenced trainers to support authenticity (Decker et al., 2008). On the other hand, Mahrer, Gold,(2009) defined virtual reality is almost a new multisensory technology mode that lets users involve themselves in a virtual world and experience a real-life place in an unnatural environment through computer-created sensory stimuli (Mahrer & Gold, 2009).

As cited in Lopreiato (2016, p. 42) virtual simulation as simulation including real people performing simulated operations, such as surgical simulators that are used for on-screen procedural training and united with a haptic device(s) (Lopreiato, 2016).

Davis R.(2009) defined virtual reality simulation (VRS) as a computer-assisted program that has objects and images as real views to give a sense of immersive, interactive, and three-dimensional (3D) characteristics to produce real-life situations, integrating physical movement; as a computer keyboard, a mouse, speech/voice communication, haptic devices (Davis, 2009; Ludlow, 2015; Shin et al., 2019).

Society for Simulation in Healthcare, (2016) defined VRS as a type of immersive technology trying to indicate actual health care situations, described by the inclusion of physical interfaces, such as haptic or motion sensors (Owen, 2016). As well, VRS is an efficient device that advances learners to the complication of clinical situations without injuring real clients (Jenson & Forsyth, 2012). On the other hand, VRS is a kind of simulation that supplies a pleasant educational strategy for teaching high-level skills in a challenging environment (Foronda et al., 2014; Jeffries, 2014). Quest Atlantis, Opensim are 3D/VR platforms, Wonderland, Active Worlds, World of Warcraft, and, with Second Life being the most common one (Jenson & Forsyth, 2012).

Virtual Reality (VR) is usually distinguished by its immersive nature, 3-dimensional features, motion sensors that are based on the concepts of ‘presence’ and ‘representation’, which the user combines with a video or computer-generated simulation and using a monitor or headset device (Cao & Cerfolio, 2019; Lopreiato, 2016).

An environment of Virtual Reality Simulation (Immersive and Non-immersive)

Virtual reality technologies create 3D spaces known as virtual environments (VEs) that users experience and explore personally, and they have a sensation and feeling of presence (Witmer & Singer, 1998). In addition, simulating locations as possible and accessible to users a feeling of actually having been somewhere. On the other hand, many factors put up the sense of presence: realism, sensory input distraction, and control.

(Di Blas & Poggi, 2007).

Simulation components include the level of immersion, physical form of the patient, and fidelity (Cant et al., 2019). So, VR-based applications contain different levels of immersion, ranging from patient representations on a computer to fully immersive head-mounted devices (HMD) with placement tracking technology (Ferguson et al., 2015; Ludlow, 2015; Ausburn et al., 2010).

The essential goal of virtual reality learning environments present experience and engagement for students in cooperative learning by a multidisciplinary and professional group working simulations as initiating emergency procedures with other real-life healthcare workers such as students, nurses, doctors, support workers, ...etc. (Cugelman, 2013).

Immersive Virtual Reality (IVR):

Learning occurs when learners are involved in actual experimentation (Kolb & Kolb, 2017). The VRS provides reflective principles and immersive and for empirical learning to promote critical reflection. A combination of knowledge acquisition, action, and engagement helps the learners' contact emotion with the client (Verkuyl & Hughes, 2019).

Kilmon and colleagues (2010), described immersive virtual worlds as where users handle on-screen descriptions of themselves in an extremely realistic scenario, becoming separated from the external environment (Kilmon et al., 2010). Immersive Virtual Reality (IVR) is defined as a tool formed of interactive computer simulations sense participant's attitude, behaviors, action, and augment the feedback to one or more senses, providing the feeling of being intellectually engaged in the simulation field (Sherman & Craig, 2018), it involves four essential parts;

- A virtual world - the space manifested as a medium, generated by computer simulation software and programmed to follow a real-world environment.
- Immersion – mental and physical sensation of being in the virtual environment, using individual head-mounted displays (HMDs)
- Sensory- feedback – An IVR system presents immediate sensory feedback to the participant based on their real situation as tracking.
- Interactivity - where the system reacts and replies to the operations of the user (Dubovi et al., 2017; Sherman & Craig, 2018).

Non-immersive VR (Computer-Based VRS):

In this form, although the user passes within the virtual world activity combining through computer technology, there is no sense of “whole immersion” in which the user is totally realized inside that environment (Simpson, 2006). The user can form the scenario from his/her computer still without joint to the real world.

Non-immersive VR described as desktop VR, and it is in the style of glass into a virtual world presented on a computer monitor and interaction via a mouse (Choi et al., 2016), Users might build an image of themselves named an AVATAR to socialize with other users and the virtual environment itself, by using a computer device (Irwin & Coutts, 2015).

Non-immersive VR is an affordable and easy strategy, for producing manageable and broad-ranging scenarios that concentrate on cognitive and hand-operated skills in nursing (Lapkin & Levett-Jones, 2011).

Historical Development of Virtual Reality Simulation

Virtual reality simulation has been used for more than four decades. So, one must identify and define the social contexts of the concept during a concept analysis involving both the past and future, time, and context are what create meanings for a concept (Wilson, 1969), which agrees with Meleis for describing the meanings that are derived from a social context, and explanations differ across disciplines, periods, regions, and cultures (Meleis, 2011).

In the late 14th century, the adjective “virtual” has been in use. Since 1959, the term has been used in the computer sense.(Manur et al., 2018) In 1838, Charles Wheatstone tried 3-D by formed a stereoscopic motion picture and believed that the human brain deals with the different two-dimensional pictures from each eye. (Zone, 2014). **(See Figure 1)**

Figure 1:

The Stereoscopic Motion Picture and the Optical.

In the 1930s, Pygmalion’s Spectacles was the second try through describing a goggles-based virtual reality by science imagination writer Stanley Weinbaum, that explained the idea of a pair of goggles that able the wearers to get in fully action of a story during touch, sight, taste, and smell. (Williams, 2015) **(See Figure 2)**.

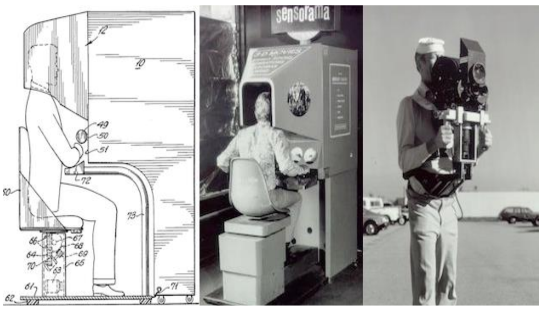
Figure 2:

Science Fiction Story Foreseen Virtual Reality.

In 1938, Antonin Artaud described the delusory environment of objects and characters in the theatre, and considered the initial available use "virtual reality" in 1958, as well as it used in a novel of The Judas Mandala of a science-fiction context for Damien Broderick in 1982 (Šenovský, 2017). On the other hand, in 1939, was introduced View-Master at New York World's Fair, as the first precursor to today's head-mounted displays that was a device for viewing photographs based on the principle of showing a different image to each eye to shape a stereoscopic 3D picture (Murray, 2017) **(See Figure 3)**.

Figure 3:

Morton Heilig's Sensorama Virtual Reality.

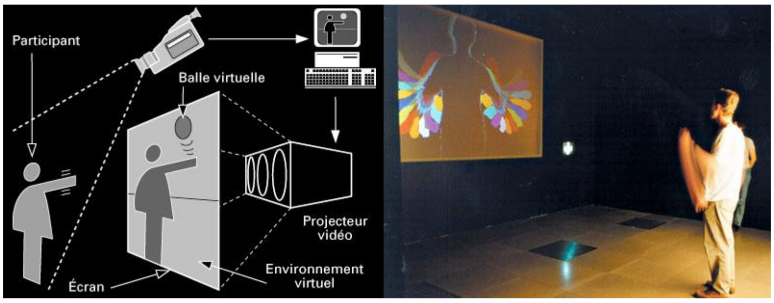


In the mid of 1950s, Morton Heilig had created films that has 3D, colors, sounds, smells, and feelings of gesture. (Jonassen, 2004). In the late 1950s, similar to what we name 4D experience today. Douglass Engelhart as an skilful in digital technology began to visualize the hulking computers as a instrument for digital could be shown by using a computer linked to a screen to solve problems. Thus, the cooperation was the beginning of personal computers, computer graphics, user-friendly computers, and the onset of virtual reality simulation (Lemle et al., 2015a, 2015b).

Later in 1960, the Telesphere Mask was invented by Morton Heilig that was the chief VR head-mounted display (HMD) that the receiver provided 3D vision (Plant & Murrell, 2007) **(See Figure 4).**

Figure 4:

Morton Heilig (HMD) Virtual Reality.



By the 1970s, initial computer-based graphics were switched with videos and models that let simulation work in actual-time. In 1976, the famous science fiction American film movie Star Wars first operated computer-generated special effects, as well as movies of Terminator and Jurassic Park. And also, by 1979, Eric Howlett was shaped a stereoscopic image with a field of view wide enough to create a conclusive sense of space and provides head-mounted displays as the basis most of the current virtual reality in which military technologists had begun to used, as well as in 1993, Sega announced a head-mounted display add-on for Sega Genesis game console called Sega VR (Lemle et al., 2015b).

By the 1980s, video game labour began to expand as a result of enhanced hardware, software, and motion control simulators. In the mid-1980, scientists, imagery, businesses, the military, and entertainment wanted interactivity environments which they usual after high-performance computers. Then, the term “Virtual Reality” was invented by Jaron Lanier in 1987 (Lemle et al., 2015b).

In 1995, many companies tried to penetrate the VR market as Nintendo Virtual Boy and Forte Technologies, but they failed to reach sales targets because of technical difficulties and reports of headaches and nausea during playtesting (Lemle et al., 2015b).

In the first decade of the 21st century, the gaming industry appeared to have lost interest in the technology of virtual reality and considered it a bad business decision (Murray, 2017). Continuously, the Oculus Rift emerged in the second decade of the third millennium (in 2012) that raised almost ten times its initial target of US$250,000 after receiving donations from 9,522 backers totaling US$2,437,429

(Oculus, 2012) **(See Figure 5),** which affected several other companies like HTC, Sony, Google, and Samsung to start to develop their virtual reality solutions. Oculus VR, LLC itself was bought by Facebook in 2014 for US$2.3 billion (Murray, 2017).

Figure 5:

Oculus Quest Virtual Reality.

Development Virtual Reality Simulation in Nursing Education

Firstly, virtual reality was used in games, after that in military and airline, manufacturing, e-commerce, construction, education, and production (Bayraktar & Kaleli, 2007). Software designers create steps to promote instructional virtual worlds. So, virtual simulation is a complementary tools to conventional forms of simulation (Foronda & Bauman, 2014).

In the education field, VR was applied in flight, training, and the military (Kaleci et al., 2017). In 1995, educational video game was developed in Japan by Packy and Marlon for diabetes children to educate them on their self-care behavior (Lupton, 2014).

In the health care field, virtual worlds provide a unique environment for online team-based collaborative learning(Rogers, 2011). In which, a diversity of VRS applications emerged practicing psychomotor tasks, disaster response, and physical assessment, … etc. to support health care education (Jeffries, 2014; Stokowski, 2013). This kind of simulation is a powerful learning tool that improves conveyance and persistence of learning, allows interactive learning and problem analysis, and attracts the active participation of students (Huang et al., 2010).

In the nursing field, Nehring and Lashley (Nehring & Lashley, 2009)mentioned that VR was the first described and used in nursing research by Phillips (Phillips, 1993). In 1996, a prototype for intravenous (IV) catheterization was developed by Merril and Barker at the State University of New York (Merril & Barker, 1996). In 2007, Skiba discussed the use of Internet-based interactive virtual environments among nurses within a classroom or anywhere in the world can assess the approach of the patient situation by an individual or within a team (Nehring & Lashley, 2009).

In 1998, the first model of VR in nursing is the CathSim Intravenous Training System (CathSim ITS) that caused a drop in intervention-related pain, which makes participants more confident and motivated (Chiang et al., 2017; Jamison et al., 2006; Vidal et al., 2013).

Afterward, clinical virtual simulation that drawn on a computer screen, which places actual people in a vital role operating simulated systems through training their communication skills, and decision-making (McGaghie et al., 2010). In addition, it depends on the concept of a virtual patient and dynamic patient scenarios, a variety of multimedia that are supported by physiological algorithms (Berman et al., 2016). Then, the user fits a part of the VR as forms the environment in reply to guidance and problem-solving technology (Simpson, 2006).

Benefits and Limitations of Virtual Reality Simulation

Virtual Reality Simulation (VR) Training immerses learners in a digital environment where they meet real-life scenarios that experiment with their knowledge without encountering real-world risk. There are overarching benefits' and limitations to its use, involving:

Benefits of Virtual Reality Simulation

Simulation-based educational interventions involve the ability to repetitive practice learning, offer immediate feedback, the blend of simulation into the curriculum, the capability to detect the difficulty level (Barry Issenberg et al., 2005). In addition, this form of simulation supports the adaptability of different types of learning strategies enjoyable for learners and encourages interactive learning through active participation, as well aids the acquisition of inter-professional knowledge, skills, and attitudes and nourishes the gain of critical thinking skills at the person and team-based levels (Jeffries, 2015).

VRS permits control, observation, and expectable outcomes by stimulating trial and error learning through immerse students into realistic and real-world scenarios and experiences in a risk-free environment "free-play" while minimizing face-to-face time and teaching resources (Ludlow, 2015), through improved asynchronous learning opportunities that students can practice simulation in their own time away university and clinical environment, diminishing costs for faculties/organizations, decreasing the number of sources asked for simulation training (Chang & Weiner, 2016; Ferguson et al., 2015; Ludlow, 2015).

VRS can help wearable physiology sensors, to get data on the student's respiration rate, heart rate, and skin conductivity, granting insight into the level of stress encountered by the learner (Chang & Weiner, 2016).

Consequently, VRS enhances learners' confidence, engagement, creativity, concentration, and motivation, and permits them to merge theory into practice and learn at their individual pace (Nehring & Lashley, 2009). In addition, it offers them the chance to training anywhere, anytime, and in realistic and safe environments without fear of mistakes and harming patients (Bülent et al., 2004). Learners participating in VRS become more successful, confident, and comfortable in real practice settings because they learn in an experimental and valuable case (Bayram & Caliskan, 2019). As well, learners can practice complex, dangerous, and costly cases that they are less likely to face in real setting (Bayraktar & Kaleli, 2007).

Limitation of Virtual Reality Simulation

VRS has the development time, attempting and evaluating the simulation, and utilizing it by distributing it through several platforms. Thus, will be needed more time and investment reliant on the level of realism and detail within the simulation in which can be highly expensive costs when thinking about VRS (Chang & Weiner, 2016; Ludlow, 2015). To positively device this technology into teaching and learning curricula, educators and learners necessitate exercise on the use of the equipment that can be at risk of faults or problems, and even safety and updates to remain operating optimally (Chang & Weiner, 2016).

Using a virtual reality headset has a lack of flexibility if programmed to work the same. So, students require to engage with VRS based on a variety of VR scenarios by updating complex scenarios to prevent linear and structured scenarios from becoming more boring, predictable leading to a lack of interest in skill practice (Ferguson et al., 2015; Ludlow, 2015). On the other hand, some VR users also feeling motion sickness and dizziness when using immersive HMD equipment, especially persons who need to remove glasses (Munafo et al., 2017). Furthermore, there are several limitations issue may encounter the users of VRS, which involve:

- Interface issue that requires a particular running system to appropriate the software as well as defining the software to in-house mode only, which may need technical updates, and software, hardware, and accessories may require updating to keep the program current (Salovaara-Hiltunen et al., 2019)

- Quality issue related to confirming that VRS has the suitable material and provides the quality of the nursing program and curricula, and several of the concepts that are required for fitting development of VRS for nursing education, as the method of learning, nurses should be elaborate in the development, scope of nursing practice, professional conduct, practice standards and ethics (Lemermeyer & Sadesky, 2016)
- The cost of VRS designs and development is one of the barrier for healthcare institutions and faculty, which includes the development costs connected with music, voice-overs, programing as well as a examining (Margreteh, 2017)And also, cost of equipment storage, maintenance, and conservation, classroom, and laboratories (Mancuso et al., 2020)
- Real patients unavailable (VRS no healthcare). While, healthcare is the concerned of humans, and thus, VR is set by humans, it is almost an explanation for patients signs and symptoms may impractical experience with a disease state (Aksoy, 2019). Learners can also inquire real-life patients any type of questions and receive feedback on those questions. With virtual/ simulated patients, learners can only provide questions that were pre-programmed for the game to reply (Aksoy, 2019; Salovaara-Hiltunen et al., 2019).

Consequently, these limitations issue lead to the mention that VRS is a supplemental tool for the education of students and nurses to help create a safe environment for the successful learning of unique and innovative skills and enhance the confidence of those learning.

Virtual Reality Simulation in Nursing Education

Nursing education has shifted significantly, ago the days of Florence Nightingale, from the trial period practice to academic-based education and training (ANA, 1965; IOM, 2010). Thus, nursing has been growing recognized as a distinguished academic profession and discipline requiring the combination of theoretical knowledge beside functional skills involving cognitive, affective, and psychomotor fields of learning (Aiken et al., 2014; Bloom, 1956).

Within the current practice of nursing education in the 21st century, and a global shortage of nursing who represent more than 50% of the current shortage in health workers (WHO, 2020), caused by the inadequacy of training programs, sites, and nursing faculty, increased demand for student clinical placements, unfamiliar ethical, legal situations, and complex of patient cases, budget constraints, fear of making mistakes that turn affect clinical learning (Juraschek et al., 2019; Pepin et al., 2017). So, new nursing graduates working in complex health care environments necessity appropriate education, performing effective skill practices, and taking rapid decisions (Hayden et al., 2014).

Simulation-based clinical education became an essential learning strategy for the improvement of nursing skills from the initial 2000s, which increased using from 3% in 2000 to 87% in 2010 (Rizzolo, 2012), which involving varieties of activities using low, medium and high-fidelity computerized task trainers and mannequins, scenarios, standardized/simulated patients, virtual reality, screen-based computer simulations, peer-to-peer learning, partial task trainer models, and haptic systems (Nehring & Lashley, 2009; Weller et al., 2012).

The National Council of State Boards of Nursing (NCSBN) and the Institute of Medicine considered simulation-based education (SBE) is integrated new teaching/learning strategies that supplied an alternative to the real-world clinical environment to create the future nursing workforce to achieve quality and safe patient care, and let educators use different clinical learning scenarios, and draws on skills and concepts (Hayden et al., 2014; IOM, 2011a; Ruyak et al., 2018).

In nursing education, nurse educators have the essential role as learning facilitators that they meet active learners who can connect with unique purposes to their individual experiences and creating their knowledge over time (Liaw et al., 2014). In addition, an active and effective instructional environment based on challenges and learning objectives, foster learning, satisfaction, emphasizing recognition and recall knowledge over memorization, as well as reduce anxiety level among students (Pennaforte et al., 2016).

Nurse educators should address and inquire about the improvement and reach of innovative teaching/learning strategies to meet the individual needs of all students as using digital technology-driven simulation strategies, games, apps, and virtual environments that provide safe clinical practice opportunities that allow developing proficiency in basic nursing skills to reform nursing education and provide opportunities for students to practice and integrate knowledge and skills, as well as, enhance psychomotor skills that will assist nursing students' skills before clinical rotations and enable them to focus on the underlying theories that advance nursing practice while caring for patients (Kardong-Edgren & Mulcock, 2016; Liou & Cheng, 2014).

Many generation students today's have been grown in the digital world, multiethnic, multicultural, and global world with technology in all fields of life as education, communication, music, entertainment, as well as, exposed to more computer-based learning techniques and social networking that reflect on a common way student engage with each other both in and out of the classroom and comfortable engaging in virtual simulation (Benner et al., 2010). The newest generations have known as Y/Millennial and Z/I entered the nursing workforce, thought and learned differently, and implementation of a diversity of new teaching methods than prior generations (Ertmer & Newby, 2013).

Nursing students need to meet the challenges of classroom learning that influence their learning abilities, motivation, and performance, as they will often attempt to learn and perform tasks to provide safe patient care (Lunenburg, 2011). So, they have to perform nursing skills before clinical turns that let them match between theory and practice by utilizing required knowledge and perform psychomotor skills that increase their self-efficacy and reduced their anxiety (Gonzalez & Kardong-Edgren, 2017).

Through virtual reality simulation, students have a difference of practical chances to replicate clinical scenarios and make instant feedback, reflections, and decisions in which they encounter real-life situations and obtain virtual reality experience without getting any risk, help students in practicing various assessments of nursing skills, complex skills of problem-solving, critical thinking, as well as enhance their satisfaction and self-confidence (Cant & Cooper, 2017; Flott & Linden, 2016; Hayden et al., 2014)

Virtual reality simulation is advaned technology that has more maintained awareness with application in nursing education (Chang, 2018), there is 98% of participation students recommended using it that helps them to master the learned concepts (Foronda et al., 2014). In addition, the environments related to virtual reality simulation preparing students for real clinical expectations through promoting competencies demanded practice and clinical decision-making skills safely (De

Gagne et al., 2013; Verkuyl et al., 2017). As well as, it improves training effectiveness, and enhances learning retention and acquisition of knowledge and skills (Verkuyl, Atack, et al., 2018; Verkuyl et al., 2017).

The Effect of Virtual Reality Simulation on Acquisition of Psychomotor Skill and Anxiety Level in Nursing Education

Acquisition of psychomotor skills requires the ability the utilization of theoretical knowledge (cognitive skill) to a mechanical skill by recreating clinical scenarios, which interpreted as the ratio of participants' knowledge of concepts and the capability of a participant to explain a skill or technique (Berman et al., 2016; Kyaw et al., 2019; Smith et al., 2016). As consequence, Bloom (1987) defined mastery learning as an approach in which students gain a detailed description of the content and enough time to complete the activities (Bloom, 1987). Acquisition of psychomotor skills is an essential portion of nursing education as well as the basis upon which teaching/learning strategies are chosen, it linked with understanding, the cognitive, and affective field features as an attraction for values and attitude (Ross & Burrell, 2019). Moreover, the acquisition of skills is directly related to nursing performance to answer the patients' needs. So, nurses should be masters the skills related to nursing interventions (Lin, 2016).

The psychomotor field is evaluated by examination of a student's capability to complete a task through accurate motor progress by using rating scales or a checklist requiring steps of skill to evaluate performance in a virtual reality simulated setting (Billings & Halstead, 2015). Then, psychomotor skills education starts with the educator lecturing on the skill using the demonstration method and continues with practice opportunities and feedback for the student until practical competence is achieved. So, stress, anxiety or the fear of making mistakes prevent student learning (Baillie & Curzio, 2009).

The use of technology and simulation-based education such as VRS help students move from the cognitive to a psychomotor phase to attain a mastery approach to learning, promote teamwork, enhance problem-solving skills, information retention, and support learning (Gaberson & Oermann, 2014). In which VRS having educational content promoting the students to learn in clinical environments, three dimensional and realistic without risking patient safety, with instant feedback and a set of odds for practice (Bauman, 2012; Ma et al., 2014).

VRS technology aids constructivism theory by directing on learning actions from learners interactively that enable diminishing the gap between student knowledge and real experience (Huang & Liaw, 2018). So, simulation-based education is any interactive activity based on a collection of rules, constructions, and strategies directed toward a clear and achievable goal, which involves a challenge, competition, motivation, trial and error, immersion, and engagement, continuous feedback that enables students to monitor their progress and practicing procedural skills (Bauman, 2012; Wouters et al., 2013).

Furthermore, VRS viewed as an innovative resolution for defeating organizational and situational limitations correlated with experiential clinical skills development and as a complement to other simulation strategies to boost the quality and safety of clinical practice (Chen et al., 2020; Cobbett & Snelgrove-Clarke, 2016; Kilmon et al., 2010; Vidal et al., 2013), which considered as an essential learning environment that exceeds the conventional learning class boundaries, place, and space, and making as virtual learning laboratory which empowers abilities, learning skills, and creativity that enables educators to devise and deliver complex knowledge in a visually attractive way (Boada et al., 2015; Ma et al., 2014), through motivating and supporting strengthen students' skills that enable the transfer of knowledge to practice in the clinical application, incorporate feedback to achieve the desired outcome, and allow students unlimited practice of procedures decreasing their anxiety(Chen & Teh, 2013; Chen et al., 2020; Ko & Kim, 2014).

VRS is emerging as an effective teaching strategy to promote the acquisition of basic psychomotor skills and validation in nursing (Smith & Hamilton, 2015), which it simulates real-life procedures and nursing experiences can allow nursing students to follow skills in a safe situation without risk to patients, improves the performance of learners that leads to reduce student anxiety and improving self-confidence and self-efficacy, and prepares them to become a professional nurse in practical skills (Chang, 2018; Dreesmann, 2018; Foronda et al., 2017; Smith & Hamilton, 2015; Vidal et al., 2013; Weiner et al., 2019). virtual reality application in teaching nursing skills is necessary in terms of quality of education, in which students can learn scientific facts faster and expertly (Fairén González et al., 2017; Kızıl & Şendir, 2019).

Anxiety is an emotional response within a person to present or create warnings to one's security. It may be a motivating force or adverse, and it influences one's sense to learn. Optimal learning takes place when one is moderately anxious and declines in the presence of high levels of anxiety.(Campbell, 1985) Kleehammer, Hart, and Keck (1990) identified fear of causing an error, beginning clinical experiences, a diversity of clinical skills, and being observed/ assessed by the faculty as circumstances of high levels of anxiety among student nurses (Kleehammer et al., 1990).

In nursing education, Non-traditional teaching strategies for the psychomotor learning domain as a visualization that is a mental representation of reality in the absence of actual stimuli as an example the mental image suggested by the expression "prick of a pin" or "reaching for a high shelf"(Eaton & Evans, 1986, p. 193), and it is a teaching strategy that has been associated with improved performance, reduced anxiety levels, and cost-effectiveness (Vines, 1988).

There was various literature addressed the relation of virtual reality simulation and anxiety level among students, as Overstreet (2008) indicated in his study that confronts patients simulation engaged students a safe way for the interpretation of their emotions, which can lead to decreasing anxiety when students meet real-life care states. In addition, Vidal et al.(2013) and Dreesmann (2018) addressed that virtual reality applications provide to reducing student anxiety, enhancing self-confidence, improve their clinical decision-making skills, furnish feedback at the end of the student's application, which helps to get the accurate technique, and allows the unrestricted implementation of clinical scenarios in a risk-free environment.

