

How to Teach Intramuscular Injection Through Virtual Learning Environment in Covid-19 Pandemic Time for Nursing Students

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Abstract

During the pandemic COVID-19 spread and the temporary lockdown of universities, there has been a global shift toward online learning. Some universities were not prepared for such circumstances, and they began attempting to meet this unprecedented task for not missing the academic year. Recently, there has been a project that is currently working on the same issue regarding teaching nursing students how to deliver intramuscular (IM) injection using online in a virtual learning environment. The objective of this study was to create a simulation in an online course using a three-dimensional (3D) learning management system (LMS) in a virtual learning environment (VLE). That can replace IM injection traditional teaching method. This LMS intended to supplement the existing lab practice to nursing undergraduate students by creating a simulated online clinic with a nurse and patient avatars. Theoretical content in the form of reading material and related videos was also provided for students' cognitive base before they start the 3D simulation training. This new course was founded on the Galvis panqueva method that resulted in a product called Online-3D-IMI-VLE. Various validation processes undertook for multiple development processes involving nursing content specialists and computer multimedia. The pilot results showed that this LMS could replace the traditional way of teaching and support online learning during the normal education environment as well as in this COVID-19 pandemic time.

Keywords: COVID-19, Virtual Learning Environment, Intramuscular Injection, Three-Dimensional Simulation, Openlearning.com®, Learning Management System

Introduction

Medication administration via injections is considered one of the vital skills for nursing students,

which include various ways of knowledge application, problem-solving, decision making, and critical thinking. IMI sites/muscles used for administration are mentioned in literature as; ventrogluteal site, dorsogluteal site, rectus femoris muscle, deltoid muscle, and the vastus lateralis muscle ^(1, 2). The criticisms of traditional teaching have led to an intensive search for new methods of nursing education.

Recently, the suspension of campus class is a precautionary step for pandemic COVID-19 ⁽³⁾. The world emphasizes and is actively using online learning to replace the traditional way of teachings temporarily and to prevent students from gathering in one place and

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to decrease the spread of the virus.

For instance, universities changed their way of teaching, e.g., in Australia, some universities moved to temporary standstill online learning like (4) and (5) while other used social distance learning between the students in the class and supplement online learning (6). Also, in Jordan during the covid-19 pandemic, many universities transferred some courses to be online courses immediately, like Al- al-Bayt University, which started to use skype, Moodle, and Google classroom to deliver live lectures by the broadcast scholar (7).

The proposed solution is to replace the traditional way of IMI teaching and to use modern technology by using the Virtual Learning Environment (VLE). The development of VLE, which incorporates innovation, interactive learning, and mimicry of the real situation, which could replace laboratory-based education, has been suggested by researchers (8).

The potential of three-dimensional virtual learning environments (3D-VLE) has intrigued many researchers recently as it allows easy replication of tools, settings, and stakeholders as virtual artefacts with minimal costs and quick turn-around time (9). Several scientists also acknowledged the suitability of using activity theory as a framework for depicting mobile learning studies' study material and dimensions (10).

Recently, schools teachers, postgraduate lecturers, and researchers of educational technology have become increasingly interested in various options of mobile learning, by using portable instruments such as laptops and smartphones, different virtual systems of education can make learning tasks more comfortable for students in a virtually created environment, these systems also backing the execution of a self-evaluation (11, 12). Campus lab and classroom-based simulations have been proven to be an efficient educational approach that can improve the graduates' shift from the schoolroom to practice in real-life. These simulations deliver the student an opportunity to comprehend relevant data, practice in making decisions in practical life, and record their response whether they would work around actual patients (13). Many studies in nursing science have discussed the assistance of handling different types of simulation learning systems to increase self-confidence and performance skills (14).

Materials and Methods

Ethical Approval

The LMS development and validation were conducted as part of an ongoing study under the Research University Grant of USM. Ethical approval for this study was obtained from the Human Ethical Committee of the institution with assigned code USM/JEPeM/17020139. All participants in the study were informed regarding their participation and voluntarily gave their agreement. Participants' information confidentiality was maintained.