The studies of Goldenberg et al.(2005) and Wilford & Doyle (2006) indicated that virtual reality simulation has the transfer of knowledge that easy happened when reduce anxiety and enhance self-confidence in real clinical environments, which aim for students to perform and apply what they learn in simulation to real settings.

There are various virtual reality practices are used as teaching strategies, include suctioning a tracheostomy tube (Noyudom et al., 2011), chronic obstructive lung disease (Tsai et al., 2015), post-op morphine treatment (Lancaster, 2014), cardiopulmonary resuscitation (Boada et al., 2015). In addition, merging the knowledge of anatomy and physiology during acting and confirming clinical competency in particular procedures such as pain management, nasogastric tube placement, intravenous and urinary catheterization (Choi et al., 2017; Guo et al., 2015; Ismailoglu & Zaybak, 2018; Jöud et al., 2010). And also, offering emergency and disaster training, decontamination training, and intubation (Farra et al., 2015; Vincent et al., 2008).

VRS keeps students' intrinsic motivations and satisfaction enhances knowledge and information retention in the learning process, promote decision making, communication skill development, and clinical reasoning that allows nurse educators to teach main nursing skills (Işık & Kaya, 2014; Ma et al., 2014; Sezgin, 2016).

Design Features of Virtual Reality Simulation Software

Development of VRS Software

Game design structures are central to developing a VRS that learners will want to play. Gaming components have assisted the program to critical thinking and engagement, knowledge retention, reinforce motivation (Cooper et al., 2015). VRS built based on an instructional design ADDIE model that nursing students can autonomously learn clinical skills, improve their performance and demonstrate the ability to transfer cognitive processes required for performing the tasks under normal operating conditions (Filatro & Piconez, 2004; Weaver, 2011).

Instructional Design and ADDIE Model

According to Branch (2010), instructional design is an orderly process that used to build training and arranging programs in solid and a steady form. In addition, it is a puzzling process that is interactive, dynamic, and inventive which is characterized as learner-cantered, focusing meaningful performance, oriented goal, measured outcomes, procedures depend on experimental evidence, self-correcting, and interactive. on the other hand, it lets educators imagine the complete picture to create rules for managing instructional design processes(Branch, 2010).

Coll, (2004) described the techno-instructional design concept by indicating the dimensions of the pedagogical and technological. In the pedagogical dimension it is essential to recognize content development, improvement, and implementation, plan the activities with suggestions and guidelines that the benefit of the technological materials in the prepared plan and develop activities to assess the processes and outcomes, as well as the goals, and skills of the virtual training (Coll, 2004). Whereas, the technological dimension has the selection of suitable technological tools of the training process to be achieved, possibilities and limitations to be analyzed, such as the virtual platform, software applications, multimedia resources (Coll, 2004). So, using instructional design models is necessary for having appropriate teaching strategies with students and obtainable equipment for teaching activities to increase the learning impact and eliminate weaknesses in traditional instruction.

Virtual reality design and development requires merging an instructional design model; based on behavioral, constructivist, and cognitive learning approaches that adapt to learning environments, which must provide the student the potential to select various methods to reach knowledge (Giraldo, 2011). In addition, subjects are accurately designated and obtainable to the student using instructional and virtual tools for interface; it includes presentations giving as graphics and sound and integrated into multimedia. So, the student has systematic and programmed contact with learning proposals and contents that transfer from simple to complex (Gamboa et al., 2019)

In the 1970s for education reasons ADDIE model was developed by Florida State University's Center for Educational Technology for the US Army (Branch, 2010). ADDIE is one of the most popular instructional design and development models, it is a relatively simple model, valid for any kind of education, and sharing of other design models (Ferriman, 2013). And also, the ADDIE model can be adapted for particular design programs, which create concurrence between goals, objectives, strategies, and evaluation of the consequent program (McMurtry, 2013).

Gagne, Wager, Golas, Keller (2005) defined the ADDIE model as an umbrella term that is related to a set of models that take part in a combined underlying structure and is an acronym referring to the main processes: Analysis, Design, Development, Implementation, and Evaluation. Furthermore, it offers a step-by-step assissting instructional designers plan and creates training programs with a framework to make certain that their instructional products and processes are effective and efficient (Gagne et al., 2005). On the other hand, the ADDIE model described as iterative in design, can re-analysis and possible modifications being made were convenient with an evaluation of each stage (Bates, 2019).

ADDIE Model in Nursing Education

The ADDIE model is considered familiar because its similarity with nursing process; it is a useful tool for educational and practice performance development, supplies a useful framework(Sezer et al., 2013), it focuses on learner-cantered, it is used to create a learning environment through blending with educational instructional strategies, in which learning and skill performance supply effective training outcomes through using of the model's processes, transferring training from fundamental knowledge to strategic skills, and developing learner to mastery-skill outcomes (Kozlowski & DeShon, 2004), which this increases efficiency and reduction of errors in the instructional design of the training program, and providing a method to treat the complexities linked with learning space(Branch, 2010; Gustafson & Branch, 2002).Virtual reality learning environment in nursing education is created based on ADDIE instructional design model, where associates with a systematic process recognizing theories of learning, thematic contents, technological medium, and the instructional strategies allowing creating environments in an interfered way and encourages the knowledge-building processes (T.-C. Hsu et al., 2014).

In clinical procedure skills, creating a virtual environment is based on constructivist theory, which provides better opportunities to design training actions and establish professional skills (Drljača et al., 2017). In this regard, Góngora and Martínez (2012) have indicated that teaching based on models allows students to use improve their knowledge and new conditions for applying and solving conflicts, and learning design is an ideal direction to achieve the educational needs. In addition, educators try to utilize creative tools in teaching-learning processes that are linked to the development of the knowledge-based society (Góngora Parra & Martínez Leyet, 2012).

Frota et al. (2013) explained in their study about the instructional design of technological education to teach peripheral venepuncture to nursing students as an effective way creating new opportunities to retain information and communication, concepts structurally associated, easily for students accept education, providing an interactive distance perspective to improved learning (Frota et al., 2013).

Cheung (2016) also described that the ADDIE model of instructional design model helps educators to develop their curricula to teach, diagnose, and manage different procedures as chest radiographs, and respiratory diseases(Cheung, 2016). Over and above, ADDIE instructional design is one of the significant strategies that help to establish nursing roles, evaluate tasks, and strengthen clinical judgment (Dillard et al., 2009). As well, virtual reality simulation is an effective training tool in the acquisition and strengthened of skills, and in improving students' knowledge and attitudes, which makes them feel confident when learning process is created and integrated with the virtual scenarios of skills in a systematic way (Herrera & Sander, 2015). Thus, VRS have to be part of the first year nursing curriculum, for training students in clinical setting (Curl et al., 2016).

ADDIE Model Stages

The ADDIE is one of the most common instructional design models that point to the major processes: Analysis, Design, Development, Implementation, and Evaluation (Ferriman, 2013), it outlines more dynamic and flexible guidance for developing learning objects (McGurr, 2011). ADDIE stages: (Andrea, 2019; Frota et al., 2013; T. C. Hsu et al., 2014)**.**

Analysis Stage

In this phase, the objectives of the system, usable content and means to support it, the needs of learners and instructors, the characteristics of work and learning environment, available technological resources of the users that involved the system, considered essentials requirements. However, it has various elements as:

- Roles interested in this stage: the director has an active role, project manager, system designer, system administrator, knowledge experts, the programmers, the artists, the Webmaster, the instructors, the apprentices, and their administrators.
- Objective analysis: An instructional objective is what the learner will be able to do at the end of her participation in the learning unit.
- Analysis of content and means to obtain it: course or content which probably to be placed in a web environment that should be explained in detail and the media in which support these contents.
- Learner Analysis: those who do not could participate in traditional learning processes, and they would benefit from the new model; taken in the mind the age, language, motivation, communication skills, openness to change, etc.
- Instructor Analysis: The instructor role in this model a guide or facilitator of the learning process of the participants, the transmitter of knowledge changes, and is highly dependent on the interaction that takes place out during training.
- Analysis of the work/learning environment: The most important of learning based on virtual reality technologies is that it reaches the apprentice's job. Thus, it is necessary to know the form of the environment.
- Looking at aspects such as Network capacity and support new information load (multimedia, images, video, etc.), acoustic, and interaction.

- Analysis of the technological infrastructure: If it is available to the user, what infrastructure is needed by user and instructor, and it is vital to provide a support service technician that facilitates their learning process

Design Stage

The design of the environment Virtual reality learning must take place since otherwise, the development of the system becomes more complex and system maintenance becomes an almost impossible task, leading to the progressive degeneration of the system. This phase, has the results of the analysis stage, making decisions related to the requirements extracted. By making a good design, generate many benefits such as Attraction of users, retention of interest in users, increases in audience size, and facilitates system expansion.

In this stage, it will be specified the instructional design of the system, the evaluation system, the navigation and presentation structure, and the interface design. The elements of this phase include:

- Roles that participate: the director, project manager, system designer, system administrator, experts in knowledge, programmers, artists, Webmaster, instructors, and editors.
- Instructional (educational) design: include the elements of instruction that let motivating the learner, specifying what will be learned, remembering and apply the knowledge acquired, provide guidance and feedback during the process of learning, assessing the understanding of learners, and enriching or correcting the trainees in areas the instructor considers (Ritchie & Hoffman, 1996). In addition, activities can be designed to help achieve the previously set objectives, which apply to education based on virtual technologies and support creative, critical thinking, and learning cooperative.
- Evaluation is important in virtual educational environments since it is one of the ways through which you can observe the progress of the learners and they in turn can see their advancement level. In addition, it is possible to know if the objectives are being achieved proposed or if the design of the learning unit needs to be modified.
- Presentation design: is the mental model of the structure of the virtual class that the participants of the same make to measure that navigate through it. The presentation scheme is how view and to navigate through the system. In which, the quality of the presentation scheme affects how successful people

will find or not find what they need. If the structure of the presentation does not make sense, for the user or if it is very complex then he will be limited to carry out his tasks.

- Appearance or interface design: it is the means through which the learners interact with the system and if not properly designed will make it difficult for learners to work. In addition, the speed limitations of transmission, the possible screen configurations of the learners and the instructors, and site colors. And also, the system must be readable, accurate, and unique and it must support different types of users, colors must be suitable, the graphics should be relevant, and the layout or how the page elements must be consistent.

Development Stage

In this phase, where educators develop and improve the ideas of the design, plans calling for the inclusion technology. It includes defining the evaluation processes and outcomes that confirm a link between the real and the expected outcomes. Development phase is essential to create the process for the authorization and production of the tools. And also, the work is implemented with the producers, practical exercises and learning environments are built.

In this phase, developing the VRS system outlined vital aspects as logical sequencing of the content, the associated activities, timing for the learners to work through the program, development of the Programme Content, as well as objective of the program. The elements of this phase include:

- Roles that participate: the project manager, system administrator, programmers, artists, and Webmaster.
- HTML: The HTML language will be present throughout the virtual environment of learning for components expository; it is the basic building step for web pages, which used small segments of programs as Javascript, ActiveX, or Java applets.
- Multimedia on the web: as animation affects inactive and expository components, tools such as Shockwave and Flash allow incorporating sound and vectoring graphics making the learner's experience enriched with the interactive applications.
- Virtual reality: Simulations are one of the ways that computers offer to shape the world; in the educational context, they offer an opportunity to

experience an experience in a micro world, hence virtual reality can be used for these purposes.

Implementation Stage

This phase includes everything that needs to be in place to ensure proper system operation with minimal trouble and maximum satisfaction of the participants. These tasks must be carried out in other traditional learning environments, but taking advantage of the information and communications, become more efficient and easier to execute. Elements of this phase:

- Roles that participate in this stage: the project manager, system administrator, instructors and trainees, and the Webmaster.
- Installation and system configuration (Setup): it has an operating system that supports the virtual learning environment; the HTTP server that allows a website to be launched; the strategies security to allow access only to people who are members of the system; the resource center where all the materials will be placed, whether articles, videos, sounds or software relevant to the course; the FTP server that allows you to place on the server and obtain from it files for learner use; backups that avoid loss information in the event of a system failure.
- implementation before the course: The quantity and quality of preparation for a class in virtual reality have a direct impact on your success; virtual classrooms require much more preparation than traditional face-to-face classes, which is due to the factors that must be taken into consideration such as dependence on technology, lack of knowledge of technology by apprentices and lack of administrative support for learners web-based education methods, compared to traditional methods.
- Implementation during the course: getting to know each other, information management, group administration, adapt to change, advice for students, and administration of the distribution system.
- Implementation after the course: perform collection, analysis, and distribution of grades, storage of files and course material.

Evaluation Stage

This stage involves the review and testing of the program, including the use of the equipment and other technologies being used in the program, An evaluation, and review of the program is done throughout the program development stage to ensure the relevance and applicability of each module, the entire program is reviewed by subject experts to ensure that the objectives of the course and training objectives are relevant and met, through an analysis of the content material, evaluation methods.

In addition to evaluating learners, during the development phase of a virtual reality educational system, it is important to evaluate the same position that graphic design, virtual programming, and interactive segment creation require a good amount of human resources and time. Therefore, before investing these resources is advisable to review the system to ensure that it will be effective. With the evaluation, can determine which are the failures at the level of analysis, design, and development. Virtual reality education is a form of software and should be treated as such testing it before putting it into operation for the public.

It consists of formative and summative evaluation. Formative evaluation indicates the evaluation which become as the development phase promoting the knowledge transfer, while summative evaluation leads to the evaluation the conclusion of the ADDIE model process, it aids educators to know if the learning objectives are achieved that it prove or disprove the notion of knowledge transfer (Branch, 2010). Elements of evaluation phase:

- Roles that participate in this stage: the project manager, system designer, system administrator, knowledge experts, the programmers, the artists, the Webmaster, the apprentices, and their administrators, instructors, and editors.
- it is important to evaluate the learners, and the system, observing their impact on the target audience and on the organizations they target. In addition, virtual reality educational environments are evaluated in all their aspects:
- Content expert evaluation: consists of reviewing the content you want to transmit through the online learning system. This evaluation must be carried out done early in the process to avoid wasting time repeating efforts.
- Rapid prototype evaluation: errors in the design are identified and the reactions of trainees before finishing the full system.
- Alpha class evaluation: evaluated the effectiveness of the changes, and whether the materials are working properly (graphics, interactions, finished pages with their respective links).

- Beta class evaluation: This evaluation seeks to assess the adjustments made as alpha class evaluation result. It shows the development of the system with the instructor's presence.

Elements of Virtual Reality Simulation Software

Virtual reality refers to Fully immersive three-dimensional Oculus Rift headgear (Albanesius, 2014), which is an affordable virtual reality headset developed by Palmer Luckey (Davis et al., 2015; Parkin, 2014), and provides a sense of complete immersion in the environment through having two distinct images, each eye filling the wearer's peripheral and stereoscopic vision field (100-degree) at high resolution (Firth, 2013).

Haptic in VR is based on the sense of touch and used as an production tool to help incorporate graphic technology and repeat an interacting virtual environment (Claudio & Maddalena, 2014). In addition, Tracking devices, which let the situation of information be sent to the receiver giving the facility to regulate the location and view of the virtual reality and merging a high level of immersive with the VRS program (Tiala, 2006).

An avatar is a image of the person who is sharing in the virtual world, and animated characterization (Schwaab et al., 2011). It known as Habitat; has come from the 1985 (Trepte & Reinecke, 2010). An avatar can do nearly everything like real world, interest in decision-making, perform gestures that consider ideal for simulation by undertaking various forms such as skill of insertion intravenous cannulas, and hand washing, vital signs, patient charts, hospitals, simulated patients, and an interface that responds with equipment (Skiba, 2009).

Evaluation of Virtual Reality Simulation Software

Technological challenges occur with all virtual experiences that affect learners' and educators' experiences, in which the evaluation step is significant for creating experiences, optimal engagement, successful uptake (Verkuyl et al., 2016; Verkuyl, Romaniuk, et al., 2018).

The main design of VRS is involving making choices, receiving feedback, replaying sections, and obtaining results, helping to provide an interactive environment associated with gamification to simplify the game's flow, motivation to acquire skills, learners' concentration on tasks, and learning opportunities (Faiola et al., 2013; Johnsen et al., 2016).

When implemented VRS into the curriculum, the students will be directed to contact faculty and the development team to meet technology-related problems, Then, a critical examination of outcomes provides self-efficacy, knowledge, and satisfaction by incorporating and making changes in virtual simulation program (Verkuyl et al., 2017). In addition, in this step, software designers are utilized student comments to make technical changes to develop the game providing in each option point regarding to reflective questions, and a rationale to be interesting, challenging, and valuable (Verkuyl et al., 2016).

CHAPTER III

Methodology

This research; was conducted in two stages (Developing and designing virtual software and Quasi-experimental) study

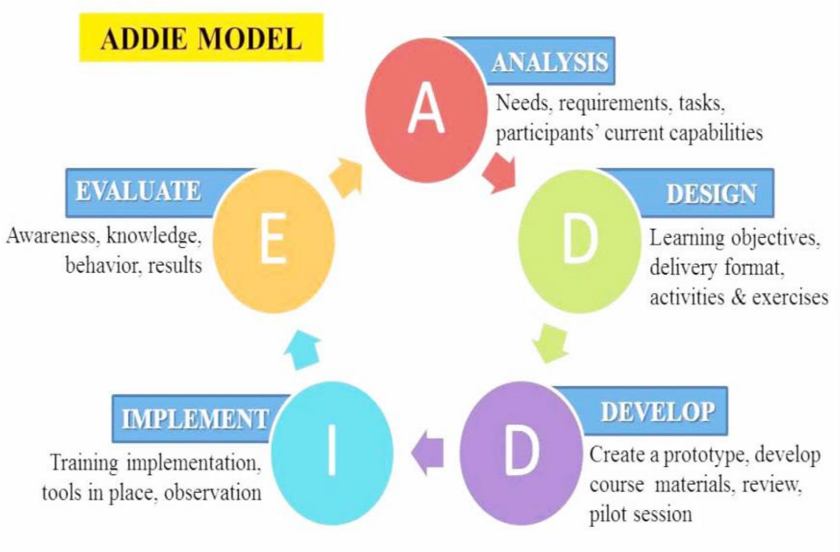
Stage I: DEVELOPING AND DESIGNING VIRTUAL SOFTWARE

Intramuscular Ventrogluteal Injection Virtual Reality Simulation

Virtual Reality Simulation in this study built on an instructional design ADDIE model as analysis, design, and development, implementation, and evaluation (**see Figure 6**), which enables nursing students with or without administered intramuscular injection in ventrolateral site experience to learn and practice related psychomotor skills. As well, it lets them autonomously learn a clinical skill/procedure enhancing their performance, and demonstrates the ability to transfer cognitive processes required for performing the tasks under normal operating conditions (Filatro & Piconez, 2004; Weaver, 2011).

Figure 6:

Developed virtual reality simulation program by using ADDIE model



Analysis phase

This phase was completed by performing needs analysis, learner analysis, and content analysis.

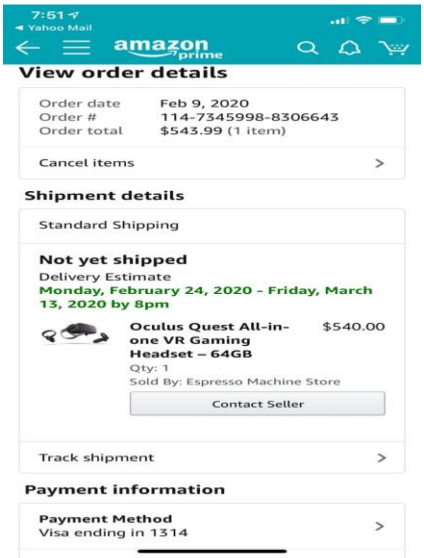
- **In the needs analysis**: the researcher indicated that the Intramuscular ventrogluteal injection skill is one of the basic professional skills in the curriculum of Near East University Faculty of Nursing. in addition, it determined as a learning requirement in terms of this study, as a result of interviews and observations with the relevant lecturers in the subject area, which was concluded that the students should learn the skill of administering intramuscular drugs. In this direction, it was decided to deal with intramuscular ventrogluteal injection skills, which is one of the important and basic psychomotor skills of nursing.
- **In learner analysis**: the researcher determined the First-year nursing students who did not take courses in the intramuscular ventrogluteal injection administration unit as the target audience. Then, she collecting socio-demographic data characteristics of the students (age, sex, occupational courses' grade point averages, having a personal computer, having education about computer/computer software, and having knowledge of virtual reality simulation/simulation software, having theoretical knowledge about intramuscular ventrogluteal injection administration and previous experience about intramuscular ventrogluteal injection administration), and also students were analyzed in terms of these characteristics. On the other hand, these characteristics of the students were used in the design process of the intramuscular injection ventrogluteal site administration simulation software, in making decisions regarding the speed of delivery of the content, the level of control of the student, the number of exercises/applications, the types, and levels of feedback and reinforcement.
- **In the content analysis**: the researcher determined and organized the content of fundamental nursing (theory and clinical skills in fundamental nursing skills administrating medication by intramuscular injection in ventrogluteal site), which was obtained through fundamental nursing. In addition, the research identified human, physical, and technological resources **(See Figure 7**), as nursing educators, students, laboratory prepared for VR simulation that has tools as a computer, virtual reality software, which was developed and prepared designs by Fiverr Company (https://www.fiverr.com). As well as VR headset (Oculus Rift), controller devices were obtained and purchased from USA Amazon Company **(See Figure 8)**.

Figure 7:

Content Analysis Related To Physical Lab Resources.

Figure 8:

Oculus Quest Headset Amazon Company.



Design phase

As a result of the data obtained during the analysis phase, and the interim evaluation, the researcher created content of each learning objective, confirmed that the subjects that included the content were interconnected, complementary and continuous, and the subject headings were arranged following the principle of succession, taking into account the learning principles from simple to complex, from concrete to abstract and from general to specific.

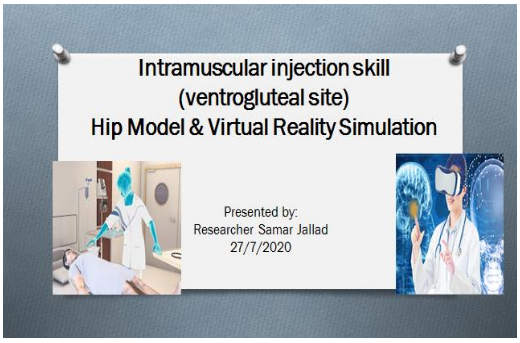
The researcher decided that the students could learn the intramuscular ventrogluteal injection skill, which has a high risk of harming the patient, with the virtual reality simulation software that was chosen as an interactive learning environment that allows student control, ensuring active participation of students in the teaching-learning process and offering a safe environment.

At this stage, target behaviors for the cognitive, affective, and psychomotor domains that students will acquire in the teaching-learning process were taken into account. The researcher in this stage designed the idea of used a VRS-based learning environment that supports immersive learning for the teaching of fundamental nursing skills, through obtained of a virtual headset (Oculus Rift), controller gloves, and construction of the content in March 2020.

- **The content addressed** was a checklist related to administrating medication by (IM) injection in ventrogluteal site based on fundamentals of nursing book ninth edition (Potter et al., 2017)
- **Information standard**; the developed Course Guide containing the information as objectives, content for each Intramuscular injection (ventrogluteal site) procedure, performed steps. Also, prepared a presentation for this skill **(See Figure9)**.

Figure 9:

Presentation Design for Intramuscular Injection (Ventrogluteal Site) Skill.



- **Supplementary standard**; given the content contained within administrating medication by intramuscular injection in ventrogluteal site skill consists of (37) steps. In addition, the equipment that used in this skill proper-size safety syringe (2 to 3 mL for an adult), needle length corresponds to the site of injection, age, and size of the patient (for adult 1.5 -inch), small gauze pad, container nursing equipment, antiseptic swab, vial or ampule of medication or skin test solution, clean gloves, puncture-roof container **(See Figure10).** And also, medication administration record (MAR)**(See Figure11)**

Figure 10:

Intramuscular Injection Skill Equipment

Figure 11:

Medication Administration Record (MAR)

Medication Card

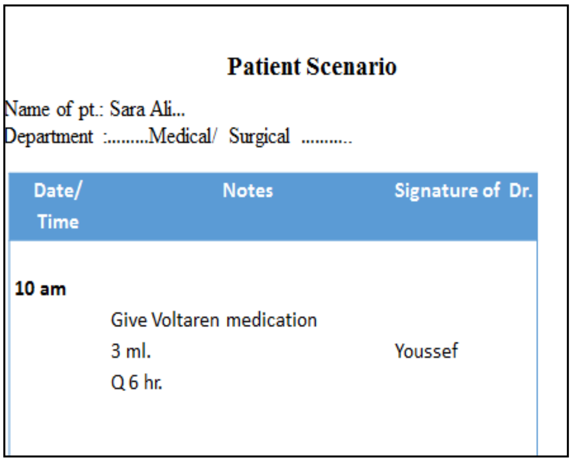
Name of pt.: Sara Ali
Department : Medical/ Surgical

Date/ time	Medication name	12 AM	6 PM	12 PM	6 AM	Signature of nurse.
26/8/2020	Voltaren Dosage 3 ml Frequency Q 6h Route IM					Nurse student NEU ....

- **Essential standard**; emphasized the activities, decision-making on a clinical case involving administrating by (IM) injection, the anatomy of ventrogluteal site, and a scenario related to these procedures.
- **Immersive and collaborative standard**; emphasized on the communication activities offered with various activities as scenario**. (See Figure12)**

Figure 12:

Patient Scenario


Patient Scenario

Name of pt.: Sara Ali...
Department :.........Medical/ Surgical ....

Date/ Time	Notes	Signature of Dr.
10 am	Give Voltaren medication 3 ml. Q 6 hr.	Youssef

Development Phase:

In the study, it was decided to be developed the ability to administer intramuscular ventrogluteal injection skills as virtual reality software, which included in the first-year curriculum of Near East University Faculty of Nursing.

During the preparation of the VR simulation software and before it was finalized, the screen design and usability features, the content of the unit were evaluated by the lecturers who are experts in the field (one lecturer from the Nursing Fundamentals Department, two lecturers from the Nursing Education Department, four lecturers from Faculty of Education (Open and Distance Education Department, Educational Technologies and Informatics Department, Computer Education Department, Industrial Engineering Department), and the necessary adjustments/changes were made after the points that needed improvement and correction were determined.

The creation of applications usually employs a toolchain consisting of 3D tools such as Blender or Maya to create the environment and the objects within, a programming IDE like Visual Studio or Mono to program interactions, and a game development engine such as Unity3D or Unreal Engine to put these parts together and add VR capabilities through a vendor delivered software development kit (SDK)(Trenholme & Smith, 2008).

Unity3D includes Unity's graphics allowing control of the appearance of the application and are highly customizable, and it allows the creation of beautiful, optimized graphics across a range of platforms, from mobile to high-end consoles and desktop. In addition, Input allowing the user to control the application using a device, touch, or gestures. Application elements can be programmed, such as the graphic user interface (GUI) or a user avatar (Dörner et al., 2013).

There are various kinds of input devices as, Keyboards and Mice, Joysticks, Controllers, Touch screens. On the other hand, In addition, Unity has Audio features that include full 3D spatial sound, real-time mixing, and mastering, hierarchies of mixers, snapshots, predefined effects. As well, Unity helps simulate physics to ensure that the objects correctly accelerate and respond to collision, gravity, and various other forces, and provides different physics as 3D, 2D, object-oriented, or data-oriented (Green et al., 2014). Created and developed theoretical material and converted it to the technological tools/processes as the instructional media and supporting materials is necessary to meet the learning objectives and encourage active learning (Caulfield, 2012; Shabiralyani et al., 2015).

In the study, to create virtual reality administered intramuscular injection ventrogluteal site simulation skills; software requirements such as Unity3D (version 2019), Maya 3D (version2014) to create a virtual nursing laboratory environment, and Visual Studio to objects programming and interaction were used. **(See Figure13)**

Figure 13:

Creation Virtual Nursing Laboratory Environment (Unity 3D).

Definition of objectives;

- During the design process of the simulation software, the creation and arrangement of the theoretical content, the application section, the relevant original/real images, and the determination of the animations and the preparation of the visualization papers (storyboard) were done by the researcher. In addition, all of the administration intramuscular injection steps (37 steps) were recorded as indicated in the fundamental of nursing book version (2017), which the researcher indicated in the design stage. Then it has been modified to suit VRS software by technical support was received during the code phase of the software, and after modifying it had been (23)steps **(See Appendix G)**

Defining course design during,

- creating an organized and efficient script by designed the course according to Bloom's taxonomy, following the cognitive, affective, and psychomotor domains during showing the virtual instructions allowing students to read and deep understanding that facilitate, evaluate, and motivate the performance of students at different levels of knowledge acquisition, encouraging educators to assist their learners in a structured and aware way to obtain specific skills from the perceived need to master simple skills (Bloom, 1987). **(See Figure14**)

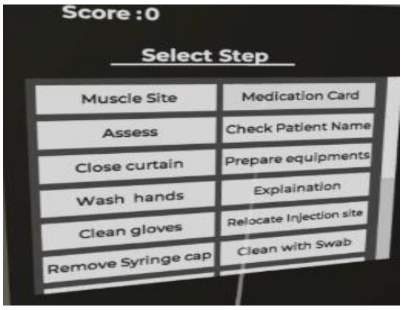
Figure 14:

Virtual Instructions Based on Bloom Taxonomy.

- Design and develop the text about " administration intramuscular injection ventrogluteal site skill", and "checklist" (to guide the use of the program) were elaborated, through the screen color and font to be consistent, font type, size, clarity, and students reading ability, which students should select accurately depending on their understanding and knowing for this skill, allowing them to improve their critical and reflective thinking, enhance their self-directed learning, and recall steps orderly one by one (Kourtesis et al., 2020). **(See Figure15)**

Figure 15:

Text Design



Description,

There are various tools were used for Intramuscular Ventrogluteal Injection Virtual Reality Simulation" software as the Unity 3D video game engine (2019) and the Autodesk Maya modeling application (version2014) were used, sensors for the headgear and controller devices that allow the user to experience interactivity and provide feedback (Strangman et al., 2003). And also, animations representation of the person who is participating in the virtual world that is called an avatar (Trepte & Reinecke, 2010). The animation prepared and the pictures used were not predicted to affect the working speed of the program (Trepte & Reinecke, 2010). It involved interactive activities, the definition of tools based on the learning process, clarifying the content, procedural, and attitudinal contents.

Includes technical rules, methods, skills/procedures strategies. Learning happens through actions and/or through situations of cognitive characters, such as text- the audio-visual commentary was developed (Clark et al., 2011; Gambier, 2013). These features were prepared in line with the relevant literature including the points to be considered in the development of the VR simulation software (Davis, 2009; Schwaab et al., 2011; Strangman et al., 2003; Tiala, 2006; Trepte & Reinecke, 2010).

Description of the development of VRS software related to administered intramuscular injection skill in ventrogluteal site:

- Active keys planned to be on VR headset and controller device (back, commence step, score, select step, step to do, continue, fine, not fine, Yes or No, confirm, exit button, etc.), C# programming language with Microsoft visual studio to write the computer code were used to perform the interactive effects and the selection the programming language(Kourtesis et al., 2020) (See Figure16).

Figure 16:

Active key on VR software.

- In the visual and sensory commentary, through control and manipulation with colors, graphics, and objects that showing inside the virtual environment. In addition, students used their virtual hand to sense the object, which VRS enhances interaction and immerse the student in the learning environment, feeling fun, comfortable, and satisfaction (Botha et al., 2021; Jallad & Işık, 2021). And, the student can note the change of color when doing the step correctly. In the study, this type of commentary appeared in the steps(6,7,9,13,15,18,19,21,31,33,37).(**See Figure17)**

Figure 17:

Sensory and Visual Commentary.

A.

B.

- In-text commentary, which describes the texts for mandatory and supplementary reading, VRS software developed various instructions can a student see and read it clearly and easily as normal text, were inserted through input the icons text that defines the correct way (references)(Kourtesis et al., 2020). It showed in the steps (18,23,28) (**See Figure18)**

Figure 18

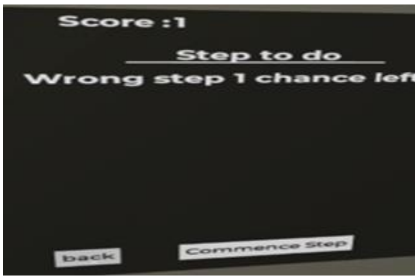
Virtual Texts Commentary.

- In the audio commentary, if the step performing correctly, the audio will be heard as an alarm. And also, in steps (2, 36, and 37) the audio was developed, during the students ask the patient about a name, if feeling pain or and having any allergy, then the patient can answer about it. So, students in this situation are felt as in a real environment (Rushton et al., 2020; Shu et al., 2019; Ulrich et al., 2014)
- There were self-assessment sections containing feedback to promote or correct the answer allowing students to try the step more than once (3 times) if students do any mistake, which is considered one of the most important features of VRS to provide a safe environment, learn from their errors, call critical thinking, demonstrate new skills and knowledge from the learner, involve students in the evaluation

process that result in increased interest and sharing with the content (Dubovi et al., 2017; Kruglikova et al., 2010)(**See Figure19**).

Figure 19:

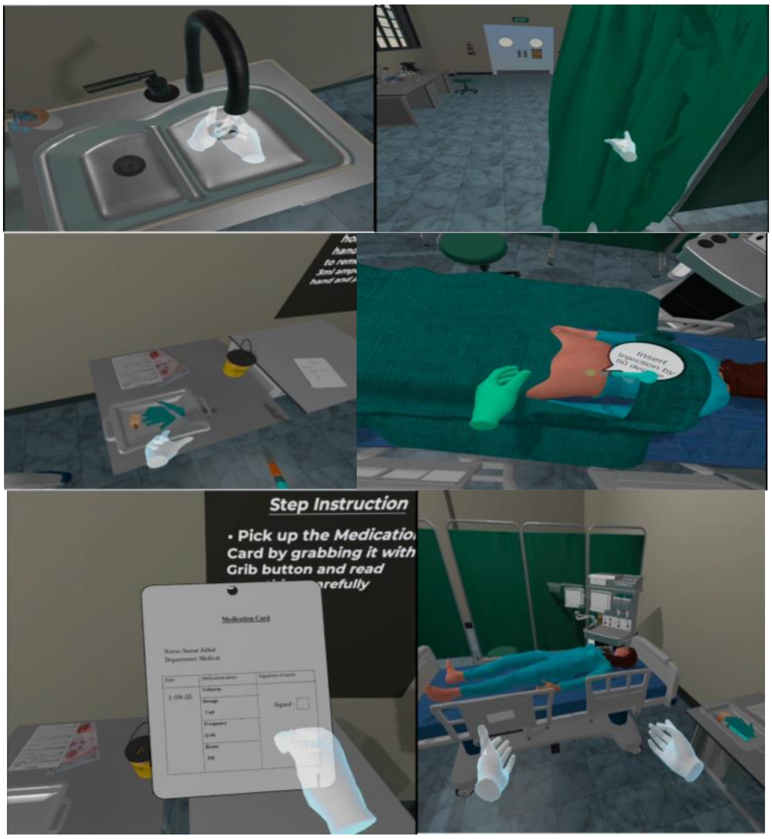
Self-Assessment during Make Error.



- Representation of the person (user gestures and patient), through used avatar who is participating in the virtual world, which can perform gestures therefore they are ideal for simulation because they can undertake clinical skills, and represent simulated patients that interact with hospitals, equipment, vital signs, and patient charts that let students involved in decision-making and solving a clinical problem(Kourtesis et al., 2020; Skiba, 2009; Trepte & Reinecke, 2010); It showed in the steps(1,4,6,7,9,10,12,13,18,19,37). **(See Figure20)**

Figure 20:

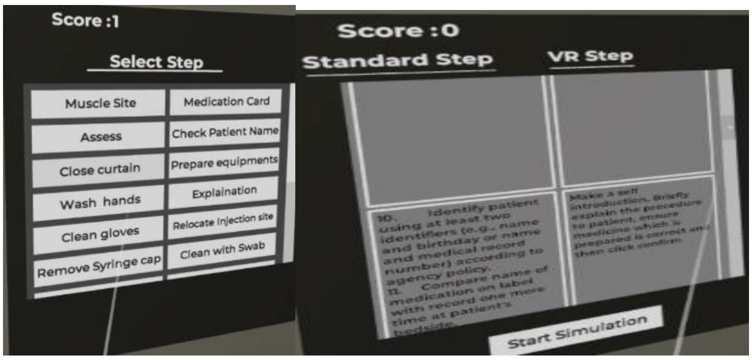
Representation Animation to Do Intramuscular Injection Steps (Gesture & Avatar)



- Includes factual content through defining the definitions and terminology of administrating intramuscular injection in ventrogluteal site skill and rational steps. In addition, standard steps with virtual steps were compromised. **(See Figure21)**

Figure 21:

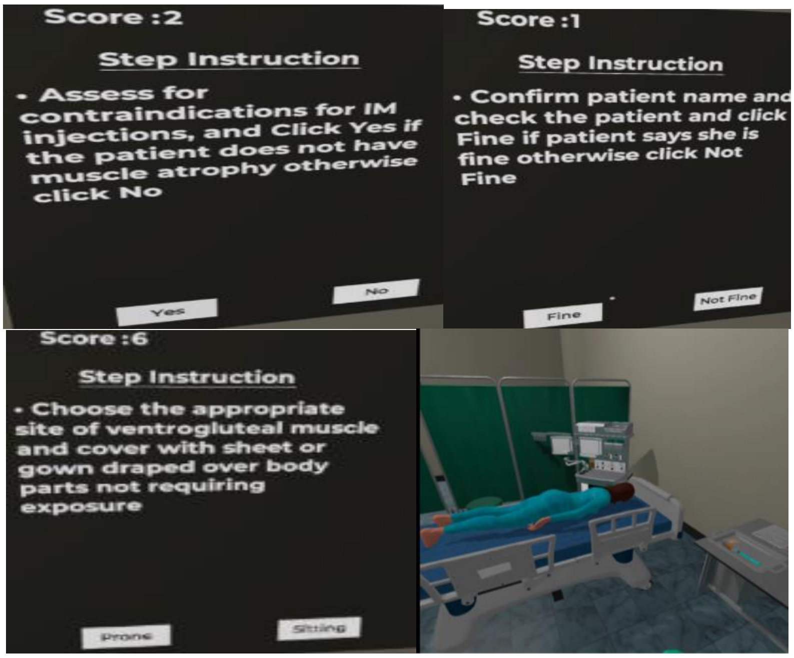
Virtual Screen Present Intramuscular Injection Checklist



- For a suitable position for the patient, let students select a correct answer that is related to a suitable position on ventrogluteal site. It showed in the steps (2-4, 5,16). (**See Figure22**).

Figure 22:

Develop VRS Software to Choose Correct Answer



- ➢ It is vital to do all of the steps in order way and systematic that includes in all of the steps, especially when preparing and withdrawing medication from ampule related to the scenario identified in the design phase. It is in step (7). **(See Figure23)**; NOTE: VRS software develops to select proper IM injection equipment; if it selects the wrong tool it makes an alarm.

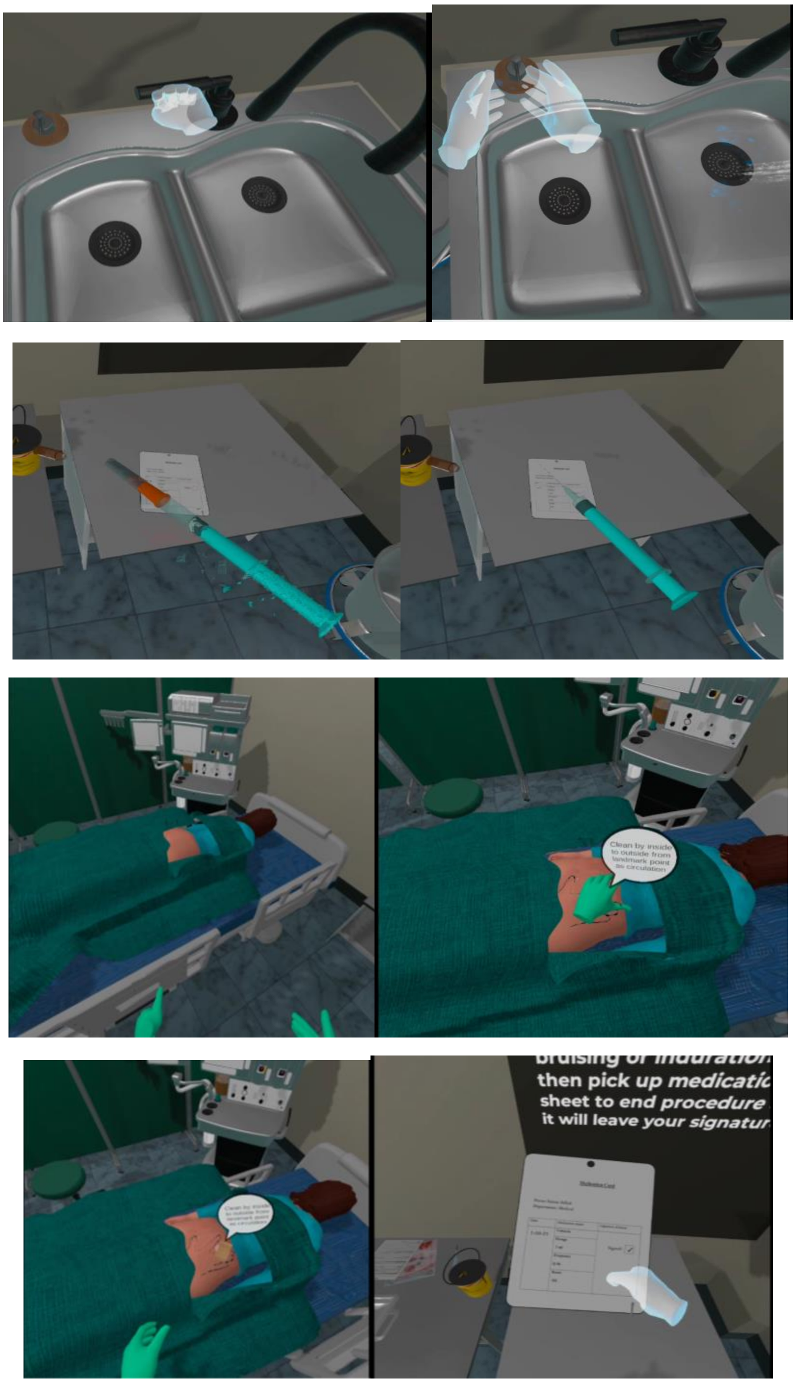
Figure 23:

Proper Equipment for Virtual Intramuscular Injection Simulation Skill

- ➢ A student was based on activities, communication skills, interaction with VRS procedures, which was offered in the study, through allowing students to contact and building relationships with the patient by letting students talk, discuss, and ask. Thus, that reduces the feeling of fear and anxiety, increases students' performance, enables them to make a decision, and solve their problem (Bayram & Caliskan, 2020; Jallad & Işık, 2021). It showed in the steps (2,4,6,8,10,11,12,17,19,21,37). **(See Figure24)**

Figure 24:

Various Activities and Interactions with VRS Steps



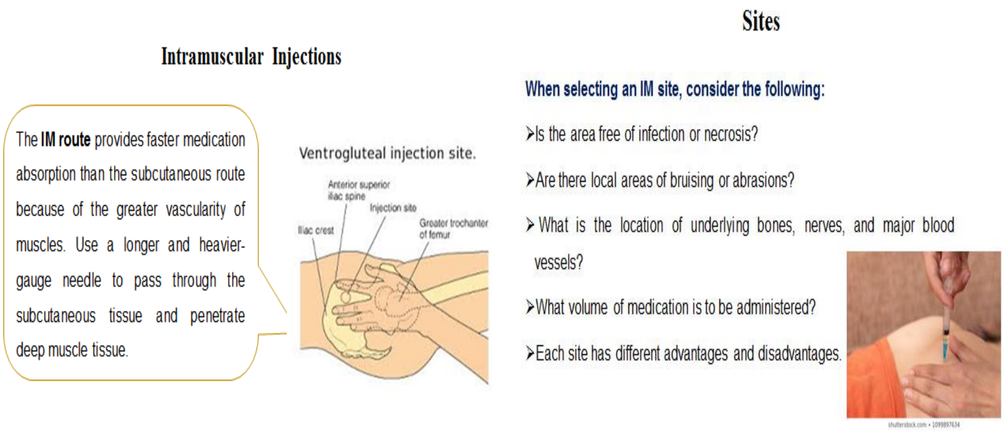
Implementation:

After created, designed, and developed educational tools and technological resources from the VRs software, which happened with enabling access to the fundamental nursing course. How to teach students to use virtual intramuscular injection simulation software was defined, through the implementation of VRS environment and educational content including ascertain of the cognitive process, and the assessment process, and the feedback to be performed by the educator.

- Firstly, before students started to implement the VRS software, the researcher offered a presentation related to administered intramuscular injection skills in ventrogluteal site through (IM definition and sites, anatomy, position, equipment, steps, rational of steps), and medication rights **(See Figure25).**

Figure 25:

Presentation of Administer Intramuscular Injection Skill in Ventrogluteal Site



VR 3D cameras which have multiple lenses that simultaneously film videos at angles that overlap slightly process the videos and combines them to form a 360° panoramic video, and thereby providing a sense of total immersion in a nursing laboratory environment. And also, it places objects at the correct distance (Firth, 2013; Tiala, 2006). It includes; Oculus Quest, VR headset (HMD), and tactile (controller) device that mimics the arms of the user and any activities between the sensor systems, senses the movement of tools, and following steps of administrating IM injection in three-dimension requiring physical contact between computer and user (3D-display), a software program, laptop computer.

A head-mounted display (HMD) system scans the surrounding room for visual features, such as a sudden immersion in color or contrast, combined with sensors is translated into a change of position in the virtual world. The tracker device provides placing information that sends to the receiver supplying the ability to adjust the view and location of the virtual reality, which these elements provide an interactive environment associated with gamification to facilitate the game's progress, learners' attention on tasks, motivation to acquire skills, and learning occasions (Faiola et al., 2013; Johnsen et al., 2016). (**See Figure 26**)

Figure 26:

Virtual Reality Simulation (Oculus Quest)

- In the study, HMD has been wear by the student, they tracking over around and interact with the virtual environment through holding controller devices; Students felt standing inside the simulation, it enabled students to observe simulations and be immersed in reality while they are physically situated elsewhere, it enabled a student to observe a simulation scenario, which is created in the design phase as reality, and focused on two of the five senses, namely sight, and hearing**. (See Figure 27)**

Figure 27:

Student Wear HMD

- ➢ The student inserted the VRS program during pressing the bottom (**See Figure 28**).

Figure 28:

First VR Platform.

- ➢ At the beginning of implementation, the student should hold and grasp the bottom of the controller device. In addition, the student should be organized and control his/her hand. At this moment he will insert in the virtual laboratory environment. Then, looking down sees the familiar bed and linens used at the canter; turning his head, the student sees the virtual laboratory, animation (virtual Patient), laboratory store involving various skill tools, and various virtual material that designed and developed for VRS intramuscular injection skill **(See Figure 29)**

Figure 29:

At the Beginning of Implementation.

➢ The black platform appeared to the students, which has guidelines related to administered intramuscular injection skill and click next bottom. **(See Figure 30)**

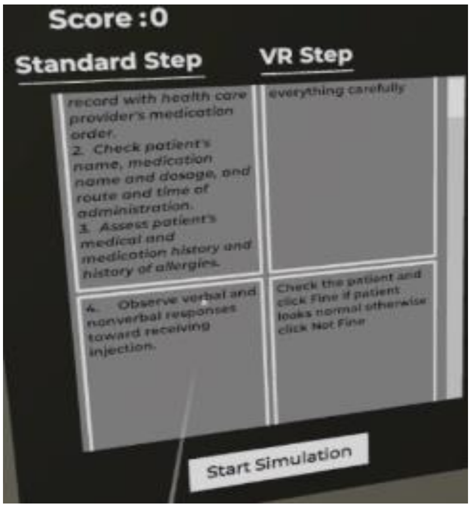
Figure 30:

Guideline of Intramuscular Injection Skill.

➢ Then, another screen will have appeared including all of the steps related to virtual administered intramuscular injection simulation skill, which he/she should read and then click start simulation. (**See Figure 31**)

Figure 31:

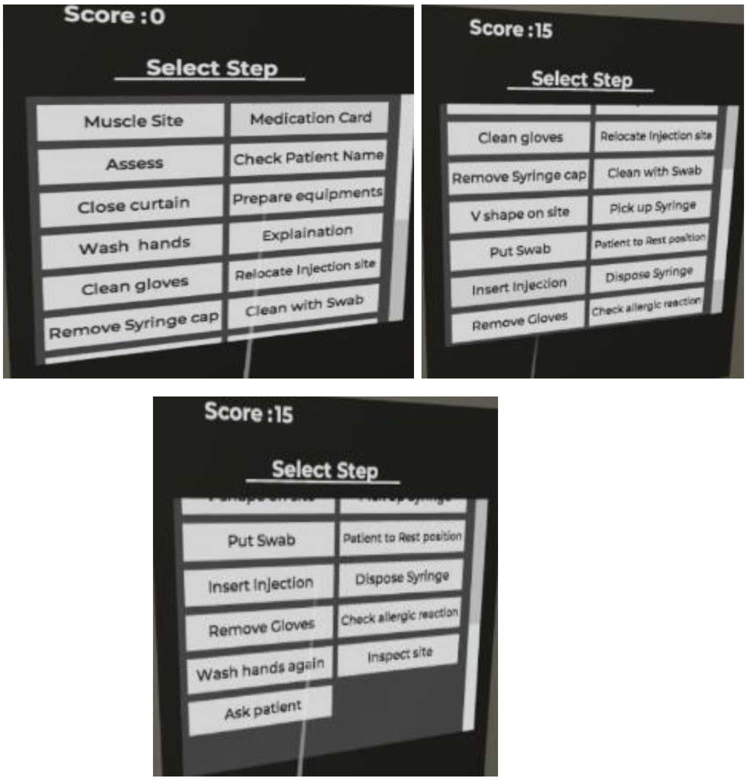
Virtual Administered Intramuscular Injection Simulation Skill Step



➢ Then, the Student will be seen a black screen that has all of the unordered steps that he/she should select the first and correct step, then press continues and following step by step in order and correct way, with keep grasping and directing controller device. **(See Figure 32)**

Figure 32:

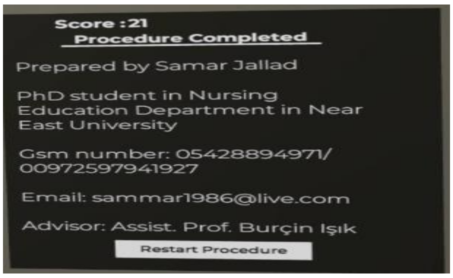
Virtual Intramuscular Injection Skill Unordered Step.



- When all of the steps were completed as described in the description development of VRS, the last screen appeared and students click to restart the procedure or closed HDM bottom **(See Figure 33**).

Figure 33:

Last screen when completed all steps



Evaluation Phase (Pilot Study):

In this stage, two types of evaluations were made: process and outcome evaluation. At the end of each stage, an evaluation was made and any deficiencies were corrected. In addition, necessary changes/corrections in the software were made with the pilot study with the students and members of academy expertise. The content of the software was arranged following the objectives and in line with the current literature. Audio and written feedback and striking visual elements were used in the software. In this context, the software has been designed simply and plainly for students to use it easily.

Sampling and Setting

For the pilot study, the reliability and validity of VRS software were evaluated by nineteen volunteers; fourteen students were randomly selected to correct the incomprehensible points, errors, and deficiencies in the "Intramuscular Injection in Ventrogluteal Site" VRS software and to determine the time to be given to the students in the experimental group to perform the skill in the VRS software, students who are in a first-year baccalaureate nursing program, registered in a fundamental nursing course in the spring semester 2019-2020, and met the inclusion criteria. The students who were taken into the pilot study were not included in the research group.

Five experts in different faculties; Faculty of Nursing and Faculty of Education (Open and Distance Education, Educational Technologies and Informatics, Computer Education, Industrial Engineering Department) in which this study was conducted in a nursing laboratory in the Near East University during July-2020. **(See Figure 34)**

Figure 34:

Expert Evaluating VRS Software

Data Collections Tool

"Intramuscular Injection in Ventrogluteal Site VRS Software Evaluation Form"

This tool determined the volunteers' opinions about the technical features, content, and thickness of motion of the "Intramuscular Injection in Ventrogluteal Site" VRS software, and accordingly determines the points that need to be developed and corrected in the software and the necessary regulations. To make changes, it was developed in the 3-Likert type; whether the sentences in the form are clear and understandable. It involved two parts. **(See Enclosure-A)**

- The first part; had 70 items to determine volunteers' views on the technical features of the "Intramuscular Injection in Ventrogluteal Side" VRS software; involved technical issues (38 items), content (19 items); and motion sickness (13 items).
- The second part; had 3 open-ended questions to determine volunteers' views on problems, features, and their suggestions of the "Intramuscular Injection in Ventrogluteal Side" VRS software. As:

✓ What are the most difficult problems while using the software?

✓ What are the things you like the most while using the software?.

✓ What are your suggestions while using the software?

Validity

The form consisting of 70 items and 3 open-ended questions was finalized by evaluating whether it met with the help of expert opinions and thesis advisor

(Brooke, 1996; Browning et al., 2020; Gyeonggi-Do & Gu, 2018; Kamińska et al., 2019; Settgast et al., 2016; Yu et al., 2019), and also, these items format in Likert-type scale; "Agree" was scored 3, "Undecided" 2, "Disagree" 1.

Reliability

To examine internal consistency, "Intramuscular Injection in Ventrogluteal Side" in Likert-type scale format was analyzed and used SPSS to calculate Cronbach's Alpha for students and expert perceptions; (Cronbach's Alpha=.84 and .85 respectively), and there was a positive relationship between them (r=.91). and is shown in Table 1

Table 1:

Reliability of Virtual Reality Simulation Software of the Skill "Intramuscular Injection in Ventrogluteal Side"

	No.	*Category*	*No. of items*	*Mean ±S.D*	*Min.-Max.*	*Cronbach's Alpha*
Evaluators	5	Technical Features	38	111.60±3.05	107-114	.729
		Content	19	52.80±2.48	51-57	.688
		Motion Sickness	13	14.60±2.61	13-19	.953
		Overall	70	179±6.63	174-190	.839
Students	14	Technical Features	38	103.57±11.33	89-133	.714
		Content	19	48.42±6.13	39-57	.840
		Motion Sickness	13	16.42±4.91	13-29	.835
		Overall	70	168.42±17.78	146-217	.845

Discussion

The form filled out by the students and expert was analyzed, in line with the feedback given by them, the necessary corrections were made in the software in four steps (6th, 7th, 15th, and 28th) of the Intramuscular Injection in Ventrogluteal Site skill, and the time to be given to the students to perform the skill in the VRS software (approximately 20 minutes) determined. The students who were taken into the pilot study were not included in the study group.

Evaluators showed that the VRS oculus device on occasion made dizziness, headache, blurred vision if it was still more than 30minute. in addition, they showed that there were a bit challenges that were faced during using the software such as interaction challenges, Time demands, Technological requirements, and enthusiasm challenges. They said for:

Time demands: "It requires a lot of time on research compared to traditional schooling. In a traditional school, I usually get all the required information at school, but it's not so with software."

Technological requirements: "There are some technical requirements that might not be readily available. Sometimes I use general internet data for connectivity that would mean a lot of spending on data."

Interaction challenges: "There is little to no direct interaction with the lecturer. Direct interaction helps in the sense that the lecturer can notice that the students did not understand without a word from them and that would prompt him/her to explain more, this is mostly not found in software".

Enthusiasm challenges: "There is a lack of enthusiasm because of the interest in direct tuition rather virtual tuition."

Furthermore, evaluators noted that VRS software showed several advantages during software demonstrations such as; Deep motive, engagement, and self-confidence.

Deep motive: VR can force one to get out of one comfort zone {in a good way}. One can be forced to learn navigating the course lectures, and effective digital communication which is helpful in today's world.

Engagement:" I believe it's beneficial to learn teamwork since it will be useful when I become a registered nurse later."

Self- Confident: "I have to be disciplined and do the practice without monitoring"

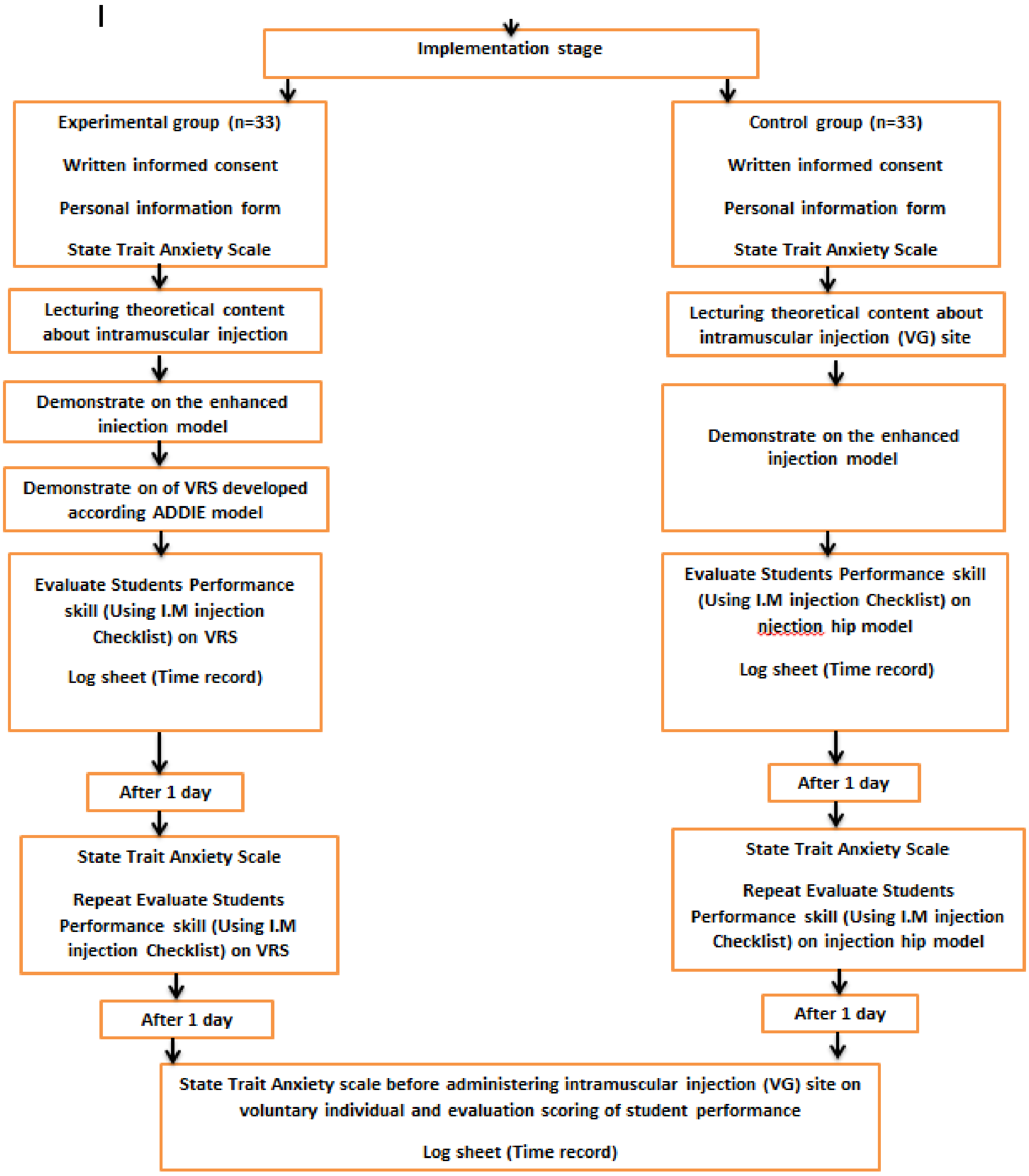
Stage II: RESEARCH METHODOLOGY

Research Design

The study was used a quasi-experimental design **(See Figure 35)**. A pre-test and post-test were administered to evaluate the effectiveness of traditional laboratory (Enhanced Injection Hip Model) and the virtual reality system (VRS; Oculus Rift VR headgear (HMD) and controller device) includes intramuscular injection development.

Figure 35:

Design of study



Variables of the Research

Quasi-experimental methods enable the researcher to manage the research situation so that causal relationships amongst variables may be evaluated (Cooper & Schindler, 2008).

- **The Dependent Variable (s)**

The dependent variables in this study are :

- ✓ Ventrogluteal injection Skill score,
- ✓ State-trait anxiety level,
- ✓ Time

- **The Independent Variable**

The Independent variables are:

- ✓ Student's sociodemographic characteristics
- ✓ Virtual reality simulation software (Virtual Reality Simulation; Oculus Rift VR and controller devices).
- ✓ Enhanced Injection Hip Model

Setting of Research

The research was conducted in Near East University Faculty of Nursing, which was established in 2018 and became the first Nursing Faculty of the Turkish Republic of North Cyprus (TRNC) providing nursing education for national and international students from various countries such as Nigeria, Palestine, etc. at the level of undergraduate, graduate and doctoral degrees. And also, Nursing Faculty is capable of conducting educational activities by having well-equipped laboratories has high- and low-fidelity simulation used as different learning methods, such scenarios, case study, and a static mannequin where students and nursing students can perform nursing applications, and conduct clinical applications following their courses at various hospitals.

Sampling and Participants

The universe of the study consisted of the first-year nursing students (220 students) who enrolled "Fundamentals of Nursing" course first time at the Near East University Faculty of Nursing in the summer semester in the 2019-2020 academic years.

Due to COVID_19 in this period, students took theoretical lessons online this semester and could not perform any practice in the laboratory. As a result of not all of the students were able to attend, and after excluding some students based on inclusion and exclusion criteria, the total population became (110 students). The sample population was calculated by using the Sample Size Calculation formula:

Sample Size = n / [1 + (n/population)]; In which n = Z * Z [P (1-P)/(D*D)]

And it has consisted of N= 66 participants for an error rate less than 0.10 and confidence level: 90%. Taking into consideration, those students included in the experimental and control groups entered the laboratory for the first time.

Knowing it was taken the similarity of the students in the groups through identified the inclusion and exclusion criteria, and as a result of statistical power analysis, 33 students were assigned to the control group and n=33 students to the experimental group, they assigned to groups by simple random sampling method by making a list of all participants of the students (single numbers for the control group and even numbers for experimental group).

The researcher started firstly with the control group that was divided into three groups each group had eleven students that extended their training for three days (pre/post/voluntary individual), the control group lasted for 9 days from (10 -19 August 2020). While The experimental group was divided into four groups, each group had 8-9 students, extended their training for three days (pre/post/voluntary individual), and lasted 12 days (8-20 September-2020). To ensure students' continuity in research;

- Necessary explanations about the study were made;
- Contact information (phone number, address) has been recorded;
- Necessary permission was obtained from the relevant faculty members of the courses included in the training program during the hours they participated in the research;
- Care was taken to ensure that the implementation plan did not conflict with the exam dates;
- Announcement of the implementation plan was made before implementation;
- The steps for prevention and safety from COVID-19 had been followed by adhering the global health protection and prevention methods that outlined by world health organization as using hygiene and washing hand, wear a mask, follow the spacing, no gatherings among participants (WHO,2020). Note that students entered the nursing laboratory one by one in both groups.

- **Inclusion Criteria**

The students who were included in the study group;

- Did not graduate from the diploma programs of the Vocational School of Health.
- Did not come with vertical transfer.
- Have no experience in intramuscular (IM) injection and preparing medication from an ampule and similar invasive administrations without this course.
- Did not work in any health institution and organization.

- Did not use virtual reality simulation related to ventrogluteal injection and similar intramuscular applications were determined as the variables that provide similarity.

- **Exclusion Criteria**

All of the students who had not taken a fundamental nursing course in English, who repeated this course more than once, as well as who had not acceptable inclusion criteria.

Data Collection Tools

"Personal Information Form", “Intramuscular Ventrogluteal Injection Skill Checklist” "State-Trait Anxiety Inventory-STAI", "Log Sheets”, “Intramuscular Ventrogluteal Injection Virtual Reality Simulation” and “Enhanced Injection Hip Model” were used as data collection tools in the research.

"Informed Consent Form"

In this form that was designed by the researcher, students were informed there would be no personal direct benefits to participation and assured that participation in the study was entirely voluntary, without any consequence related to their grades. Thus, it was obtained from students before participation in the study. **(See Appendix B)**

"Personal Information Form"

This tool gathered the descriptive socio-demographic characteristics of participants and was designed by the researcher as questions **(See Appendix C)**, such as:

- Gender
- Age
- Grade Point Average (GPA)
- Did you have a personal computer?
- Did you have an education about computer/computer software?
- Did you know virtual reality simulation/simulation software?
- Did you graduate from the diploma programs of the Vocational School of Health?
- Did you come with the vertical transfer?

- Did you train and have experience in intramuscular (IM) injection and preparing medication from an ampoule and similar invasive administrations without this course?
- Did you work in any health institution and organization?
- Did you use virtual reality simulation related to ventrogloteal injection and similar intramuscular applications?

"Intramuscular Ventrogluteal Injection Skill Checklist"

The "Intramuscular Ventrogluteal Injection Skill Checklist" was used to collect data on students' intramuscular (IM) ventrogluteal injection skills. This checklist, prepared by the researcher based on the fundamentals of nursing book ninth edition (Potter et al., 2017) to evaluate the skills performance level of students, listed 37 steps in IM ventrogluteal injection procedure. Each step in the form was scored as done (1), and not done (0). While the highest possible score to be obtained is 37, the lowest possible score is 0. Higher scores indicate higher IM Ventrogluteal Injection Skill levels. **(See Appendix D)**

For this study, this checklist was used by the researcher and two observers, who are educators and specialized in the fundamental and surgical department in the Nursing faculty, to assess students who administered the intramuscular injection ventrogluteal site to know the level of their psychomotor performance skill. In addition, the average of the researcher and two observers was taken and the skill scores of the students were calculated accordingly. And also, students were evaluated during 3 days, the first day (students were provided theoretical lecturing and demonstrating on hip injection model/VRS then performed skill that was pre-test); second day (after one day was post-test); and third day (after one day was on the voluntary individual). And each student performed this skill once time.

The consistency between the researcher and the observers was accepted as the reliability of the measurement (Erefe, 2002) and is shown in Table 3.2.1

The Cronbach's alpha value of the "Intramuscular Ventrogluteal Injection Skill Checklist" was calculated as (.74) for the control group and (.62) for the experimental group in the pre-test. And, in post-test (.67) for both groups. While, (.67) for the control group and (.66) for the experimental group in volunteer individuals.

Table 2

Consistency between Researcher and Observers in Evaluation of Intramuscular Ventrogluteal Injection Skill

Groups / Test	Researcher and Observers	A score of Intramuscular Ventrogluteal Injection Skill $\bar{X}$ ± SS	*t*	*p*	*r***	*p*
Control Group (n=33)						
Pre test	Researcher_ observer1	28.72 ±3.64 27.75 ±3.20	*1.097*	*.281*	*-.097*	***.591***
	Researcher_ observer2	28.72 ±3.64 27.21± 3.51	*3.479*	.001	*.756*	***.001***
	observer1_ Observer2	27.75 ±3.20 27.21± 3.51	*.643*	.525	*-.051*	***.779***
Post-test	Researcher_ observer1	31.09 ± 4.41 29.61 ±3.91	*10.23*	*.001*	*.987*	***.001***
	Researcher_ observer2	31.09 ± 4.41 29.75 ±3.63	*3.499*	*.001*	*.869*	***.001***
	observer1_ Observer2	29.75± 3.63 29.60 ±3.91	*.457*	*.651*	*.875*	***.001***
Before Practice on Voluntary individual	Researcher_ observer1	31.96± 3.77- 30.60± 3.56	*8.140*	*.001*	*.967*	***.001***
	Researcher_ observer2	31.97± 3.77 30.45± 3.50	*5.56*	*.001*	*.911*	***.001***
	observer1_ Observer2	30.60± 3.56 30.45 ±3.50	*.487*	*.630*	*.872*	***.001***
Experimental Group (n=33)						
Pre test	Researcher_ observer1	27.66 ± 4.76 27.84± 4.44	*-.180*	*.86*	*.205*	***.251***
	Researcher_ observer2	27.66 ± 4.76 27.48± 4.22	*.350*	*.729*	*.786*	***.001***
	observer1_ Observer2	27.84 ± 4.44 27.48± 4.22	*.410*	*.685*	*.310*	***.079***
Post test	Researcher_ observer2	32.54± 2.91 31.51± 2.68	*8.128*	*.001*	*.970*	***.001***
	observer1_ Observer2	32.54± 2.91 31.15± 3.22	*4.444*	*.001*	*.832*	***.001***

	Researcher_ observer1	31.15 ±3.22 31.51± 2.68	*-1.109*	*.276*	*.811*	***.001***
Before Practice on Voluntary individual	Researcher_ observer1	34.00 ±3.09 32.39 ±2.76	*10.25*	*.001*	*.959*	***.001***
	Researcher_ observer2	34.00 ±3.09 32.15± 2.82	*6.971*	*.001*	*.871*	***.001***
	observer1_ Observer2	32.39± 2.76 32.15 ±2.82	*.821*	*.418*	*.816*	***.001***
TOTAL (N=66)						
Pre-test	Researcher_ observer1	28.19± 4.24 27.80± 3.84	*.588*	*.559*	*.096*	***.444***
	Researcher_ observer2	28.19± 7 4.24 27.34± 3.86	*2.450*	*.017*	*.763*	***.000***
	observer1_ Observer2	27.80 ± 3.84 27.34± 3.96	*.746*	*.458*	*.175*	***.161***
Post test	Researcher_ observer1	31.81± 3.78 30.45 ± 3.47	*.850*	*.001*	*-.454*	***.651***
	Researcher_ observer2	31.81 ± 3.78 30.56 ± 3.46	*.979*	*.001*	*12.617*	***.001***
	observer1_ Observer2	30.45± 3.47 30.56± 3.46	*.853*	*.001*	*-5.568*	***.001***
Before Practice on Voluntary individual	Researcher_ observer1	32.98 ± 3.57 31.500± 3.28	*12.94*	*.001*	*.967*	***.001***
	Researcher_ observer2	32.98 ± 31.30 31.30± 3.27	*8.867*	*.001*	*.902*	***.001***
	observer1_ Observer2	31.500± 31.30	*.925*	*.358*	*.861*	***.001***

**** t-test;** Paired Sample t test ***p<*** 0.001

According to the control group, in the pre-test, there is a significant correlation between the researcher and observer 2 (r=.756, p= .001). In posttest and voluntary individuals, there is a significant correlation between all of the observers (p<,001). According to the experimental group, in a pre-test, there is a significant correlation between the researcher and observer 2 (r=.786, p= .001). In posttest and voluntary individuals, there is a significant correlation between all of the observers (p<,001).

According to the total, in the pre-test, there is a significant correlation between the researcher and observer 2 (r=.763, p= .001). In the posttest, there is a significant correlation between the researcher and observer 2 (r=.12.617, p= .001), and between observers 1 and 2 (r=-5.568, p=.001). In Volunteer individuals, there is a significant correlation between all of the observers (p<,001).

"State-Trait Anxiety Inventory (STAI)"

This part measured the anxiety level for students who performed an intramuscular injection procedure in ventrogluteal site by Hip Model Injection (control group) and VRS intramuscular skill (experimental group) through the state-trait anxiety scale “State-Trait Anxiety Inventory” (STAI); that developed in 1964 by Spielberger and contains one set of 20 self-reporting items that measure both state and trait anxiety (40) items. The T-Anxiety scale used a four-point Likert-type scale: (1) rarely, (2) sometimes, (3) often, and (4) almost always. While, the 20 state anxiety items from the State-Trait Anxiety Inventory (STAI) were presented with a 4-point Likert type scale, which asks the respondents to rate themselves on each item were (1 = not at all, 2 = somewhat, 3 = moderately so, and 4 = very much so). Alpha reliability coefficients for the T-Anxiety scale ranged from .83 to .92 and concurrent validity ranged from .73 to .85. while, the magnitude of the reliability coefficients ranged from 0.65 to 0.86, whereas the range for the state anxiety scale was 0.16 to 0.62 (C. Spielberger, 1983).

This scale was provided to each participant in both groups (control and experimental) in Pre-/Post-test and Before implementing an intramuscular injection procedure on a voluntary individual. **(See Appendix E)** And reliability of both groups is shown in Table 3

Table 3

State-Trait Anxiety Inventory Internal Consistency Reliability Coefficients of Control and Experimental Groups

Scale	**Control Group Cronbach Alpha**	**Experiemantal Group Cronbach Alpha**
State Anxiety Inventory		
Before practice	.63	.76
After practice	.74	.67
Before practice on voluntary individual	.70	.69
Trait Anxiety Inventory		
Before practice	.77	.64
After practice	.79	65
Before practice on voluntary individual	.77	.62

State Anxiety Inventory (STAI): State anxiety is an episodic and temporary emotion experienced by an individual in response to a situation or event, which includes symptoms of uneasiness, tension, and activation of the autonomic nervous system, which vary in intensity from situation to situation (Moscaritolo, 2009; C. D. Spielberger, 1983; Spielberger & Reheiser, 2004).

This scale identifies how the individual feels at a certain moment and under certain conditions. Individuals respond to the items in the scale according to the severity of their feelings at that moment. For example, "I feel comfortable". In cases where the individual perceives the stressful situation as threatening, the level of "state anxiety" is high, and it is low when this danger is not perceived as threatening (Aradilla-Herrero et al., 2014; Kaipper et al., 2010).

The 20 state anxiety items from the State-Trait Anxiety Inventory (STAI) were presented with a 4-point Likert type scale, which asks the respondents to rate themselves on each item were (1 = not at all, 2 = somewhat, 3 = moderately so, and 4 = very much so) according to the degree of severity of the feelings, thoughts or behaviors expressed by the items, with the lowest total score being 20 and the highest total score being 80. A high score indicates a high level of anxiety and a low score indicates a low level of anxiety (Kaipper et al., 2010; Spielberger et al., 1983).

Trait Anxiety Inventory(STAI-T): Trait anxiety is an enduring temperament or predisposition to experience the state of anxiety frequently, the perception of the stressful situation as dangerous or threatening, and the increase in the frequency and intensity of state emotional reactions to these threats and their continuity (Spielberger & Reheiser, 2004).

It measures anxiety according to how the individual feels "usually" and "constantly", regardless of the situation and conditions he or she is in. Individuals respond according to the frequency of the emotions they feel. For example, "I am usually in good spirits" (Wells, 2011).

In the Trait Anxiety Scale, according to the severity of the feelings, thoughts, or behaviors expressed by the items: (1) rarely, (2) sometimes, (3) often, and (4) almost always. It is requested to tick one of the options such as The Trait Anxiety Inventory includes 20 items and is a 4-point Likert-type scale, with the lowest total score being 20 and the highest total score being 80. A high score indicates a high level of anxiety and a low score indicates a low level of anxiety(Öner, 1997; Wells, 2011), The scales in the State and Trait Anxiety Inventory contain two types of statements, direct (straight) and reversed. Direct expressions of negative emotions; reversed expressions indicate positive emotions. 10 items (1, 2, 5, 8, 10, 11, 15, 16, 19, and 20) in the State Anxiety Scale, and 7 items (21, 26, 27, 30, 33, 36, and 39) in the Trait Anxiety Scale. items) were reversed (Öner, 1997; Wells, 2011),

Scoring of the scales is done in two ways, manually and by computer. When scoring manually, two separate keys are prepared to determine the total weights of direct and reversed statements. The total weighted score for the reversed statements is subtracted from the total weighted score for the direct statements. A predetermined and unchanging value is added to this number. This constant value is 50 for the State Anxiety Inventory and 35 for the Trait Anxiety Inventory. Computer scoring is generally recommended for large sample groups (Öner, 1997; Wells, 2011).

A total score of 0-19 indicates no anxiety, a total score of 20-39 indicates mild anxiety, a total score of 40-59 indicates moderate anxiety, and a total score of 60-79 indicates severe anxiety. points out that the individual needs professional help (Öner & Le Compte, 1998). individuals can answer both scales in approximately 10minuts, although there is no limited time for answering them(Öner, 1997; Wells, 2011).

Log Sheets

A log sheet is a record of specific activities or events, used to track patterns or operations to monitor hours worked, visit,…etc. In this study, the log sheet aimed to involve participants' practice time when using the VRS and Hip Model Injection, by recording practice begin time, and practice end time, and the total time per minute for each participant took in Pre-/Post-test, and on a voluntary individual in both groups. (**See Appendix F**)

Implementation of Research

The implementation was carried out in August- September in the 2019- 2020 academic year.

Procedure of Research

Before the recruitment of participants and the start of data collection, expedited review, and approval by the university Institutional Review Board (IRB) were obtained (Approval #YUD/2020/76-985). The principal investigator verbally introduced the study to all participants (n=66) during one hour of a fundamental nursing lecture about the theory underlying administered intramuscular injection skill in ventrogluteal site, at which time participants were allowed to familiarize themselves with the equipment, they asked study questions, and then have answered. Participants were assigned randomized into two groups (control and experimental) by the principal investigator. An appropriate time was designated for each group to begin conducting the study, which began with the control group.

Implementation of the Control Group

The implementation plan was prepared as a three-day for each control group (3 groups; each one has11 participant) program to be carried out under the supervision of the researcher. During the implementation process of the Control Group, two observers in charge of the laboratory from the Nursing Department accompanied the researcher. To ensure standardization in this direction, before starting the application, the researcher and two other observers were worked with and language unity was achieved, in addition, it was confirmed that all the necessary suitable equipment for this application were available. The researcher told the Head of Nursing faculty about a voluntary individual, on the day when the students in the experimental and control groups practice their Intramuscular injection skills on him.

Enhanced Injection Hip Model

Each participant in both groups in the Pre-test used the Injection Hip model that used in the professional skill laboratory is like the real human hip, which is a functional teaching aid that enables a learner to develop manipulative skills and improve techniques, and is designed to provide students with the visual and tactile experience needed to learn intramuscular injection techniques, and help learners make the transition from the idealized classroom setting to the realities of ward duty (Nasco Life Form, 1982). (**See Figure 36)**

Figure 36:

Enhanced Injection Hip Model.

Day 1 (Pre-test/Application in Enhance Hip Injection Model)

- **9:00-9:30**: all of the students (11 students) entered the laboratory with taking instructions of COVID-19, as hand hygiene and spacing, and explain them the aim and importance of this study, then completed the " consent form", "Information Form" and the "State-Trait Anxiety Inventory". On the other hand, a researcher told the students the importance of waiting after the finish to provide lecturing theoretical content and demonstrated the enhanced injection model.
- **9:35-10:05:** the researcher shared the theoretical content about the "Intramuscular Injection (IM) ventrogluteal site" skill, as a professional injection skill by using the presentation education method.
- **10:10-10:40:** researcher applied the checklist of the "Intramuscular Injection (IM) ventrogluteal site" skill step by step by demonstrating it on the enhanced hip injection model.
- **10:45-11:00:** researcher provided students time to any inquires. After that, asked them to leave the lab and enter one by one.
- **11:15-14:15:** students started to enter one by one, the researcher asked the student to apply "Intramuscular Injection (IM) ventrogluteal site" skill" on the enhanced hip injection model within undetermined time. During this time, the researcher and observers evaluated them in line with the steps in the checklist and recorded the total time taken on the log sheet. An average of 12 minutes was studied for each student.

Day 2 (Post-test/ Application in Enhance Hip Injection Model)

This day extended From 9:00- 13:00

- One by one (11 students) was allowed to enter the nursing laboratory were prevented from watching each other.
- Each student performed intramuscular injection ventogluteal site skills on the developed enhanced injection hip model without limited time. During this time, the researcher and observers evaluated them in line with the steps in the checklist and recorded the total time taken on the log sheet. An average of 9 minutes was studied for each student.
- Each student completed the "State-Trait Anxiety Inventory" within 3-4 min. after completing the application.

Day 3 (Application on voluntary Individual)

This day extended From 9:00- 13:00

- One by one students entered the nursing laboratory.
- Each student completed the "State-Trait Anxiety Inventory" within 3-4 min. before starting performed on voluntary Individual, who assumed the role of the patient.
- Each student a playing role (act drama) to perform intramuscular injection ventogluteal site skill on voluntary Individual without limited time, which may be a limitation because it would be unethical to apply the step of entering the muscle and injecting the drug on the individual who assumed the role of the patient. During this time, the researcher and observers evaluated them in line with the steps in the checklist and recorded the total time taken on the log sheet. An average of 9 minutes was studied for each student. **(See Figure 37)**

Figure 37:

Participants Performed Ventrogluteal Injection Skill on a Hip Injection Model.

Implementation of Experimental Group

The experimental group was divided into four groups, each group had 8-9 students, the implementation plan was prepared as a three-day program to be carried out under the supervision of the researcher. The preparation of the virtual reality simulation learning environment, tools, and equipment in which the intramuscular (IM) injection ventrogluteal site virtual reality simulation software will be implemented, was prepared in advance. In addition, before starting the experimental group, the researcher has taken them one day to educate and teach them how to wear, try, and train about VRS tools before starting the study. **(See Figure38)**

Figure 38:

Researcher Introduced Ventrogluteal VRS Software.

Day 1 (Pre-test/Application in Virtual Reality Simulation (VRS) Software)

- **9:00-10:00:** all of the students (8 students) entered the laboratory with taking instructions of COVID-19, as hand hygiene and spacing, and explain them the aim and importance of this study, then completed the " consent form", "Information Form" and the "State-Trait Anxiety Inventory". On the other hand, the researcher told the students the importance of waiting after the finish to provide lecturing theoretical content and demonstrated on the enhanced injection model then VRS. After that, asked them to leave the lab and enter one by one.
- **10:00-10:35:** The researcher shared the theoretical content about the "Intramuscular Injection (IM) ventrogluteal site" skill, as a professional injection skill by using the presentation education method.
- **10:45-11:30:** researcher applied the checklist of the “Intramuscular Injection (IM) ventrogluteal site” skill step by step by demonstrating it on the enhanced hip injection model.
- **11:35-12:00:** researcher started to prepare VRS software devices (Oculus Quest and controller) and connected them with a computer device, turned on the system.
- **12:05-13:05:** researcher applied the checklist of the “Intramuscular Injection (IM) ventrogluteal site” skill step by step by demonstrating it as a virtual

simulation skill by wearing Oculus Quest device and controller, at the same time all of the students saw it on computer device as a group.

- **13:10-13: 35:** researcher provided students time to any inquires.
- **13:45-20:00:** students started to enter one by one, researcher asked the student to wear Oculus Quest (HMD) and controller gloves device, and entered the program as he/she learned before one day. Without limited time and knowledge on virtual intramuscular injection simulation skill software, the student started performing steps related to "the intramuscular (IM) injection ventrogluteal site " skill that converted as virtual reality simulation environment. During this time, the researcher and observers evaluated them in line with the steps in the checklist by seen on the computer device and recorded the total time taken on the log sheet. An average of 39 minutes was studied for each student.

Day 2 (Post-test/Application in Virtual Reality Simulation (VRS) Software)

This day extended From 9:00- 17:00

- One by one (8 students) was allowed to enter the nursing laboratory were prevented from watching each other.
- Each student performed virtual intramuscular injection ventogluteal site simulation skills, through wearing Oculus Quest device and controller devices without limited time. During this time, the researcher and observers evaluated them by seeing on a computer device in line with the steps in the checklist and recording the total time taken on the log sheet. An average of 22 minutes was studied for each student.
- Each student completed the "State-Trait Anxiety Inventory" within 3-4 min. after completing the application.

Day 3 (Application on voluntary Individual)

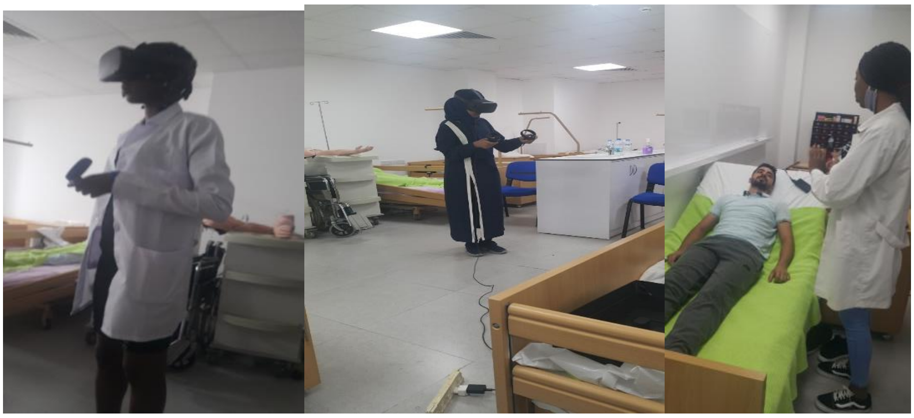
This day extended From 9:00- 12:00

- One by one students entered the nursing laboratory.
- Each student completed the "State-Trait Anxiety Inventory" within 3-4 min. before starting performed on voluntary Individual, who assumed the role of the patient.
- Each student a playing role (act drama) to perform intramuscular injection ventogluteal site skill on voluntary Individual without limited time, which may

be a limitation because it would be unethical to apply the step of entering the muscle and injecting the drug on the individual who assumed the role of the patient. During this time, the researcher and observers evaluated them in line with the steps in the checklist and recorded the total time taken on the log sheet. An average of 9 minutes was studied for each student. **(See Figure 39)**

Figure 39:

Students Performed Ventrogluteal Injection Skill on VRS Software.



All of the procedures were taken 2 months to finish, that distributed over four weeks long for each group. The time commitment required for each student was open-ended, which commenced and concluded with performance evaluation based on a checklist (pre-test /post-test/on the actual individual) under the supervision of the Researcher and two specialist observers **(See Figure 40).**

Figure 40:

Evaluated Performance Scores

Ethical consideration

The study data were collected from nursing students who volunteered to take part in the study after written permission from the Near East University Institutional Review Board (IRB) was obtained (Approval #YUD/2020/76-985). An informed consent form was signed by the nursing students who agreed to participate in the study. (**Appendix I**)

Financial resources

All of designing and developing virtual simulation software, and purchasing Oculus Quest device had been cost (2950$). The researcher obtained funding for this project in connection with the design and development of a virtual simulation environment for intramuscular injection skills, which was carried out by software developers in Fiverr Company by Tamkeen Foundation that was concerned about Palestinian women researchers in Palestine ($2000). In addition, regarding the Oculus Quest device, it was purchased from Amazon company (USA) by the researcher ($600). As well, the researcher paid for coding and installing the virtual software in the Oculus device ($350) to the information technology (IT) specialist.

Data Analysis

Data were analyzed by using SPSS Statistics version 25 for Windows (Statistical Package for the Social Sciences). Frequency percentages, arithmetic means, standard deviation values were used to analyze the descriptive statistical evaluation of the data. Paired sample T-test, and t-test for correlation among 3 observers. Mann-Whitney U test was used to assess the difference between and among both groups (pre-test, post-test, and on the actual individual) performance psychomotor skills, and state-trait anxiety scale. In addition, ANOVA; repeated measured ANOVA, Bonferroni test was used to assess time performance that was spent between and among both groups in the pre-test, post-test, and on a voluntary individual.

CHAPTER IV

Findings and Discussion

In this section, the results obtained from the study showing the effect of the virtual reality simulation as a learning strategy on an acquisition of ventrogluteal injection skill and anxiety level are presented in three parts;

• Findings on students' socio-demographic characteristics,

• Findings regarding the comparison of the checklist score averages for intramuscular ventrogluteal injection skill of the students in the control and experimental groups,

• Findings related to the comparison of state and trait anxiety levels of the students in the control and experimental groups according to the group and time **Findings**

Findings Related to Socio-Demographical Characteristics of Students

Socio-demographic characteristics of the students are presented in Table 4

Table 4:

Comparison of Students' Socio-Demographic Characteristics for Control and Experimental Group

	Experimental Group (n= 33)		Control Group (n = 33)		Total (N= 66)		Significance Level	
Age	**Mean ±SD**		**Mean ±SD**				**X^2**	**p**
	20.97±2.97		22.03±2.96				3.93	.14
	n	**%**	**n**	**%**	**n**	**%**		
Age groups								
17 - 20	19	57.6	11	33.3	30	45.5		
21 - 24	8	24.2	12	36.4	20	30.3		
≥25	6	18.2	10	30.3	16	24.2		
Gender							.000	1.00
Male	11	33.3	11	33.3	22	33.3		
Female	22	66.7	22	66.7	44	66.7		
Grade Point Average (GPA)	**Mean ±SD**		**Mean ±SD**					
	3.12±1.02		3.33±1.45				6.59	.36
	n	**%**	**n**	**%**	**n**	**%**		
GPA								
AA	0	0	2	6.1	2	3.05		
BA	12	36.4	7	21.2	19	28.8		
BB	8	24.2	10	30.3	18	27.3		
CB	10	30.3	11	33.3	21	31.8		
CC	3	9.1	1	3.0	4	6.1		
DD	0	0	1	3.0	1	1.5		
FD	0	0	1	3.0	1	1.5		
Have a personal computer	**n**	**%**	**n**	**%**	**n**	**%**	.26	.61
Yes	11	45.8	13	54.2	24	50		
No	22	52.4	20	47.6	42	50		

There was no statistically significant difference (p>, 05) between experimental and control groups in terms of "age, gender, mean professional courses' grade point average, having the personal computer". Groups were similar in terms of these characteristics. The control group's mean age was 22.03±2.96, 36.4% ranged between 21-24 age of, 66.7% were female, mean of professional courses' grade point average was 3.33±1.45 (successful), 33.3% had CB as a letter grade, 54.2% had a personal computer.

The experimental group's mean age was 20.97±2.97, 57.6% ranged between 17-20 age of, 66.7% were female, mean of professional courses' grade point average was

3.12±1.02 (successful), 36.4% had BA as a letter grade, 52.4% had not a personal computer.

Findings Related to the Comparison of the Intramuscular Ventrogluteal Injection Skill Checklist Scores of the Students Between Groups

The comparison of the mean scores of the students in the control and experimental groups regarding the items in the intramuscular ventrogluteal injection skill checklist over time as shown in (Appendix H)

Table 5

Comparison of Control and Experimental Group Students' Performance Psychomotor Skill

Group	Experimental Group (n=33)		Control Group (n=33)	Z	p-value
Performance psychomotor skill	**Test**	**Mean**	**Mean**		
	Pre	34.08± 3.90	31.17± 3.46	Z=-3.130	P=**0.002*****
	Post	31.73± 2.81	30.15± 3.86	Z=-1.420	P=0.15
	Before Practice on Voluntary Individual	32.84± 2.78	31.01± 3.51	Z=-2.208	P=**0.020****

*** Z=Mann-WitnnyU**

****p≤0.05 *** p≤0.01 ****p≤0.001**

There was a statistically advanced significant difference between the groups (p<,001) determined in pre- evaluation. And, There was a statistically significant difference between the groups in terms of before practice on voluntary individual application (p<,05) determined. And also, the mean of performance psychomotor skill in the experimental group (pre-evaluation 34.08± 3.90, post-evaluation 31.73± 2.81, and before practice on voluntary individual 32.84± 2.78, higher than the control group.

In pre-evaluation, there was a statistically highly significant difference between the groups in terms "Check accuracy and completeness of each record with health care provider's medication order"; "Assess patient's medical and medication history and history of allergies. "; "Relocate site using anatomical landmarks. "; "Remove gloves and perform hand hygiene." (p<,01) determined. While, there were statistically very advanced significant differences between the groups in terms "Assess for contraindications for IM injections, and diagnose whether the patient has muscle atrophy. "; "Close room curtain or door." ; "Hold swab or gauze between third and fourth fingers of the non-dominant hand. ”; “Hold the syringe between thumb and forefinger of dominant hand IM: Hold as a dart, palm down”; “Stay with patient and observe for any allergic reactions. ”; (p<,001) determined **(Appendix H)**.

İn post-evaluation, there was a statistically significant difference between the groups in terms “Remove needle cap or sheath from the needle by pulling it straight off” (p<,05) determined. And also, in before practice on voluntary individual evaluation in terms “Apply clean gloves.”; “Sheet or gown draped over body parts not requiring exposure.”; “Remove needle cap or sheath from the needle by pulling it straight off”; “Withdraw needle while applying alcohol swab or gauze gently over the site”; “Help the patient to a comfortable position. ” **(Appendix H)**.

Table 6:

Comparison of the Mean Scores within Groups for Performance Psychomotor Skill Checklist

Group		**Test**	**P (within-group)**
		Pre vs. Post	0.9952
		Pre vs. Before Practice on Voluntary Individual	**0.0173***
Performance psychomotor skill	**Experimental**	Post vs. Before Practice on Voluntary Individual	**0.0154***
		Pre vs. post	**0.0062****
		Pre vs. Before Practice on Voluntary Individual	**0.0068****
	Control	Post vs. Before Practice on Voluntary Individual	0.9999

***p≤0.01 **p≤0.001**

In table 6, the finding showed that there was a statistically significant difference within the experimental group in terms of pre/post and Before Practice on Voluntary Individual (p<,01) determined. And also, showed that the mean of performance psychomotor skills scores is highest in pre-application (34.08± 3.90). While, within the control group showed that there was a statistically highest significant difference in terms of pre and post-application, and pre and before-practice on voluntary individual application (p<,001). And also, showed that the mean of performance psychomotor skills is higher in pre-application and before practice on voluntary individual application (31.17± 3.46; 31.01± 3.51) respectively than post-application (30.15± 3.86).

Comparison of the Performance Times of the Experimental and Control Groups Regarding the Practicing Intramuscular Ventrogluteal Injection Skill

Table 7, shows the comparison of the time to practice intramuscular ventrogluteal injection skills of the students in the experimental and control groups.

Table 7:

Comparison of Control and Experimental Group Students' Performance Time (Between Groups)

	Group	**Experimental Group (n=33)**	**Control Group (n=33)**	**Lower - Upper 95% CI (Control Group)**	**Lower - Upper 95% CI (Experimental Group)**	**P (between groups)**
Performance time (Min.)	**Test**	**Mean**	**Mean**			
	Pre	38.67± 11.13	11.79± 3.68	10.48-13.09	34.72-42.61	<0.001***
	Post	22.24± 7.62	8.82± 2.07	8.09-9.55	19.54-24.94	<0.001***
	Before Practice on Voluntary Individual	9.273± 2.09	9.00± 2.95	7.96-10.05	8.53-10.02	0.990

***p≤0.001

In table 7, the finding showed that there was a statistically very advanced significant difference between the groups in terms of pre-application and post-application (p<,001) determined. And also, showed that the mean of performance psychomotor skills time scores according to the control group (pre-application 11.79± 3.68, post-application 8.82± 2.07, and Before Practice on Voluntary Individual-application 9.00± 2.95) was Faster than the experimental group (pre-application 38.67± 11.13, post-application 22.24± 7.62, and Before Practice on Voluntary Individual-application 9.273± 2.09).

Table 8:

Comparison of Control and Experimental Group Students' Performance Time (Within Group)

Group		Test	P (within-group)
Performance Time	Experimental	Pre vs. Post	**<0.0001*** **
		Pre vs. Before Practice on Voluntary Individual	**<0.0001*** **
		Post vs. Before Practice on Voluntary Individual	**<0.0001*** **
	Control	Pre vs. Before Practice on Voluntary Individual	**<0.0001*** **
		Pre vs. Before Practice on Voluntary Individual	**0.0016** **
		Post vs. Before Practice on Voluntary Individual	**0.9972**

$^{**}p\leq0.001$ $^{***}p\leq0.0001$

In table 8, the finding showed that there was a statistically very advanced significant difference within the experimental group in terms of all of the tests (p<,0001) determined. And also, showed that the mean of performance psychomotor skills time scores are the fastest in minutes before practice on voluntary individual application (9.273± 2.09). While, within the control group showed that there was a statistically very advanced significant difference in terms of pre and post-application (p<,0001), and pre and before practice on voluntary individual-application (p<,001). And also, showed that the mean of performance psychomotor skills time scores are the faster in a minute in post-application and before practice on voluntary individual application (8.82± 2.07; 9.00± 2.95) respectively than pre-application (11.79± 3.68).

Findings Related to the Comparison of State and Trait Anxiety Levels of the Students in the Control and Experimental Groups According to the Group and Time

Table 9 identified the students' anxiety level about performing ventrogluteal intramuscular ventrogluteal injection skills related to the State-Trait Anxiety Inventory (STAI) Scale by the group for experimental and control groups.

Table 9:

Comparison of State and Trait Anxiety Levels of Students in Control and Experimental Groups by Group

	Group	**Experimental Group (n=33)**	**Control Group (n=33)**	**Z***	**Statistical Analysis**
State Anxiety	**Test**	**Mean**	**Mean**		**p**
	Pre	52.76±8.19	47.39±5.83	-5.36	**0.036****
	Post	50.24±6.51	48.79±6.62	-1.46	0.90
	Before Practice on Voluntary Individual	51.42± 7.22	47.76±6.55	-3.67	0.28
Trait Anxiety	Pre	49.48±5.62	46.12±6.62	-3.36	0.168
	Post	48.58±4.87	47.15±7.009	-1.42	0.914
	Before Practice on Voluntary Individual	48.09±5.33	45.49±7.167	-2.15	0.772

*** Mann-WitnnyU-test ** p≤0.05**

As seen in Table 9, it was determined that the students in the control group had moderate state anxiety (47.39±5.83) and moderate trait anxiety (46.12±6.618) scores at pre-application. It was determined that the students in the experimental group had moderate state anxiety (52.76±8.19) and moderate trait anxiety (49.48±5.62) anxiety scores at pre-application. It was determined that there was a statistically significant difference between the state and trait anxiety mean scores of the students in the control and experimental groups pre-application (p≤0.05).

According to the control group had moderate state anxiety (48.79±6.62) and moderate trait anxiety (47.15±7.009) scores at post-application. It was determined that the students in the experimental group had moderate state anxiety (50.24±6.51) and moderate trait anxiety (48.58±4.87) anxiety scores at post-application. It was determined that there was no statistically significant difference between the state and trait anxiety mean scores of the students in the control and experimental groups post-application (p>.05).

According to the control group had moderate state anxiety (47.76±6.55) and moderate trait anxiety (45.49±7.167) scores at Before Practice on Voluntary Individual application. It was determined that the students in the experimental group had moderate state anxiety (51.42± 7.22) and moderate trait anxiety (48.09±5.33) anxiety scores at Before Practice on Voluntary Individual application. It was determined that there was no statistically significant difference between the state and trait anxiety mean scores of the students in the control and experimental groups Before Practice on Voluntary Individual application (p>.05).

Table 10:

Comparison of State and Trait Anxiety Levels of Students within Group

Group		**Test**	**P (within group)**
		Pre vs. Post	0.666
		Pre vs. Before Practice on Voluntary Individual	0.9699
State Anxiety	**Experimental**	Post vs. Before Practice on Voluntary Individual	0.8286
		Pre vs. post	0.9709
		Pre vs. Before Practice on Voluntary Individual	>0.9999
	Control	Post vs. Before Practice on Voluntary Individual	0.8739
		Pre vs. Post	0.9711
		Pre vs. Before Practice on Voluntary Individual	0.7739
Trait Anxiety	**Experimental**	Post vs. Before Practice on Voluntary Individual	0.9797
		Pre vs. post	0.9897
		Pre vs. Before Practice on Voluntary Individual	>0.9999
	Control	Post vs. Before Practice on Voluntary Individual	0.8917

In table 10, the finding showed that there was no statistically significant difference within groups in the State-Trait anxiety scale in all of the tests. While the mean of State-Trait Anxiety is the highest in the pre-application (52.76±8.19; 49.48±5.62) in the experimental group respectively. And, the mean of State-Trait Anxiety is the highest in the post-application (48.79±6.62; 47.15±7.009) respectively in the control group.

Table 11 identified the students' anxiety level about performing ventrogluteal intramuscular injection skills related to the State-Trait Anxiety Inventory (STAI) Scale by the time for experimental and control groups.

Table 11:

Comparison of State and Trait Anxiety Levels of Students in the Control and Experimental Groups by Time

Group	**Time**	**Pre**	**Post**	**Before Practice on Voluntary Individual**	**f***	**Statistical Analysis p**
State Anxiety	Experimental Group (n=33)	52.76±8.19	50.24±6.51	51.42± 7.22	1.580	.148
	Control Group (n=33)	47.39±5.83	48.79±6.62	47.76±6.55		
Trait Anxiety	Experimental Group (n=33)	49.48±5.62	48.58±4.87	48.09±5.33	2.294	.032
	Control Group (n=33)	46.12±6.62	47.15±7.009	45.49±7.167		

There was no significant statistical difference in three times between the experimental and control groups related to State trait anxiety (f=1.580, p=0.148) (p>0.05).while, in Trait Anxiety, there is a significant statistical difference in three times between the experimental and control group (f=2.294, p=0.032) (p>0.05) (Table 11).

Discussion

In the nursing profession, contraction the gap between theory and practice in nursing education is a continuous encounter for academic educators. in this study, the researcher using two various learning strategies as injection hip model and virtual reality simulation (VRS) to demonstrate the effectiveness of VRS as a learning strategy to acquisition intramuscular ventrogluteal injection skills among the first year of nursing students in NEU.

Understanding the procedural step by step is an important condition to perform skill as a successful execution, through skill acquisition theory; learning skill includes the cognitive that essential to carry out a skilled performance of a sequence; associative that involves experiential learning, learners practice and improve their performance based on what they know until effective patterns of performance appear (Anderson, 1983; Fitts & Posner, 1967; Dubovi et al., 2017), which learning with VRS lets experiential learning and error training.

The findings obtained from the study which was planned to design and create, and develope virtual reality simulation for intramuscular ventrogluteal injection skill in nursing education, and to determine the effectiveness of virtual reality simulation on acquisition skill and anxiety level were discussed in accordance with the literature as;

• Comparing the mean scores of the control and experimental group students' checklist scores for intramuscular ventrogluteal injection skill, and

• Comparing the state and trait anxiety levels of the students in the control and experimental groups according to the group and time.

When the distribution of students according to their socio-demographic characteristics is examined; The average age of the students in the control group is 22.03±2.96 and the majority (36.4%) are in the 21-24 age group. The weighted grade point average of vocational courses is 3.33±1.45and the majority (66.7%) are women. The average age of the students in the experimental group is 20.97±2.97, and (57.6%) are in the age group of 17-20. The weighted grade point average of vocational courses is 3.12±1.02 and the majority (66.7%) are women.

Most of the students in the control group (54.2%) did not have a personal computer, and (52.4%) of the students in the experimental group did not have a personal computer.

Intramuscular Ventrogluteal Injection Skill Checklist Mean Scores of the Students in the Control and Experimental Groups

- **Hypothesis 1_0:There is no difference between the groups in terms of skill level in the laboratory section of ventrogluteal injection training with Model and Virtual Reality.**

In this study, the between-group noted that there was a highly significant difference in the mean score of a pre-test for the skill of administrating intramuscular injection in ventrogluteal site in the experimental group(34.08±3.90; p<.01), and within-group, there was a statistically significant difference within the experimental group in terms of pre/post and Before Practice on Voluntary Individual and the mean of performance psychomotor skills scores is highest in pre-application (34.08± 3.90), which it is agree with the study of Bayram et al. (2019) that indicated the first mean scores for the inner cannula cleaning (p=0.000)and peristomal skincare (p=0.033) skills of the students in the experimental group were higher than those of the control group at a statistically significant level. It should be considered that inner cannula cleaning and peristomal skincare are a mechanical procedure that is rather easier than other skills and can be learned by watching the demonstration and repeating the procedural steps only once (Bayram & Caliskan, 2019). So, the administration of intramuscular injection based on VRS in this study can be learned through observing and presenting the most critical points that related to it such as identify the correct site of injection, defining the medication rights, perform the skills orderly,..etc.

In addition, there is another study agree this study, Jamison et al, (2006) that reported there was a significant increase ($p < 0.05$) from pre-test (mean= 9.40) to post-test (mean= 10.90) scores for the experimental group, who used virtual simulation IV cannulation, which related to students perceived that the most important educational practices in learning the skill of IV cannulation were feedback (mean= 2.1) and diverse ways of learning (mean= 2.2). In addition, it used the most important design features to include in an ‘‘ideal’’ simulation was perceived to be feedback/debriefing by the students (mean= 1.7) and cueing (Jamison et al., 2006), and study of (Dubovi, 2017) showed that the VRS has the features allowing students to obtain information at their own pace, using both visual and auditory sensory channels to process-related information leading to better learning. Thus, helps focus students' attention on the suitable task in the practical environment.

In the study of Ismailoglu & Zaybak (2018), the students who participated and practiced VIS were higher scores in the experimental group than those in the control group which practiced on the plastic arm model, this reason related to enabling VIS provides various case scenarios and realistic complications, and thus allows students to develop cognitive and psychomotor skills necessary for IV interventions (Ismailoglu & Zaybak, 2018), as well this study agree (Jung et al., 2012; Sotto et al., 2009; Wilfong et al., 2011)studies.

There were various studies indicated that we can use virtual reality simulation in different skills, which improved mean tests scores ($p < 0.05$) as suctioning, chronic obstructive lung disorder, post-op morphine treatment, cardiopulmonary resuscitation, advanced life support game-based virtual reality application (Boada et al., 2015; Buttussi et al., 2013; Lancaster, 2014; Noyudom et al., 2011; Tsai et al., 2015).

On the other hand, in the study of Ismailoğlu and Zaybak (2018), showed that the mean psychomotor skills score during IV catheterization of the control group was lower than of the experimental group that (Z = 5.294, P = .000), although knowledge scores related to IV catheterization there was no statistically significant difference between the experimental and control groups in terms on pre-test and post-test, because both groups were applying with relevant theoretical knowledge and then performed the IV catheter intervention steps in the laboratory as several times as they wanted, which may have enhancing the knowledge of all participants, it is not surprising that agree on the study of (Engum et al., 2003; Reyes et al., 2008; Seo et al., 2014). Teaching psychomotor skills is a significant process that comprises transferring students' theoretical knowledge to practice and developing their performance skills (White & Evan, 2002). Within the group, in this study there were significant differences in pre-/post-application and before practice on voluntary individual and the mean highest in pre-application in the experimental group, which is related students take lecture theoretical and demonstrated in two education method (hip injection model then VRS) before performed intramuscular injection skill that can enable them to keep their knowledge, and performed this skill in standard steps.

Hypothesis 30: There is no difference between the groups in terms of skill level on the voluntary individual of ventrogluteal injection training with Model and Virtual Reality.

İn this study, showed that there was a statistically significant difference between the groups in terms of before practice on voluntary individual application ($p<,05$). And the mean of performance psychomotor skill in the experimental group (32.84± 2.78) was higher than the control group, which agreed the study of Vidal et al. (2013) that indicated for those trained on the simulated limbs performed better had significantly produced less few hematomas when they attempted phlebotomy skills on actual patients. These results showed that VRS is an efficient teaching-learning method and the environment because they are accurate models of reality, allow practicing without harming the patient/individual, and give a free learning environment that allows for individual in-depth learning with these areas. As well as, they are beneficial in performing psychomotor skills exactly for nursing education (Işık & Kaya, 2014; Tsai et al., 2004).

It is notable that both methods of training are not perfect by themselves and do not completely represent the intramuscular injection skill as performed on patients. Thus, students who have higher performance scores also had an improved level of preparedness (Pamela, 2015). For example, neither the Hip Model Injection nor the VRS provides a challenge in palpation of the site and the selection of the insertion site. Those trained using the simulated device can easily choose the site when relocating prone position related to the ventrogluteal skill steps through palpating by controller gloves. Therefore, the use of VRS has been confirmed to be useful in teaching psychomotor skills as a supplemental tool for learning strategies, such as administrating intramuscular injection in ventrogluteal sites, which are too complicated to completely learn through a single observation in the traditional laboratory and rare practice in clinical settings.

Performance Times of the Experimental and Control Groups Regarding the Practicing Intramuscular Ventrogluteal Injection Skill

Between-group, this study showed that the mean of performance psychomotor skills time scores according to the control group better than the experimental group (p<,001). That means to complete performance all steps of the intramuscular procedure in the experimental group took longer time on mean scores of pre and post-test than the control group. that agree with the results observed in studies by Bayram et al. (2019), Vidal et al. (2013). Because there is a gap between completing virtual cases and real practice in nursing skills on account of the immaturity of VR technology which student nurses had used the first time and they didn't have any experience of virtual simulation systems before (Succar et al., 2013). In addition, may be related to technical issues that are not found in traditional hip model injection such as network disconnect, limited device charging. Furthermore, students didn't try to perform intramuscular injection procedures before requiring maintenance knowledge and several steps to complete, deep understanding, critical thinking, decision making, reflective thinking, and competency in psychomotor skills. Thus, that does not mean that learning outcomes with VRS decreased, but it may be that the use of a VR-based system as a supplement to the traditional method is the optimal program for training nurses (Foronda et al., 2020). This study showed significant difference performance time scores within groups in pre, post-test, and actual individuals that had the fewest minutes in the experimental group, that agreed with studies by smith et al. (2016) ($p = .016$) and Jung et al. (2012) ($p=0.007$), this may be because performing skill by using VRS is easy to complete in order and without error as appeared in the laboratory. And within the group, showed that there was a statistically very advanced significant difference within the experimental group in terms of all of the tests and the mean of performance psychomotor skills time scores is the fastest in a minute in before practice on voluntary individual-application (9.273± 2.09), which this confirms that VRS considered as an accessible learning environment, by allowing repetitive exposure to educational content to develop cognitive and skill mastery among nursing students, which increasing competency of them to perform skills and providing patient safety (Chang, 2018; Rourke, 2020; Smith et al., 2016). And agree with the study of Smith et al (2016) that showed initially and at the 5-month time point in the VRS group participants performed the decontamination faster than the control group, which assists decontamination to be faster at the retention time point. Thus, students get faster at a task with repetition, improving retention of skill in procedural memory, and they will learn faster by having experience with the action, previous knowledge, and familiarity (Richards, 2003)

State and Trait Anxiety Levels of the Students in the Control and Experimental Groups

- **Hypothesis 2₀: There is no difference between the groups in terms of anxiety level in the laboratory section of ventrogluteal injection training with Model and Virtual Reality.**

We found a limited articles that outlined the measurement of student anxiety and virtual reality simulation. In this study, the between-group, there is a significant difference in a pre-test in state anxiety level, and mean was higher in the experimental group than the control group, which related to unfamiliarity with the intramuscular injection VR simulator skill during initial experiences. Whereas, the state anxiety levels of students after practice on the VR simulator in the experimental group are lower than before practice on the simulator and on the voluntary individual, which agreed with the literature that indicates that VR simulation decreases anxiety levels by enhancing active participation in the teaching-learning process and providing an effective and productive learning experience (Işık & Kaya, 2014; McCaughey & Traynor, 2010). While, within the group, there was no statistically significant difference within groups in State-Trait anxiety scale in all of the tests. Although the mean of State-Trait Anxiety is the highest in the pre-application in the experimental group because there is no experience for students to this method, there is fear feeling that affects their performance. And, the mean of State-Trait Anxiety is the highest in the post-application in the control group.

- **Hypothesis 4$_0$: There is no difference between the groups in terms of anxiety level on the voluntary individual of ventrogluteal injection training with Model and Virtual Reality.**

This study showed that anxiety experienced during practice on the voluntary individual higher than the experienced in a laboratory setting in both groups, which agreed with the study (Melincavage, 2011) showed that participants feeling anxiety because they didn't have real practice experience, the chance of making mistakes or harming patients. Also, probably anxiety levels appeared from the technical issues surrounding the environment of VRS not simulation itself compared hip injection model, which has been more comfortable for students, which is congruent with the study (Cobbett & Snelgrove-Clarke, 2016). On the other hand, According to practice on human, this study showed that the mean score of state anxiety (51.42± 7.22) and trait anxiety (48.09±5.33)in the experimental group was higher than the mean score of state anxiety (47.76±6.55) and trait anxiety (45.49±7.167) in the control group on before practice on volunteer individual, which is agreeing the study of Bayram & Caliskan (2020) that indicated the anxiety experienced by the experimental group that inserted virtual IV catheterization might be since it was their first clinical experience (Bayram & Caliskan, 2020). The same result in the study of Gold et al. (2005) indicated 57 of the participants found that children delivered to VR distraction reported significantly less pain ($p < .05$). Likewise, children in the VR group reached less effective needle pain than children in flat-screen VE distraction and the cartoon groups (Gold et al., 2005).

Limitations of the Research

- ✓ The research was carried out in the 2019-2020 academic year, at Near East University. It is limited to 66 first-year students studying at the Faculty of Nursing who participated in this study and the results of the research cannot be generalized.
- ✓ Failure to elect new students to replace those who left (2 students) selected for the experimental and control groups, because there is no transportation for them.

- ✓ Implementing in a short time (3 days) for each group to prevent peer interaction, and once time for each student.
- ✓ No applied the intramuscular injection skill on a real patient and did this skill by acting case on a voluntary individual.
- ✓ Due to the pandemic, the research process has undergone a mandatory change and students learned the IM injection unit theoretically online in the Fundamentals of Nursing course. Therefore, students had pre-learning on the subject before applying the skill to the voluntary individual

Situations Encountered During the Conduct of the Research

Positive Situations;

- ✓ The willingness and voluntary participation of the students who met the criteria for presence in the study group facilitated the conduct of the study.

Adverse Situations;

- ✓ Inability to obtain the necessary support for the development of the Virtual Reality Simulation from the Scientific Research Projects Unit of the university
- ✓ The unintentional prolongation of the data collection process due to the worldwide pandemic caused by the covid-19 virus.

CHAPTER V

Conclusion and Recommendation

Conclusion

As a crucial health profession, nursing needs to continue realistic, skills-based learning and integrated it between the classroom and the practical setting. In addition, nurse educators must transform nursing education, from side to side the use of current and advanced technology and related education to our nursing student's quality whenever convenient.

Psychomotor skills are a essential element for all medical practices (Ahern & Wink, 2010). Simulation provides a novel and innovative way for teaching psychomotor skills. Nevertheless, quantitative research about the ability of this teaching strategy is widely requiring, mainly in the nursing literature. Given the significance of experienced psychomotor skill performance, it is radical that teaching strategies discovered for usefulness(Bayram & Caliskan, 2020).

This study not contributed only to narrowing the gap in the study concerning the usability of VRS software based on the ADDIE instructional model the perception of the use of deliberate practice and game-based learning in nursing education to promote students’ skill learning and retention.

Similar any teaching-learning strategy, this VR game may not be ideal alone, so it should be supported with other traditional teaching strategies/methods.

This study showed the might use of VR as a complementary tool to traditional learning/teaching methods, as used it in administrating intramuscular injection skill in ventrogluteal site alongside traditional laboratory environment, it is a valuable teaching-learning strategy for training in clinical and psychomotor skills demanding the ordering of skill steps in teaching, in which may have a positive impact on a performance level, and a decrease in anxiety levels for nursing students and reduce their errors. In addition, providing realistic injection experiences that instead of the unavailability of actual patients in clinical settings encourage safe nursing practice.

The merging of virtual clinical simulation into current standardized nursing curriculum content is cost-effective, and achievable strategy for providing an further means for student skill acquisition and evaluation, as well as an accessible solution that allows students to repeatedly interact in VR environments.

Practical Implications for Nursing Education

The future is bright in this direction with the current trend in technology and the growing ease to manipulate and access programs from distant locations. The use of Virtual Reality Simulations will promote the study of many topics including nursing education.

Nursing students today are modern, digital natives, and adult learners who prefer learning and practical experience similar to the way they have gained information in life, interactively, and enriched with audio, visual, and kinesthetic (motor) media that are different from previous generations.

This study was completed as a supplement to education acquired in the traditional physical laboratory. VRS will become an increasingly important skill with the current trend toward computer-based learning. Students will need to become comfortable interacting with computer learning modules as interact with classroom lessons. The availability of nursing skills on Oculus Rift software will be an asset to providers who are unable to ask advice from their colleagues as well as providers who are in training.

This type of VR learning will also be useful to those who have graduated and left the traditional lab at the university. And also, who are far away from their colleagues to utilize, explore and reexamine all the nursing skills, such as intramuscular ventrogluteal injection skills at a time that is suitable to their need.

The literature suggested using innovative alternatives to traditional apprentice-based methods of teaching and learning in nursing education that become feasible, with appearing technological advances and more educational tools. Nurse educators need to explore the choices and locate evidence to support the strategic implementation of these tools for learning.

The findings of this study subscribe to the want of literature concerning the use of virtual reality simulation for practicing procedural skills in nursing education. In addition, this study affords a sample learning tool, and empirical results the following contributions for future research:

- The designed and developed VRS software of this study can be used as a learning tool to improve skills concerning nursing concepts and procedures.
- The VRS software should intend regarding the wanted learning outcomes and capabilities of the target audience.

- The implemented practice opportunity of VRS software supports the qualified learners to enhance their performance and reduced anxiety levels.
- Software like VRS (Oculus Rift) that stimulates visual and hearing senses with multimedia for practical utilization in Fundamental nursing courses should engage digital native nursing learners.
- The findings of this study will be contributed to a developing knowledge base in nursing education research about the effects of VRS software on student performance and recognized proficiency in fundamental content knowledge by adding new information to the body of evidence related to gaming simulation instruction.
- Nursing stakeholders (i.e., nursing education accreditors, administrators, program chairs, and faculty) accountable for decision-making whether to embrace VRS software used to fulfill nursing curriculum can enable themselves with evidence-based decisions from this study in their decision-making.

Recommendations for Future Research

The use of VRS in education has expanded greatly in the past decade, which has become a vital part of education and will continue to grow in use. So, this study offers further recommendations:

- This study recommended generalizing findings, by using other samples of fundamental nursing students, whose registered in diploma and practical nursing programs, community colleges, and public higher education institutions.
- More research with larger and various samples may discover additional advantages or disadvantages of VRS to learning not shown by those in this study.
- In this study was used one type of VRS application that stimulated the senses of vision and touch. So, further studies are required using other types of VRS (partial reality or full reality) to identify if there are differences when two or more different senses are stimulated.
- Recommended using different VRS software versions for other nursing courses as mental health, pediatric, and medical nursing. And also, in

different nursing skills as intravenous skill, blood pressure measurement, colostomy care, etc. to construct the body of evidence practice.

- Nurse educators require to know technical and educational tools in technology-enhanced learning environments through designing and creating learning environments where to encourage and support student learning.
- Nurse educators and faculties improving and developing an undergraduate curriculum of nursing education by inserting and merging innovative strategies methods as virtual reality simulation in various practical nursing skills that lead raising student performance by letting the indefinite applying of various clinical scenarios in a risk-free environment, which assists the motivation and satisfaction of the student.
- There is a requirement for further research in the field of designing and developing technology and integrated with nursing to help students perform various nursing skills.
- There is a requirement for further research on the use of VRS software with present technology to examine the cost and effectiveness of improving knowledge, skills, and effective outcomes as satisfaction, self-efficacy, and anxiety.
- Further researches are required to evaluate the relationship between VRS and students' transfer knowledge and skill acquisition from the simulation environment to the real clinical setting.
- Produce interdisciplinary (relevant departments of universities and relevant institutions/organizations) R&D projects in the development of simulation software/simulators,
- Perform intentional learner debriefing and/or self-reflection to confirm the benefit of learning and the capability to carry practice from the VR to patient care to decide the effect on patient outcomes relating to patient safety.
- Define what is more comfortable for nursing students' when they using technology/ gaming that affects performance outcomes.
- VR that has standalone head-mounted displays (HMDs) may offer high-quality displays, more flexible, and comfortable usage to the users that can be affected their performance and satisfaction.
- This study recommended adding and designing different learning scenarios by using the other virtual tools and nursing skills.

- This VRS software can be evaluated by novice nurses in-service training.
- Future work should be done fully experimental, and with different student groups, and More days of practice may be recommended.

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APPENDICS

APPENDIX (A)

Evaluation Form

Dear Students,

This form is an evaluation of a virtual reality simulation software of the skill "Intramuscular Injection in Ventrogluteal Side" was developed to determine your thoughts on. Research results to be reliable, please carefully read each question and mark the appropriate option. and take care not to leave any questions blank. Thank you very much for your participation.

Msc. Samar THABET JALLAD
PhD student in YakınDogu University, Lefkosa/TRNC
sammar1986@live.com

Student ID Number:..............................

Your Views on The Technical Features of The "Intramuscular Injection in Ventrogluteal Side " Virtual Reality Software			
	I agree	**Undecided**	**I don't agree**
1. The method for adjusting the VR glasses on my head was effective			
2. I felt comfortable wearing this type of VR glasses			
3. I was satisfied with the VR glasses lenses			
4. I was satisfied with the material of the VR glasses			
5. This type of VR glasses had good shading features			
6. The cursor (controller gloves) could precisely select the target			
7. I could understand the guiding intention of the cursor			
8. I was satisfied with the size of the cursor design.			
9. I was satisfied with the navigation of the interface design.			
10. I was satisfied with the screen brightness			
11. I was satisfied with the main interface design			
12. I was satisfied with the design of the 3D video playing scenarios that related to intramuscular injection ventrogluteal side			
13. I was able to operate the main interface correctly.			
14. I was able to find the main interface quickly.			
15. Expressions of the interface prompt in VR simulation software were clear			
16. The landing page/start of the software was remarkable.			
17. I was able to turn the page in the video interface.			
18. I was able to return the list in the video interface easily.			
19. I was able to complete the 3D video that related to intramuscular injection ventrogluteal side operations.			
20. I was able to exit the video playing interface easily.			
21. the graphical display had an image and the 3D depth that were indicated easily.			
22. I was able to move and manipulated the objective indicated easily.			
23. I was able to interact with objects and tools as indicated effectively			

24. I was able to identify parts of the environment which may be created unexpected effects such as moving through walls and floating objects.			
25. I was able to interact with other controls, such as menus and palettes			
26. It was easy to learn the commands of the VR simulation software.			
27. I was able to adjust the volume of the VR simulation software myself			
28. I was able to adjust the flow time of the VR simulation software myself.			
29. The VR simulation software allowed me to fix it when I made a mistake.			
30. The VR simulation software provided the opportunity to return to the screens I worked on before.			
31. It was easy to move within the VR simulation software.			
32. The special keys (forward-backward, close button, etc.) in the software were easy to use.			
33. Feed backs used in the VR simulation software were supportive of learning.			
34. Students were allowed to interact with the VR simulation software.			
35. The VR simulation software was easy to use.			
36. There was no working and programming error in the VR simulation software.			
37. I believe the VR simulation software is a tutorial.			
38. I really like using the VR simulation software.			
Your Views on The Content of The "Intramuscular Injection in Ventrogluteal Side " Virtual Reality Software			
39. The topics included in the software were easy to find.			
40. In the VR simulation software, the purpose and objectives of the unit met my requirements.			
41. In the VR simulation software, the content plan of the unit met my requirements.			
42. the VR simulation software, gender, race, etc. it was arranged in a way that does not discriminate according to student characteristics.			
43. VR simulation software was more effective than traditional education methods.			
44. I felt that I had accomplished an important job while using the VR simulation software.			
45. I felt more responsibility to learn while using the VR simulation software.			
46. The VR simulation software gave an opportunity to use advanced computer technologies.			
47. The VR simulation software was designed to facilitate the learning of risky practices/skills.			
48. The VR simulation software students were prepared for future experiences.			
49. The "Intramuscular injection (IM) by ventrogluteal side" stages of the VR simulation software was well designed, I did not have any difficulties in application.			
50. I think that I would like to use this VR simulation software frequently			
51. I think the VR simulation software was easy to use			
52. I think that I would need the support of a technical person to be able to use this VR simulation software			
53. I found the various functions in this VR simulation software were well-integrated			

54. I thought there was too much inconsistency in this VR simulation software			
55. I would imagine that most people would learn to use this VR simulation software very quickly			
56. I felt very confident using VR simulation software.			
57. I needed to learn a lot of things before I could get going with this VR simulation software.			
Your Views on The Motion Sickness of The "Intramuscular Injection in Ventrogluteal Side" Virtual Reality Software			
58. I felt Nausea			
59. I felt Difficulty concentrating			
60. I felt Headache			
61. I felt Dizziness			
62. I felt Drowsiness			
63. I felt Fatigue			
64. I felt Difficulty focusing			
65. I felt General discomfort			
66. I felt Boredom			
67. I felt Tired eyes			
68. I felt Eyestrain			
69. I felt Blurred vision			
70. I felt Sore/aching eyes			

71. What are the most difficult problems while using the software, explain briefly.

....

....

72. What are the things you like the most while using the software, explain briefly.

....

....

73. What are your suggestions?

....

APPENDIX (B)
INFORMED CONSENT FORM

Name of The Study: "The Effectiveness of Virtual Reality Simulation as a Learning Strategy on Acquisition of Ventrogluteal Injection Skill and Anxiety Level."

Coordinators of The Study: Msc. Samar THABET IBRAHIM JALLAD, Assist. Prof., PhD, BSN, Burçin IŞIK

Aim of the Study: This study was planned to determine to determine the effectiveness of virtual reality simulation as a learning strategy on acquisition of ventrogluteal injection skill and anxiety level.

In this work, your name will not be mentioned in any way. All data will be collected by the researcher and stored safely.

My name is ...., I have read the text above and fully understood the scope and purpose of the work I was asked to participate, and the responsibilities that I voluntarily took on me. I had the opportunity to ask and discuss about the study and I received satisfactory answers. I understood that I could leave this work whenever I wanted and without having to state any reason, and that I would not face any adverse attitudes when I left. Under this circumstances, ı agree to participate in research without any pressure and coercion.

Participant	**Researcher**	**Interview Witness**
Name-Surname:	Name-Surname:	Name-Surname:
Signature:	Signature:	Title:
Date:	Date:	Signature:
		Date:

APPENDIX (C)
INFORMATION FORM

Distinguished Student,

This form is designed to collect data about your socio-demographic characteristics. Your responses will directly affect the scientific validity of the study. The data of the work will be kept confidential. Thank you for your participation .

Msc. Samar THABET JALLAD
PhD student in YakinDogu University, Lefkosa/TRNC
sammar1986@live.com

Student ID number:..................

1. **Gender:** ( ) Female ( ) Male
2. **Age:**

   ( )18 ( )19 ( )20 ( )21 ( )22

   ( )23 ( )24 ( )25 ( )Other ....
3. **Grade Point Average (GPA)**

   ( )AA=4.00 ( )BA=3.50()BB=3.00 ()CB=2.50( )CC=2.00

   ( )DC =1.50 ( )DD=1.00 ( )FD=0:50 ( )FF=0.00
4. **Did you have a personal computer?** ( ) Yes ( ) No
5. **Did you have education about computer/computer software?**

   ( ) Yes ( ) No
6. **Did you have knowledge of virtual reality simulation/simulation software?** ( ) Yes ( ) No
7. **Did you graduate from the diploma programs of the Vocational School of Health?** ( ) Yes ( ) No
8. **Did you come with vertical transfer?** ( ) Yes ( ) No
9. **Did you train and have experience in intramuscular (IM) injection and preparing medication from an ampoule and similar invasive administrations without this course?** ( ) Yes ( ) No
10. **Did you work in any health institution and organization ?**

    ( ) Yes ( ) No
11. **Did you use virtual reality simulation related to ventrogluteal injection and similar intramuscular applications?** ( ) Yes ( ) No

APPENDIX (D)

FUNDAMENTALS OF NURSING SKILLS (CHECK LIST)

Administering Injections Intra muscular injection (IM) (Ventrogluteal site)			
	Procedure Steps	**Done (1)**	**Not Done (0)**
1.	Check accuracy and completeness of each record with health care provider's medication order.		
2.	Check patient's name, medication name and dosage, and route and time of administration.		
3.	Assess patient's medical and medication history and history of allergies.		
4.	Observe verbal and nonverbal responses toward receiving injection.		
5.	Assess for contraindications for IM injections, and diagnose whether the patient has muscle atrophy		
6.	Perform hand hygiene.		
7.	Aseptically prepare correct medication dose from ampule or vial. Check label of medication with record times while preparing medication.		
8.	Apply the six rights of medication administration throughout medication administration.	.	
9.	Close room curtain or door.		
10	Identify patient using at least two identifiers (e.g., name and birthday or name and medical record number) according to agency policy.		
11	Compare name of medication on label with record one more time at patient's bedside		
12	Explain steps of procedure and tell patient that injection will cause slight burning or sting.		
13	Apply clean gloves.		
14	sheet or gown draped over body parts not requiring exposure.		
15	Select appropriate injection site. Inspect skin surface over sites for bruises, inflammation, or edema.		
	IM ventrogluteal site: ▪ Note integrity and size of muscle and palpate for tenderness or hardness.		
16	Help patient to comfortable position: **(IM ventrogluteal site):** ▪ Position patient depending on site chosen (e.g., on side, or prone).		
17	Relocate site using anatomical landmarks.		
18	Clean site with an antiseptic swab. Apply swab at center of site and rotate outward in circular direction for approximately 5 cm (2 inches).		
19	Hold swab or gauze between third and fourth fingers of nondominant hand.		
20	Remove needle cap or sheath from needle by pulling it straight off.		
21	Hold syringe between thumb and forefinger of dominant hand **IM: Hold as dart, palm down.**		
22	Option: If patient's muscle mass is small, grasp body of muscle between thumb and fingers. Place the palm of your hand over the greater trochanter of the patient's hip		

	with the wrist perpendicular to the femur. Use the right hand for the left hip, and use the left hand for the right hip. Point the thumb toward the patient's groin and the index finger toward the anterior superior iliac spine; extend the middle finger back along the iliac crest toward the buttock. The index finger, the middle finger, and the iliac crest form a V-shaped triangle; the injection site is the center of the triangle		
23	Insert needle into muscle with smooth, steady motion.		
24	After needle pierces skin, grasp lower end of syringe barrel with nondominant hand to stabilize syringe.		
25	Continue to hold skin tightly with nondominant hand.		
26	Move dominant hand to end of plunger.		
27	Do not move syringe.		
28	Pull back on plunger 5 to 10 seconds. If no blood appears, inject medicine slowly, at rate of 1 mL/10 seconds.		
29	Wait 10 seconds. Then smoothly and steadily withdraw needle and release skin.		
30	Withdraw needle while applying alcohol swab or gauze gently over site.		
31	Apply gentle pressure. Do not massage site. Apply bandage if needed.		
32	Help patient to comfortable position.		
33	Discard uncapped needle or needle enclosed in safety shield and attached syringe into puncture-proof, leak-proof receptacle.		
34	Remove gloves and perform hand hygiene.		
35	Stay with patient and observe for any allergic reactions.		
36	Return to room and ask if patient feels any acute pain, burning, numbness, or tingling at injection site.		
37	Inspect site, noting any bruising or induration. Document bruising or induration if present.		

APPENDIX (E)

State-Trait Anxiety Inventory-State (STAI-S)

Instruction: Below are some expressions that people use to express their feelings. Read each emoticon carefully, then scribble the emoticons you are feeling right now by scribbling the appropriate parentheses. There is no right or wrong answer. Tick the answer that shows how you feel instantly without spending much time on any expression.

Thanks

	Items	Not at all	Somewhat	Moderately so	Very much so
1.	I am currently calm	1	2	3	4
2.	I feel safe	1	2	3	4
3.	I'm currently nervous	1	2	3	4
4.	I am in remorse	1	2	3	4
5.	I am in peace at the moment	1	2	3	4
6.	I currently don't have any tips	1	2	3	4
7.	I am concerned about what will happen to me	1	2	3	4
8.	I feel rested	1	2	3	4
9.	I'm worried right now	1	2	3	4
10.	I feel comfortable	1	2	3	4
11.	I have confidence in myself	1	2	3	4
12.	Currently suffering from irritable	1	2	3	4
13.	I am very nervous	1	2	3	4
14.	I feel that my nerves are very tense	1	2	3	4
15.	I feel relieved	1	2	3	4
16.	I'm satisfied with my situation right now	1	2	3	4
17.	I'm worried	1	2	3	4
18.	I feel surprised at the excitement	1	2	3	4
19.	I'm happy now	1	2	3	4
20.	I'm in a good mood right now	1	2	3	4

APPENDIX (E)

State-Trait Anxiety Inventory-Trait (STAI-T)

Instruction: Below are some expressions that people use to express their feelings. Please read each statement carefully, then scribble the appropriate brackets on the right side of the statements you are currently feeling. There is no right or wrong answer. Tick the answer that shows how you feel instantly without spending much time on any expression.

Thanks

	Items	Almost Never	Sometimes	Often	Almost Always
1.	I am happy	1	2	3	4
2.	I am content	1	2	3	4
3.	I feel pleasant	1	2	3	4
4.	I feel satisfied with myself	1	2	3	4
5.	I feel secure	1	2	3	4
6.	I feel inadequate	1	2	3	4
7.	I feel like a failure	1	2	3	4
8.	I wish I could be as happy as others seem to be	1	2	3	4
9.	I lack self-confidence	1	2	3	4
10.	I am a steady person	1	2	3	4
11.	I am `calm, cool, and collected'	1	2	3	4
12.	I make decisions easily	1	2	3	4
13.	I feel rested	1	2	3	4
14.	Some unimportant thought runs through my mind and bothers me	1	2	3	4
15.	I worry too much over something that really doesn't Matter.	1	2	3	4
16.	I take disappointments so keenly that I can't put them out of my mind.	1	2	3	4
17.	I feel that difficulties are piling up so that I can't overcome them	1	2	3	4
18.	I feel nervous and restless	1	2	3	4
19.	I get in a state of tension or turmoil as I think over my recent concerns and interests	1	2	3	4
20.	I have disturbing thoughts	1	2	3	4

APPENDIX (F)

LOG SHEET

INJECTION HIP MODEL

(CONTROL GROUP)

Date	Student Name	ID Student Number	Time Beginning (Min.)	Time Ended (Min.)	Total of Time (Min.)

VIRTUAL REALITY SIMULATION

(EXPERIMENTAL GROUP)

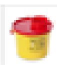
Date	Student Name	ID Student Number	Time Beginning (Min.)	Time Ended (Min.)	Total of Time (Min.)

APPENDIX(G)

Developing Virtual Intramuscular Injection (Ventrogluteal Site) simulation Skill Software

	Standard Step	Editing (VR)
1.	Check accuracy and completeness of each record with health care provider's medication order.	Merge these steps by insert Dr. order paper have notes (medication, pt. name, Pt. history…etc), I will supply this order and students pick it.
2.	Check patient's name, medication name and dosage, and route and time of administration.	
3.	Assess patient's medical and medication history and history of allergies.	
4.	Observe verbal and nonverbal responses toward receiving injection.	student will need to click on a button where to confirm that he has observed that patient is ready for receiving the injection. Note: I want insert student voice in this step to speak about what he/ she observes (as pain, anxiety, …) (RATIONAL)
5.	Assess for contraindications for IM injections, and diagnose whether the patient has muscle atrophy	instruction panel will say click on confirm button that there are no contraindications for IM injections or patient has muscle atrophy. Note: I want insert student voice in this step to speak about what he/ she observes contraindication (RATIONAL)
6.	Perform hand hygiene.	it will say go and wash hands, and student will go and put on the tap and put water in the hand and once both hands are inside then student can complete this step. very important step; insert equipment here as (water, sink, soap, towel)
7.	Aseptically prepare correct medication dose from ampule or vial. Check label of medication with record times while preparing medication.	Merge these steps. It is important, student will need to click on a button on panel where prepare equipment for this procedure, student should pick its (Ampule/ vial, syringe, needle, gauze, swab, medication sheet, gloves, and basin /trolly (which I put it in photo). When user picks the ampule or vial, I want to insert user voice to observe and speak what he reads on medication ampule/ vial (label) and to speak medication rights (medication name, route, dose, expired date, frequency, pt. name, signature of user) all of these on medication sheet.
8.	Apply the six rights of medication administration throughout medication administration.	
9.	Close room curtain or door.	Very important step (privacy). Student should hold curtain (this important tool in laboratory) to close around bed of pt. student should say and make that.

10	Identify patient using at least two identifiers (e.g., name and birthday or name and medical record number) according to agency policy.	Merge these steps. It is important, student will need to click on a button on instruction panel will say (user introduce self, ask pt. about name, and explain the procedure and ensure medication which is prepared in (7+8 step) all of that when students on pt. bed side and student would need to confirm it.
11	Compare name of medication on label with record one more time at patient's bedside.	
12	Explain steps of procedure and tell patient that injection will cause slight burning or sting.	
13	Apply clean gloves.	instruction panel will say to press a button to change gloves and when student press it then gloves will be changes. (important step)
14	sheet or gown draped over body parts not requiring exposure.	Merge these steps. It is important when user finish of previous steps exposure the site of injection: • We need user to click bottom on instructional panel to select/ choose the correct/ appropriate site of ventrogluteal muscle: 1. Sitting position, 2. Prone position, 3. On side position, 4. supine position, 5. semi setting position) • When user select the appropriate position (on side, or prone), need to put pt. in this site (animation) • Then, insert the bottom on instruction panel for inspect the skin if has any (edema, inflammation, redness, bruises), user should click and say/speak (user voice)
15	Select appropriate injection site. Inspect skin surface over sites for bruises, inflammation, or edema. **IM ventrogluteal site:** ▪ Note integrity and size of muscle and palpate for tenderness or hardness.	
16	Help patient to comfortable position: (**IM ventrogluteal site**): ▪ Position patient depending on site chosen (e.g., on side, or prone).	
17	Relocate site using anatomical landmarks.	it will say to relocate site to make sure correct position and again user will need to take hand close.
18	Clean site with an antiseptic swab. Apply swab at center of site and rotate outward in circular direction for approximately 5 cm (2 inches).	Merge these steps, it will tell user to pick up the swap and apply to the glowing area (after 17 step) I will make the injection area glow a little). And the same swab which user pick up and circulation want to hold it (not remove)
19	Hold swab or gauze between third and fourth fingers of nondominant hand.	
20	Remove needle cap or sheath from needle by pulling it straight off.	user will pick the needle from one hand and then remove the sheath from other.
21	Hold syringe between thumb and forefinger of dominant hand **IM: Hold as dart, palm down.**	not possible, student will be just grab the needle like normal supported (okay, not like normal but least hold syringe right way 90 degree (rational for I.M)
22	Option: If patient's muscle mass is small, grasp body of muscle between thumb and fingers. Place the palm of your hand over the greater trochanter of the patient's hip with the wrist	it is important step; User should use right hand for left hip (V shape) use thumb and index finger to make V shape

	perpendicular to the femur. Use the right hand for the left hip, and use the left hand for the right hip. Point the thumb toward the patient's groin and the index finger toward the anterior superior iliac spine; extend the middle finger back along the iliac crest toward the buttock. The index finger, the middle finger, and the iliac crest form a V-shaped triangle; the injection site is the center of the triangle.	 
23.	Insert needle into muscle with smooth, steady motion.	from point 23 to 29 I will have to make it simple; user will insert the inject to glowing area and very important (28 step) user should Pull back on plunger 5 to 10 seconds. If no blood appears (I want user speak that (user voice)). Then if no blood user then will press the trigger button and it will inject medicine slowly, and after medicine is injected all then student will need to move back his hand.
24.	After needle pierces skin, grasp lower end of syringe barrel with nondominant hand to stabilize syringe.	
25.	Continue to hold skin tightly with nondominant hand.	
26.	Move dominant hand to end of plunger.	
27.	Do not move syringe.	
28.	Pull back on plunger 5 to 10 seconds. If no blood appears, inject medicine slowly, at rate of 1 mL/10 seconds.	
29.	Wait 10 seconds. Then smoothly and steadily withdraw needle and release skin.	
30.	Withdraw needle while applying alcohol swab or gauze gently over site.	as student will move the needle away then with 2nd hand student will need to put swab or gauze (the same swap which user hold in steps 18+19 steps) or as you see the suitable if user pick another swab or gauze
31.	Apply gentle pressure. Do not massage site. Apply bandage if needed.	
32.	Help patient to comfortable position.	It is very important to return pt. to comfortable position; user should return the same bottom in instruction panel which put on (14+15+16 steps) and select the correct answer (sitting or supine position) which insert in the options
33.	Discard uncapped needle or needle enclosed in safety shield and attached syringe into puncture-proof, leak-proof receptacle.	student will need to throw needle to safety shield (sharp box) 
34.	Remove gloves and perform hand hygiene.	remove gloves by clicking on button, and show recycle (wastepaper basket) and wash hand again the user should return click the same bottom in (6 step)
35.	Stay with patient and observe for any allergic reactions.	click on instruction panel to confirm there is allergic reaction to patient
36.	Return to room and ask if patient feels any acute pain, burning, numbness, or tingling at injection site.	Insert bottom on instruction panel if pt. feels any acute pain, burning, numbness, or tingling at injection site comfortable position. (user voice)
37.	Inspect site, noting any bruising or induration. Document bruising or induration if present.	Documentation it is very important step; User Return to step (7+8) and pick the same medication sheet and signature name

Appendix H

Comparison of the Mean Scores of the Control and Experimental Groups for the Items in the Intramuscular Ventrogluteal Injection Skill Checklist

No.	Groups Performance Items	Test	Experimental Group Mean±SD	Control Group Mean±SD	Z*	P
1.	Check accuracy and completeness of each record with health care provider's medication order.	Pre Post Before Practice on Voluntary Individiual	1,00±,00 1,00± ,00 ,94 ± ,24	,82±,39 ,97± ,17 ,97 ±,17	-2,550 -1,000 -,586	,011*** ,317 ,558
2.	Check patient's name, medication name and dosage, and route and time of administration.	Pre Post Before Practice on Voluntary Individiual	,97±,17 1,00± ,00 ,97 ±,17	,85±,36 ,97 ±,17 ,97 ±,17	-1,700 -,586 ,000	,089 ,558 1,000
3.	Assess patient's medical and medication history and history of allergies.	Pre Post Before Practice on Voluntary Individiual	,82±,39 ,82 ±,39 ,85 ± ,36	,52±,51 ,82 ±,39 ,88 ± ,33	-2,591 ,000 -,356	,010*** 1,000 ,722
4.	Observe verbal and nonverbal responses toward receiving injection.	Pre Post Before Practice on Voluntary Individiual	,55±,50 ,76 ±,43 ,79± ,42	,36±,49 ,73 ±,45 ,79 ± ,42	-1,472 -,279 ,000	,141 ,780 1,000
5.	Assess for contraindications for IM injections, and diagnose whether the patient has muscle atrophy	Pre Post Before Practice on Voluntary Individiual	,73±,45 ,79± ,42 ,82 ± ,39	,24±,44 ,67± ,48 ,67± ,48	-3,911 -1,097 -1,397	,001**** ,273 ,163
6.	Perform hand hygiene.	Pre Post Before Practice on Voluntary Individiual	,76±,44 ,88±,33 ,94 ± ,24	,76±,44 ,85 ± ,36 ,94 ± ,24	,000 -,356 ,000	1,000 ,722 1,000
7.	Aseptically prepare correct medication dose from ampule or vial. Check label of medication with record times while preparing medication.	Pre Post Before Practice on	,88±,33 ,94 ± ,24 ,97 ± ,17	,76±,44 ,91± ,29 ,97 ± ,17	-1,267 -,462 ,000	,205 ,644 1,000

	Voluntary Individiual				
8. Apply the six rights of medication administration throughout medication administration.	Pre	,67±,48	,64±,49	-,256	,798
	Post	,55± ,51	,64 ± ,49	-,769	,442
	Before Practice on Voluntary Individiual	,88 ± ,33	,82± ,39	-,681	,496
9. Close room curtain or door.	Pre	,88±,33	,58±,50	-2,743	**,006****
	Post	,45 ±,51	,58 ± ,50	-1,024	,306
	Before Practice on Voluntary Individiual	,88± ,33	,79 ± ,42	-,983	,325
10. Identify patient using at least two identifiers (e.g., name and birthday or name and medical record number) according to agency policy.	Pre	,58±,50	,52±,51	-,491	,624
	Post	,97 ± ,17	,91± ,29	-,745	,456
	Before Practice on Voluntary Individiual	,73± ,45	,61 ± ,49	-1,037	,300
11. Compare name of medication on label with record one more time at patient's bedside.	Pre	,42±,50	,42±,50	,000	1,000
	Post	,73± ,45	,91 ± ,29	-,978	,328
	Before Practice on Voluntary Individiual	,67± ,48	,55± ,51	-1,000	,317
12. Explain steps of procedure and tell patient that injection will cause slight burning or sting.	Pre	,97±,17	,91±,29	-1,024	,306
	Post	,73 ± ,45	,64 ± ,49	-1,024	,306
	Before Practice on Voluntary Individiual	,94 ± ,24	,85± ,36	-1,190	,234
13. Apply clean gloves.	pre	,91±,29	,76±,44	-1,639	,101
	Post	,58± ,50	,61± ,49	-1,900	,057
	Before Practice on Voluntary Individiual	,88 ± ,33	,67 ± ,48	-2,040	**,041****
14. Sheet or gown draped over body parts not requiring exposure.	Pre	,64±,49	,36±,49	-2,199	**,028****
	Post	,94 ± ,24	,97 ± ,17	-,787	,431
	Before Practice on Voluntary Individiual	,42 ± ,50	,52± ,51	-,734	,463
15. Select appropriate injection site. Inspect skin surface over sites for bruises, inflammation, or edema.	Pre	,55±,51	,76±,44	-1,795	,073
	Post	,82 ± ,39	,94 ± ,24	-,248	,804
	Before Practice on Voluntary Individiual	,70 ± ,47	,88± ,33	-1,793	,073
16. Help patient to comfortable position	Pre	,97±,17	,88±,33	-1,385	,166
	Post	,94 ± ,24	,94 ± ,24	-,586	,558

	Before Practice on Voluntary Individiual	1,00 ±,00	1,00± ,00	,000	1,000
17. Relocate site using anatomical landmarks.	Pre	,97±,17	,76±,44	-2,492	,013**
	Post	,39± ,49	,61 ± ,49	-1,497	,134
	Before Practice on Voluntary Individiual	,82 ±,39	,88 ± ,33	-,681	,496
18. Clean site with an antiseptic swab. Apply swab at center of site and rotate outward in circular direction for approximately 5 cm (2 inches).	Pre	,94±,24	,82±,39	-1,497	,134
	Post	,82 ± ,39	,97± ,17	,000	1,000
	Before Practice on Voluntary Individiual	,94 ± ,24	,88± ,33	-,850	,395
19. Hold swab or gauze between third and fourth fingers of nondominant hand.	Pre	,42±,50	,61±,49	-1,467	,143
	Post	,94 ± ,24	,94 ±,24	-1,710	,087
	Before Practice on Voluntary Individiual	,91± ,29	,58± ,50	-3,073	,002****
20. Remove needle cap or sheath from needle by pulling it straight off.	Pre	,88±,33	,88±,33	,000	1,000
	Post	,82 ± ,39	,97± ,17	-1,984	,047**
	Before Practice on Voluntary Individiual	,85 ± ,36	,85 ± ,36	,000	1,000
21. Hold syringe between thumb and forefinger of dominant hand IM: Hold as dart, palm down.	Pre	,73±,45	1,00±,000	-3,204	,001****
	Post	,94 ± ,24	,94 ±,24	,000	1,000
	Before Practice on Voluntary Individiual	,94 ± ,24	,94 ± ,24	,000	1,000
22. Place the palm of your hand over the greater trochanter of the patient's hip with the wrist perpendicular to the femur.(V-shape)	Pre	,94±,24	,94±,24	,000	1,000
	Post	,97 ± ,17	,97 ± ,17	,000	1,000
	Before Practice on Voluntary Individiual	,97± ,17	1,00±,00	-1,000	,317
23. Insert needle into muscle with smooth, steady motion.	Pre	,88±,33	,94±,24	-,850	,395
	Post	,94 ± ,24	,94± ,24	,000	1,000
	Before Practice on Voluntary Individiual	1,00 ±,00	1,00± ,00	,000	1,000
24. After needle pierces skin, grasp lower end of syringe barrel with nondominant hand to stabilize syringe.	Pre	,67±,48	,82±,39	-1,397	,163
	Post	,67 ± ,48	,64± ,49	-,256	,798
	Individual voluntery	,79± ,42	,88 ± ,33	-,983	,325
25. Continue to hold skin tightly with nondominant hand.	Pre	,48±,51	,70±,47	-1,739	,163
	Post	,42 ±,50	,55 ± ,51	-,978	,328
	Before	,76± ,44	,73± ,45	-,279	,780

	Practice on Voluntary Individiual				
26. Move dominant hand to end of plunger.	Pre Post Before Practice on Voluntary Individiual	,88±,33 ,91 ± ,29 ,94± ,24	,73±,45 ,97± ,17 ,88 ± ,33	-1,739 -1,024 -,850	,082 ,306 ,395
27. Do not move syringe.	Pre Post Before Practice on Voluntary Individiual	,61±,49 ,64 ± ,49 ,73± ,45	,64±,49 ,76± ,44 ,70± ,46	-1,536 -1,063 -,270	,125 ,288 ,787
28. Pull back on plunger 5 to 10 seconds. If no blood appears, inject medicine slowly, at rate of 1 mL/10 seconds.	pre Post Before Practice on Voluntary Individiual	,91±,29 ,97 ± ,17 ,91 ± ,29	,82±,39 ,91± ,29 1,00± ,00	-,252 -1,024 -1,759	,801 ,306 ,079
29. Wait 10 seconds. Then smoothly and steadily withdraw needle and release skin.	Pre Post Before Practice on Voluntary Individiual	,85±,36 ,79 ± ,42 1,00± ,00	1,00±,00 ,94± ,24 ,97± ,17	-1,068 -1,780 -1,000	,286 ,075 ,317
30. Withdraw needle while applying alcohol swab or gauze gently over site.	Pre Post Before Practice on Voluntary Individiual	,85±,36 ,94± ,24 ,97 ± ,17	,94±,24 1,00±,00 ,97± ,17	-2,308 -1,425 ,000	,021** ,154 1,000
31. Apply gentle pressure. Do not massage site. Apply bandage if needed.	Pre Post Before Practice on Voluntary Individiual	,64±,49 ,67 ± ,48 ,73 ±,45	,48±,51 ,76± ,44 ,73 ± ,45	-1,231 -,809 ,000	,218 ,418 1,000
32. Help patient to comfortable position.	Pre Post Before Practice on Voluntary Individiual	,85±,36 ,88± ,33 ,73± ,45	,67±,48 ,94±,24 ,94± ,24	-1,710 -,850 -2,294	,087 ,395 ,022**
33. Discard uncapped needle or needle enclosed in safety shield and attached syringe into puncture-proof, leak-proof receptacle.	Pre Post Before Practice on Voluntary Individiual	,88±,33 ,85±,36 ,91± ,29	,94±,24 ,94± ,24 ,79 ± ,42	-,850 -1,190 -1,363	,395 ,234 ,173
34. Remove gloves and perform hand hygiene.	Pre Post	,94±,24 ,79 ±,42	,70±,47 ,85± ,36	-2,534 -,633	,011*** ,526

	Before Practice on Voluntary Individiual	,82± ,39	,85± ,36	-,328	,743
35. Stay with patient and observe for any allergic reactions.	Pre Post Before Practice on Voluntary Individiual	,79±,42 ,79± ,42 1,00± ,00	,85±,36 ,88 ± ,33 ,70± ,47	-,633 -,983 -3,407	,526 ,325 ,001****
36. Return to room and ask if patient feels any acute pain, burning, numbness, or tingling at injection site.	Pre Post Before Practice on Voluntary Individiual	,91±,29 ,91±,29 1,00± ,00	,85±,36 ,91± ,29 ,91± ,29	-,749 ,000 -1,759	,454 1,000 ,079
37. Inspect site, noting any bruising or induration. Document bruising or induration if present.	Pre Post Before Practice on Voluntary Individiual	,94±,24 ,94± ,24 ,97± ,17	,79±,42 ,97 ± ,17 ,94 ± ,24	-1,780 -,586 -,586	,075 ,558 ,558

EK: 1044-2020

YAKIN DOĞU ÜNİVERSİTESİ
BİLİMSEL ARAŞTIRMALAR ETİK KURULU

ARAŞTIRMA PROJESİ DEĞERLENDİRME RAPORU

Toplantı Tarihi	: 23.01.2020
Toplantı No	: 2020/76
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9. Doç. Dr. Emil Mammadov (ÜYE)
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	Name of the Institution where he/she was graduated	**Graduation year**
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Lecturer	American Arab University	2013-2015
Instructor	Cyprus International University	2020-untile now

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English	Very good	Very good	Excellent

Foreign Language Examination Grade								
YDS	ÜDS	IELTS	TOEFL IBT	TOEFL PBT	TOEFL CBT	FCE	CAE	CPE
		***						

	Math	**Equally weighted**	**Non-math**
ALES Grade			
(Other) Grade			

Computer Knowledge

Program	**Use proficiency**
Office (word, excel, PowerPoint)	Very good

***Evaluate as very good, good, moderate, poor.

Scientific activities:

Jallad, S. and Sayej. S. (2016). "Effects of Selected Organizational Climate Factors on Nursing Performance and Patient Satisfaction in Renal Dialysis Units in West Bank Hospitals." Journal of Health, Medicine and Nursing 29: 72-86

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Future of nursing education: Changing values, educational paradigm, and learner-educator profiles and roles. **Italy**

The potential of social media and nursing education: E-professionalism, nurse educator–learner role, benefits, and risks**. (Geirna)**

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Virtual Reality

Yazar Bur in l ik

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TURKISH REPUBLIC OF NORTH CYPRUS
NEAR EAST UNIVERSITY
INSTITUTE OF GRADUATE STUDIES

The Effectiveness of Virtual Reality Simulation as a Learning Strategy on Acquisition of Ventrogluteal Injection Skill and Anxiety Level

SAMAR THABET IBRAHIM JALLAD
PhD

NURSING

MENTOR
Assist. Prof. Dr. BURÇİN IŞIK

2021 -NICOSIA

Virtual Reality

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Original article

The Effectiveness of Virtual Reality Simulation as learning strategy on Acquisition of Intramuscular Injection Skill and Anxiety Level among Nursing Students

Running Head: Virtual Reality Simulation in Acquisition Medical Skills

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Abstract

Background: In order to narrow the gap between theory and practice in medical field as general, and nursing field as especially, nurse educators and faculties should use innovative and beneficial learning strategies to facilitate the transition from novice practitioner to professional nurse, and ensuring patient safety.

Aim: Design and develop virtual reality simulation software related to intramuscular injection skill in nursing education and determine effectiveness of virtual reality simulation as learning strategy on acquisition skill and anxiety level.

Method: A quasi-experimental design, First-year nursing students (n=66) at Near East University were conducted, and divided into experimental and control groups.

Results: There is significant difference between both groups in pre-test and before practice on voluntary individual in performance psychomotor skills scores, and in a pre-test in state anxiety level, and significantly long period time in minute that mean was higher in experimental group.

Conclusion: Virtual reality simulation is a useful learning strategy in acquisition psychomotor skills requiring the ordering of skill steps in teaching alongside traditional laboratory environment, it increases students' performance, and leads to less time spent, and decreases errors that happen during training. This study was recommended nurse educators and faculties inserting innovative teaching-learning strategies in various practical medical and nursing skills that providing safe environment

Keywords: Virtual reality simulation; Nursing education; Intramuscular injection; Motor skill, Anxiety.

Introduction

Nursing discipline considered a practical profession that demands a blend of theoretical knowledge with practical skills, clinical practice, and experience as primary in nursing education (O'connor & Andrews, 2016). In which nursing students usually consider that clinical experiences as the most anxiety-producing part of their nursing program (Sharif & Masoumi, 2005), as well adaptation to university life, meeting an intense academic program, and starting a new career often lead to anxiety among students (Gibbons et al., 2011; Halloran, 2017). So, the acquisition of psychomotor skill is an integral part of an undergraduate nursing program (Fotheringham, 2010) which inextricably linked with cognitive, motor skills, attitude, academic achievements, satisfaction, self-efficacy, and aims in the learning nursing environment which taught in traditionally or in simulated clinical practice (Forehand et al., 2017; Işık & Kaya, 2014; Sawyer et al., 2015).

The use of technology and simulation-based education such as virtual reality simulations (VRS) help students move from the cognitive to a psychomotor phase to attain a mastery approach to learning, promote teamwork, enhance problem-solving skills, information retention, and support learning (Oermann et al., 2016), allowing reducing the gap between student knowledge and real experience (Huang & Liaw, 2018). In which VRS having educational content promoting the students to learn in clinical environments, three dimensional and realistic without risking patient safety, with a lot of opportunity for repeated practice and immediate feedback in a visually attractive way, decreasing their anxiety (Bauman, 2012; Crookall, 2010; Jenson & Forsyth, 2012; Korhan et al., 2018; Ma et al., 2014).

In nursing education, nursing students learn various psychomotor skills, and they should be ready to know, understand, remember and competently perform these skills in which they are at risk of causing harm when they learn and practice on an actual patient, as performing intramuscular injection (Freitag et al., 2015). One of the most important factors that have caused nursing educators to look for alternative strategies to supplement the traditional ways of clinical practice experience, the need to prepare competent students about drug administration which an important nursing responsibility with ethical and legal liabilities to reduce malpractice and provide safe and high-quality patient care (Işık & Kaya, 2014; Shepherd et al., 2010; Stassi et al., 2007).

World Health Organization and the National Council of State Boards of Nursing provided recommended the use of simulation-based activities like virtual reality simulation in health-related fields as an effective teaching/learning strategy in a clinically realistic environment to improve the safety of patients (Hayden et al., 2014; Medicine, 2011; WHO, 2010).

In literature, virtual reality simulation practices were used on acquisition skills about caring for Tracheostomy tube (Bayram & Caliskan, 2019), IV catheterisation (Ismailoglu & Zaybak, 2018; Jung et al., 2012), Phlebotomy (Vidal et al., 2013), Decontamination (Farra et al., 2013; Smith et al., 2016), and Folly's catheterization (Smith & Hamilton, 2015). The variation of this study from other studies is the first time had developed and designed VRS as an application of Intramuscular (IM) injection skill in Oculus Quest in which nurses' students can repeat the procedure through having Oculus Rift device and upload this application at the time and place they want. This study focuses on administrating

Intramuscular (IM) injection in ventrogluteal (VG) site skill in nursing education, in which the students of the Fundamentals of Nursing course were challenged to practice psychomotor skills and did not have an opportunity to practice in the clinic. (see Figure1)

Fig.1 Student nurse using Oculus Rift

Background

In nursing education, nurse educators and faculties are constantly challenged to meet all of the Y and Z generations' learning needs, which wanted to integrate multimedia environments and technology into their curricula (Li et al., 2017; Somyürek, 2014). In addition, nurse educators seek frequently to find and utilize innovative and effective learning strategies narrowing the gap between theory and practice during the educational process, through acquisition of psychomotor skills, facilitating transition from novice practitioner to professional nurse, and ensuring patient safety (Butt et al., 2018; Dubovi et al., 2017; Foronda et al., 2013; Georg et al., 2015; Hege et al., 2017).

Simulation is becoming a valuable tool and an essential part of nursing education increasingly common, in which Virtual Reality (VR) has become one of the most methods of simulation effective for teaching (Shin et al., 2015; Smith & Hamilton, 2015). Virtual Reality Simulation (VRS) defined as one of technology based on computer, using a variety of immersive and interactive three-dimensional (3D), and having highly visual characteristics replicating real-life situations and health care procedures through integrating physical movement, and other interfaces including a computer keyboard, speech/voice communication, motion sensors/haptic devices (Ferguson et al., 2015; Lioce et al., 2020).

VRS is one of the beneficial strategies in nursing education, allows students to engage in an active learning experience (Bhoopathi et al., 2007), encourages them reflection to develop their ways of thinking, skills, and attitudes (Kolb, 2014; Lewis & Ciak, 2011), bridges the gap between theoretical and clinical skills, through offering realistic clinical scenarios in a risk-free environment that assist focus students' attention, reduce their anxiety, and speed their skills performance time (Dreesmann, 2018; Dubovi et al., 2017; O'Leary et al., 2014; Vidal et al., 2013). Furthermore, virtual reality-based applications have varying levels of immersion, ranging from virtual worlds or patient representations on a computer-simulated program; simulation devices including virtual worlds; to full-scale simulators, to fully immersive head-mounted devices (HMD) with position tracking technology that was used in this study (Fealy et al., 2019; LeFlore et al., 2012; Strangman et al., 2003).

Intramuscular (IM) injection take a significant place in injection applications, it is not a benign skill, it is one of the essential skills to be taught to students that causes many complications, and considered ventrogluteal (VG) site the safest, which selecting by defining the anatomic marking points (Freitag et al., 2015; Gülnar & Özveren, 2016). So, necessary for nurse's students obtain competence to perform critical skills confidently and effectively in the clinical

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setting to prevent errors that risk the safety of patients, and reduce clinical practice time with real patients through repetitive practice with feedback to support motor skill learning and retention (Gonzalez & Kardong-Edgren, 2017; Kilic et al., 2014; Oermann, 2015; Tugrul & Denat, 2014). Additionally, students should have time to practice these skills and proactively implement them prior to entering the clinical environment than it supports students in their physical, emotional, and behavioral responses to stress and anxiety, helping students cope with the demands present in the clinical learning environment (Clark & Pelicci, 2011; Gibbons et al., 2009). Peplau (1991) described anxiety as an energy source associated with human development from infancy to death and required for biological and emotional growth that separated into two categories: trait and state. In which state anxiety is unpleasant emotional reaction that consists of subjective feelings of tension, apprehension, nervousness, and worry that results from the current experience of anxiety. While, trait anxiety is the tendency to see the world as dangerous, which description of differences in individuals' anxiety as a personality trait (Peplau, 1991; Spielberger, 1979).

The researcher has developed VRS software that included an intramuscular injection procedure skill, in order to define if that VRS can promote conceptual and psychomotor learning through providing realistic opportunities and duplicate clinical scenarios in a risk-free environment, which may reduce student's anxiety, allow them to obtain knowledge, improve their performance, and speed their skills performance time.

Methodology

Aim of study

The aim of the study is to design and develop virtual reality simulation software related to intramuscular injection skill in nursing education and to determine the effectiveness of virtual reality simulation as a learning strategy on acquisition of intramuscular injection skill and anxiety level among nursing students.

Study design and setting

The research was planned as a quasi-experimental design, at Near East University Faculty of Nursing in the spring semester of 2019-2020 academic years was conducted. (see Figure2)

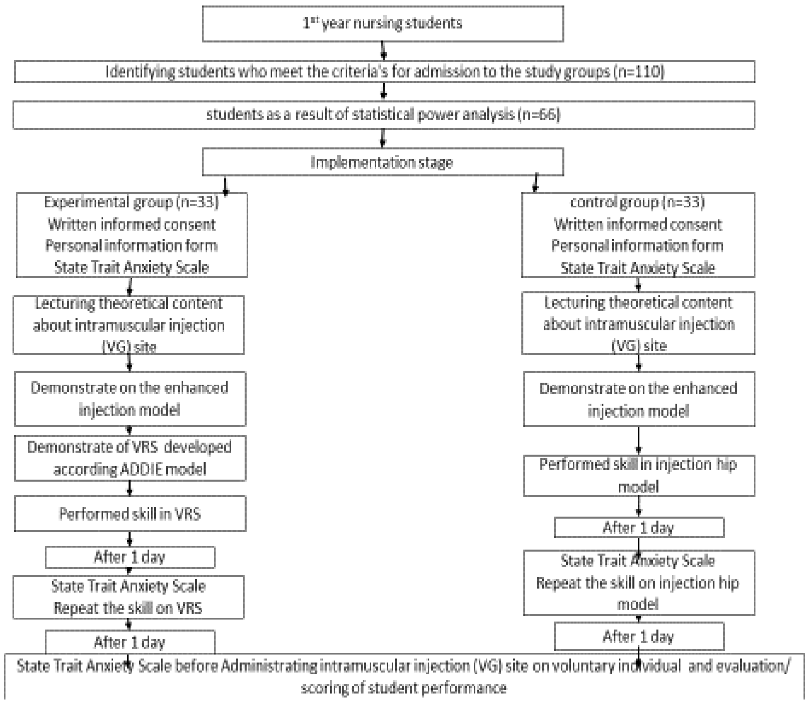

Fig2 Design of study

Study Participants

The universe of the study was consisted of the first-year students (220 students) who enrolled “Fundamentals of Nursing” course first time. Students were divided into two groups as experimental and control groups. 66 students as a result of statistical power analysis conducted experimental and control groups using the simple random sampling method. 33 volunteer students in the control group performed the skill with an Enhanced Injection Hip Model in the laboratory environment and 33 volunteer students in the experimental group with virtual simulation system (VRS; Oculus Rift VR headgear (HMD) and controller device). In order to ensure the similarity of the students in the groups, variables that may affect the results of the research have been identified and appropriate sample will be selected from the students accordingly. The students who included in the study group; should be homogeneous in terms of age, sex, occupational courses’ (anatomy, physiology, biochemistry, histology) grade point averages, having a personal computer, having education about computer/computer software, and having knowledge of virtual reality simulation/simulation software; and also, the groups were heterogeneous in themselves, in terms of not to graduate from the diploma programmes of the Vocational School of Health, not to come with vertical transfer, have not been trained and have no experience in intramuscular (IM) injection and similar invasive administrations without this course, not working in any health institution and organization, and not use virtual reality simulation related to ventrogluteal injection and similar intramuscular applications was determined as the variables that provide similarity.

Data collection:

To collect data, “Personal Information Form”, “Intramuscular Ventrogluteal Injection Skill Checklist", "State-Trait Anxiety Inventory (STAI)", “Enhanced Injection Hip Model”, “Ventrogluteal Injection Skill Virtual Reality Simulation”, and “Log Sheets” were used.

"Personal Information Form"

That was designed by a researcher, and this instrument gathered the descriptive characteristics of participants, such as age, gender, country and Grade Point Average-GPA).

“Intramuscular Ventrogluteal Injection Skill Checklist"

This checklist, prepared by the researcher based on the fundamentals of nursing book ninth edition (Potter et al., 2017) to evaluate the skills performance level of students, listed 37 step in IM ventrogluteal injection procedure. For this study, it was used to assess participants who administered the ventrogluteal injection. Each step in the form was scored as done (1), and not done (0). While the highest possible score to be obtained is 37, the lowest possible score is 0. Higher scores indicate higher IM Ventrogluteal Injection Skill levels.

"State-Trait Anxiety Inventory (STAI)"

This scale developed in 1964 by Spielberger and contains one set of 20 self-reporting items that measure both state and trait anxiety (40) items. The T-Anxiety scale used a four-point Likert-type scale: (1) almost never, (2) sometimes, (3) often, and (4) almost always. While, the 20 state anxiety items from the State-Trait Anxiety Inventory (STAI) were presented with a 4-point Likert type scale, which asks the respondents to rate themselves on each item were (1 = not at all, 2 = somewhat, 3 = moderately so, and 4 = very much so). Alpha reliability coefficients for the T-Anxiety scale ranged from .83 to .92 and concurrent validity ranged from .73 to .85. while, the magnitude of the reliability coefficients ranged from 0.65 to 0.86, whereas the range for the state anxiety scale was 0.16 to 0.62 (Spielberger, 1983).

"Enhanced Injection Hip Model"

Injection Hip model used in the professional skill laboratory is like the real human hip; Intramuscular injection Hip model is designed to provide students with the visual and tactile experience needed to learn intramuscular injection techniques. It is a functional teaching aid that enables a learner to develop manipulative skills and improve techniques. It helps learners make the transition from the idealized classroom setting to the realities of ward duty (Nasco Life Form, 1982) was provided to each participant in both groups in the Pre-test .

"Ventrogluteal Injection Skill Virtual Reality Simulation (Oculus Rift)"

VRS software was built on an instructional design ADDIE model as analysis, design, develop, implement and evaluate (see Figure 1), that enables nursing student with or without administered intramuscular injection in ventrogluteal site experience to learn and practice related psychomotor skills. In addition, nursing students can autonomously learn a clinical skill/procedure to improve their performance and demonstrate the ability to transfer cognitive processes required for performing the tasks under normal operating conditions (Filatro & Piconez, 2004; Weaver, 2011). Administered intramuscular injection by applying VRS (Oculus rift) uses headgear and tactile device, which requires physical contact between computer and user (3D-display), a software program, laptop computer, virtual IM injection in ventrogluteal site viewer on virtual patient. The controller device mimics the arms of user and any activities between the sensor system, which senses the movement of tools and following steps of administrating IM injection in three dimension. The computers convert these data into VR images. All of IM injection steps showing as virtual image on the screen of headgear (see Figure 3). It was measured post-test intervention in the experimental group.

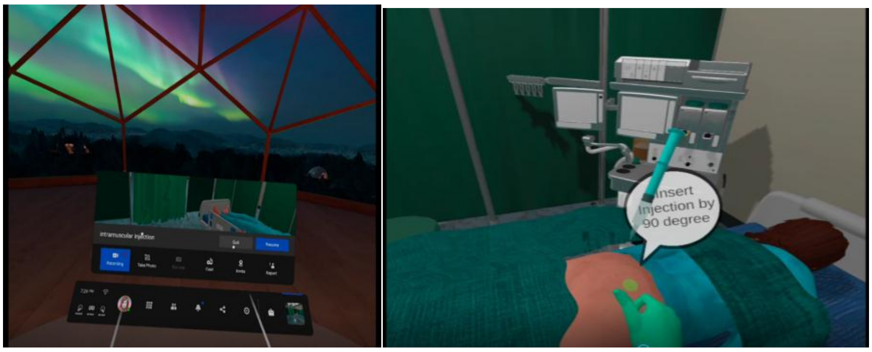

Fig.3 Virtual Image for IM injection steps in VRS Oculus Rift

Log Sheets

It designed by the researcher, which involved participants' practice time (start -end time, and total time per minute) when using the VRS and Hip Model Injection, in Pre-/Post-test, and on a voluntary individual.

Implementation of Procedure

Prior to the recruitment of participants and start of data collection, expedited review, and approval by the university Institutional Review Board (IRB) were obtained (Approval #YUD/2020/76-985). The principal investigator verbally introduced study to all participants (n=66) during one hour of a fundamental nursing lecture about the theory underlying administered intramuscular injection skill in ventrogluteal site, at which time participants were given the opportunity to familiarize themselves with the equipment, ask questions about study, and then have answered. Provided a study information sheet, provided informed consent for study participants before they assigned to control and experimental groups, that students aware would in no way affect their course grade, and potential subjects were also assured that information gathered in this study would be used for educational purposes only. All participants completed personal information and principal investigator obtained it. Participants were randomized into two groups. Principal investigator demonstrated administered IM injection in ventrogluteal site to participants in control group on hip injection model in accordance with guidelines, then each participant in control group performed this skill on the hip model injection once time under the supervision of instructor. Whereas, participants in experimental group first attended an identical demonstration on hip injection model. Then principal investigator introduced intramuscular VRS system. Each participant of experimental group applied VRS system on virtual simulator.

Participants in both groups performed IM injection on a hip model, and then participants in experimental group continued to perform on VRS. All of procedures were taken 2 months to finish, that distributed over the four weeks long for each group. The time commitment required for each student was open-ended, which were commenced and concluded with performance evaluation based on a checklist (pre-test /post-test/ on voluntary individual) (see Figure 4).

Fig4 Implementaion procedure between both group(experimental and control)

Data Analysis

Data was analysed by using SPSS Statistics version 25 for windows (Statistical Package for the Social Sciences). Frequency-percentages, arithmetic means, standard deviation values were used to analyze descriptive statistical evaluation of the data. Mann-Whitney U test was used to assess the difference between and among both group (pretest, posttest, and on actual individual) performance psychomotor skills, and state-trait anxiety scale. In addition, ANOVA was used to assess time performance that spent between and among both group in pretest, posttest, and on voluntary individual.

Results

Control group's mean age was 22.03±2.96, 66.7% were female, mean of professional courses' grade point average was 3.33±1.45 (successful), 47.6% had not personal computer. Experimental group's mean age was 20.97±2.97. Of the students, 45.5,0% ranged between the ages of 17-20, 30.3% between 21-24 and over 25 years ranged 24.2%, 66.7% were female, mean professional courses' grade point average was 3.12±1.02 (successful). 45.8% had personal computer. There was no statistically significant difference (p>,05) between experimental and control groups in terms of “age, gender, mean professional courses’ grade point average, having personal computer”. Groups were similar in terms of these characteristics.

Performance Psychomotor Skills Scores

The finding showed that the mean ± SD of performance psychomotor skills scores in experimental group significantly higher than the mean ± SD in control group in pre-test (89.54± 7.89) (83.3± 9.59) (P=0.002), respectively. While, in post-test, there is no significant difference between both of group, although the mean ± SD of performance psychomotor skills scores in experimental group higher than the mean ± SD in control group (95.21± 8.42) (90.45± 11.60) (P=0.15), respectively, and on voluntary individual, the mean ± SD of performance psychomotor skills scores in experimental group significantly higher than the mean ± SD in control group (98.54± 8.34) (93.03± 10.54) (P=0.02), respectively (Table 1).

Table1. Comparison of Control and Experimental Group Students’ Performance Psychomotor Skill

Group		Experimental Group (n=33)	Control Group (n=33)	Z	p value
Performance psychomotor skill	**Test**	**Mean**	**Mean**		
	Pre	34.08± 3.90	31.17± 3.46	Z=-3.13,	P=**0.002***
	Post	31.73± 2.81	30.15± 3.86	Z=-1.42	P=0.15
	Before Practice on Voluntary Individual	32.84± 2.78	31.01± 3.51	Z=-2.208,	P=**0.02***

*** p≤0,05**

Performance Psychomotor Skill Time Score

The finding showed that the mean of performance psychomotor skills time scores in experimental group significantly long period time in minute than the mean in control group (pre-test= 38.67, post-test=22.24, actual individual=9.2), (pre-test= 11.79, post-test=8.81, actual individual=9 min), respectively. While, within groups the mean of performance psychomotor skills time scores in experimental group significantly fewest time in minute in voluntary individual and post-test fewer time than pre-test (Pre vs. Post=16.42; Pre vs. Actual= 29.39; Post vs. Actual=12.97) (p <0.0001). (Table 2)

Table2. Comparison of Control and Experimental Group Students' Performance Time

	Group	Experimental Group (n=33)	Control Group (n=33)	Lower - Upper 95% CI (Control Group)	Lower - Upper 95% CI (Experimental Group)	P value
Performance time (Min.)	**Test**	**Mean**	**Mean**			
	Pre	38.67± 11.13	11.79± 3.681	10.48-13.09	34.72-42.61	<0.0001
	Post	22.24± 7.62	8.818± 2.068	8.09-9.55	19.54-24.94	<0.0001
	Voluntary Individual	9.273± 2.096	9± 2.947	7.96-10.05	8.53-10.02	0.9991

Anxiety Level Scores

The finding showed that there is no significant difference between both of group in State-Trait anxiety scale (p > 0.05), although the mean ± SD of anxiety scores in experimental group in pre-post/voluntary individual higher than the mean ± SD in control group. While, there is significant difference between both of group in state anxiety scale in pre-test, and the mean ± SD of anxiety scores in experimental group significantly higher than the mean ± SD in control group (52.76±8.19) (47.39±5.83) (P=0.036), respectively. (Table 3)

Table3. Comparison of Control and Experimental Group Students' State and Trait Anxiety Level According to Time and Group

Time	Group	Experimental Group (n=33)	Control Group (n=33)	Z	P value
State Anxiety	**Test**	**Mean**	**Mean**		
	Pre	52.76±8.19	47.39±5.83	-5.36	0.036*
	Post	50.24±6.51	48.79±6.62	-1.46	0.90
	Before Practice on Voluntary Individual	51.42± 7.22	47.76±6.55	-3.67	0.28
Trait Anxiety	Pre	49.48±5.62	46.12±6.618	-3.36	0.168
	Post	48.58±4.87	47.15±7.009	-1.42	0.914
	Before Practice on Voluntary Individual	48.09±5.33	45.49±7.167	-2.15	0.772

* p≤0.05

Discussion

Teaching psychomotor skills is a significant process that comprises transferring students' theoretical knowledge to practice and developing their performance skills (White & Evan, 2002). In this study, there is no statistically significant difference but an increase was observing in pre and post-test mean scores for the skill of administrating intramuscular injection in ventrogluteal site in both control and experimental group students and was higher in experimental. Similar to this study, Bayram et al. (2019) have indicated that the skill of inner cannula cleaning skills in the first and last mean sores was higher for the students who used a game –based virtual reality application on tracheostomy care. Because the pre skill scores of the students in the experimental group were higher than those of the control group, it should be considered that administrating intramuscular injections a vital procedure that can allow student nurses to be learned by observing the demonstration and repeating the procedural steps without mistakes. So, it might have assisted the student to employ this skill on the hip injection model properly during the laboratory class. And the same results found in study by Ismailoğlu and Zaybak (2017) that reported there was significant difference in performance psychomotor skill scores between groups that were higher in experimental group students who used VRS intravenous catheterisation skills, while no significant difference was found between both groups on actual patient (P = .841). In which runs counter to this study, that reported there was significant mean scores between both groups that was higher for those nurses' students who performed intramuscular injection skills on actual individual after used VRS and agreed the results were found in study by Vidal et al. (2013) that those trained on the simulated limbs performed better had significantly produced less few hematomas when they attempted phlebotomy skills on actual patients. These results showed that VRS are an efficient teaching-learning method and environment because they are accurate models of reality, allow practicing without harming the patient/individual, and give a free learning environment that allows for individual in-depth learning with these areas. As well as, they are beneficial in performing psychomotor skills exactly for the purposes of nursing education (Işık & Kaya, 2014; Mazıcığlu, 2002; Tsai et al., 2004).

It is notable that both methods of training are not perfect by themselves and do not completely represent the intramuscular injection skill as performed on patients. For example, neither the Hip Model Injection nor the VRS provides a

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challenge in palpation of the site and the selection of the insertion site. Those trained using the simulated device can easily choose the site when relocating prone position related to the ventrogluteal skill steps through palpating by controller gloves. Therefore, the use of VRS has confirmed to be useful in teaching psychomotor skills as a supplemental tool for learning strategies, such as administrating intramuscular injection in ventrogluteal site, that are too complicated to completely learn through a single observation in the traditional laboratory and rare practice in clinical settings.

Performance Psychomotor Skill Time

Between both groups in this study, to complete performance all steps of intramuscular procedure in the experimental group took longer time on mean scores of pre and post-test than control group, that agree the results which observed in studies by Bayram et al. (2019), Vidal et al. (2013). Because there is a gap between completing virtual cases and real practice in nursing skills on account of the immaturity of VR technology which student nurses had used it first time and they didn’t have any experience of virtual simulation system before (Succar et al., 2013). In addition, may be related to technical issues that not found in traditional hip model injection such as network disconnect, limit device charging. Furthermore, students didn’t try to perform intramuscular injection procedure before requiring maintain knowledge and several steps to complete, deep understanding, critical thinking, decision making, reflective thinking, and competency in psychomotor skill. Thus, that does not mean that learning outcomes with VRS decreased, but it may be that the use of a VR-based system as a supplement to the traditional method is the optimal programme for training nurses (Foronda et al., 2020). This study showed significant difference performance time score within groups in pre, post-test, and actual individual that had the fewest minutes in experimental group, that agreed with studies by smith et al. (2016) (p = .016) and Jung et al. (2012) (p=0.007), this may be because performing skill by using VRS is easy to complete in order and without error as appeared in the laboratory. This confirms that VRS considered an accessible learning environment, by allowing repetitive exposure to educational content to develop cognitive and skill mastery among nursing students, which increasing competency of them to perform skills and providing patient safety(Chang, 2018; Rourke, 2020; Smith et al., 2016).

State-Trait Anxiety Level Scores

This study showed there is a significant difference in a pre-test in state anxiety level in which the mean was higher in the experimental group than control group, which related to unfamiliarity with the intramuscular injection VR simulator skill during initial experiences. Whereas, the state anxiety levels of students after practice on the VR simulator in the experimental group are lower than those before practice on the simulator and on individual volunteer, which agreed with the literature that indicates that VR simulation decreases anxiety levels by enhancing active participation in the teaching-learning process and providing an effective and productive learning experience (Baxter et al., 2009; Işık & Kaya, 2014; McCaughey & Traynor, 2010; Tsai et al., 2004).

This study showed that anxiety experienced during practice on the voluntary individual greater than that experienced in a laboratory setting in both groups, which agreed with the study (Melincavage, 2011) that showed participants feel anxiety because they didn't have real practice experience, chance of making mistakes or harming patients. Also, probably anxiety levels appeared from the technical issues surrounding the environment of VRS not simulation itself compared hip injection model, which has been more comfortable for students, which is congruent with the study (Cobbett & Snelgrove-Clarke, 2016). Furthermore, the results showed that students in the control group had lower trait anxiety level before practice on voluntary individual than before and after practice; whereas those in the experimental group had lower trait anxiety level than after practice and before practice on humans. Before practice in experimental groups had higher trait anxiety level than control group, this result agreed with study Erol et al. (1998) that showed teens who were 18-19 age had a middle trait anxiety level (55,3±6,7) that addressed in Turkish Mental Health Profile report. So, when examined both group's trait anxiety levels in the current study, it could be stated that this result is expected in terms of reflecting anxiety level of young population in community.

Limitation of study

This research was conducted at only one nursing faculty (Near East University) in Turkish Republic of North Cyprus. The results can only be generalized to the students at this nursing faculty and cannot be generalized to all nursing students. Also, due to pandemic conditions, students practiced actual volunteers in the laboratory setting instead of practicing on patients at the clinic.

Conclusion and Recommendation

VRS is a beneficial teaching-learning strategy for training in clinical and psychomotor skills requiring the ordering of skill steps in teaching. AS well, VRS increases students' performance and readiness, leads to less time spent, and decreases errors that happen during training. on the other hand, this study concluded that VRS can use as a supplemental tool of learning strategy on several skills as administrating intramuscular injection skill in ventrogluteal site alongside traditional laboratory environment through using 3D headgear (Oculus Rift), and controller device (based on the sense of touch), that help nurses' students with learning injection skills well and completing intramuscular injections quickly. As well as, offering realistic injection experiences that substitute the unavailability of actual patients in clinical settings and reducing costs. On the other hand, this study was recommended nurse faculty and nurse educators to develop and improve the undergraduate curriculum of nursing education by inserting innovative strategies methods as virtual reality simulation in various practical nursing skills that lead to reduce student anxiety by allowing the unlimited implementation of clinical scenarios in a risk-free environment, which in turn contributes to the motivation and success of the student.

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