Participants:

This study exclusively needed a nursing content-specialist who have experience in nursing science and computer science. Five nursing contents-specialists were recruited in the study who are currently working as lecturers in the faculty of nursing, and they voluntarily participated in the study after they were informed about it, and their contribution was to ensure the contents of the LMS are valid and reliable; these issues are discussed later in validity and reliability. Also, our research team leader made a written contract with IT designers from another government university to design the simulated 3D part, and their team consisted of six personnel. Add to them the pilot group, which includes thirty students from year three undergraduate nursing program.

Materials

The WebGL by Unity® software package was used by the IT designers to design the 3D part while arranging the contents and building them into the educational platform Openlearning.com was done by the researcher. A rental server was rent for two years to upload the software on.

Procedure

The study started with data collection regarding building the LMS and how to put the lesson contents which been chosen carefully to meet the objectives of the study. Then building and designing the LMS and the simulation 3D part. At the end of the study, the validation process was employed to check whether it can replace the traditional way of IM injection teaching. A pilot study was conducted to ensure face validity; thirty students from year three nursing program were

volunteered to participate.

Design

The development of this learning management system was adopted from ⁽¹⁵⁾ comprised of five phases :

1) Analysis:

By analyzing the intended teaching content and measurable outcomes, the instructional objectives were defined. The analysis also evaluated the tutor related aspects, which included technological infrastructure and the work/study environment. The steps of analyzing for the creation of LMS included • Characteristics of the target students • Course selection • Determination of educational goals • Content definition

2) Design:

The steps followed in this phase include; • Instructional design • Construction of educational objectives according to Bloom's taxonomy • Determination of the evaluation approaches used in the LMS • Navigation mapping of the learning environment • Selection of learning modules on the primary interface and design of the layout.

3) Development:

It was accomplished through the rental of an internet domain for 3D practical skill module and uploaded on www.openlearning.com® for one year, development of the program layout by the IT personnel; data upload to the rented domain for didactic learning; installation and configuration of the LMS; selection of the software package management that would be utilized for the specific VLE; 3D-VLE was designed by the software development package WebGL by Unity®.

4) Evaluation:

During this phase, the entire LMS developed by IT experts was evaluated by content experts and faculty members.

5) Administration:

The administration phase consists of the process lesson selection, LMS end-user registration, proper guidance tools, learning evaluations, and post technical usage support. Frequent check-ups of the seamless

functioning of the LMS were performed, and security copies were backed-up online to avoid any data loss.

Results

Results shown here are the LMS itself and the pilot group results. By using the methodology of Galvis Panqueva for designing the LMS, the Online 3D-VLE-IMI was developed. This LMS allows the undergraduate nursing students to learn and practice simulation the IMI technique in an Online 3D-VLE.

The chosen educational platform was openlearning.com®, which is an open-source software that was nominated to enable the building of the education atmosphere since it allows the integration and use of the developed applications. It provides simultaneous access to the data by multiple users, records the actions of the users, provides a questions/answers forum, allows the students to write and share information or start public or private discussions which enable interactive learning, ensures stability and security of the system, allows easy retrieval of the data.

The students can use the system anytime and anywhere to ensure them having a VLE that enables them to read and practice about IMI using the LMS. System requirements are 1) Any working desktop or laptop 2), Internet connection (only during loading the software), 3) Web browsers.

System Tools

1) Home:

It is the default screen that the user will access after clicking the provided URL <https://www.openlearning.com/courses/online-3d-im-injection-vle/HomePage>. It provides the lesson description and general information about the educational and 3D practical skill modules of the LMS.

2) IM Theory:

The third tab contains two slideshow presentations that provide the academic content about IMI. Three CDC videos were also added, which were produced according to the nursing procedure manual that explained step by step procedure of IMI administration.

3) 3D practice:

The fourth tab contains a link to another URL that loads the 3D skill learning module on how to deliver IMI in simulation. It includes a virtual clinic with two avatars (One nurse and one dummy patient), figure (1).



Figure 1-Virtual clinic, Nurse and Patient Avatar

After the user clicks on the patient, the user can start by choosing one of the five muscles to practice the skill figure (2).

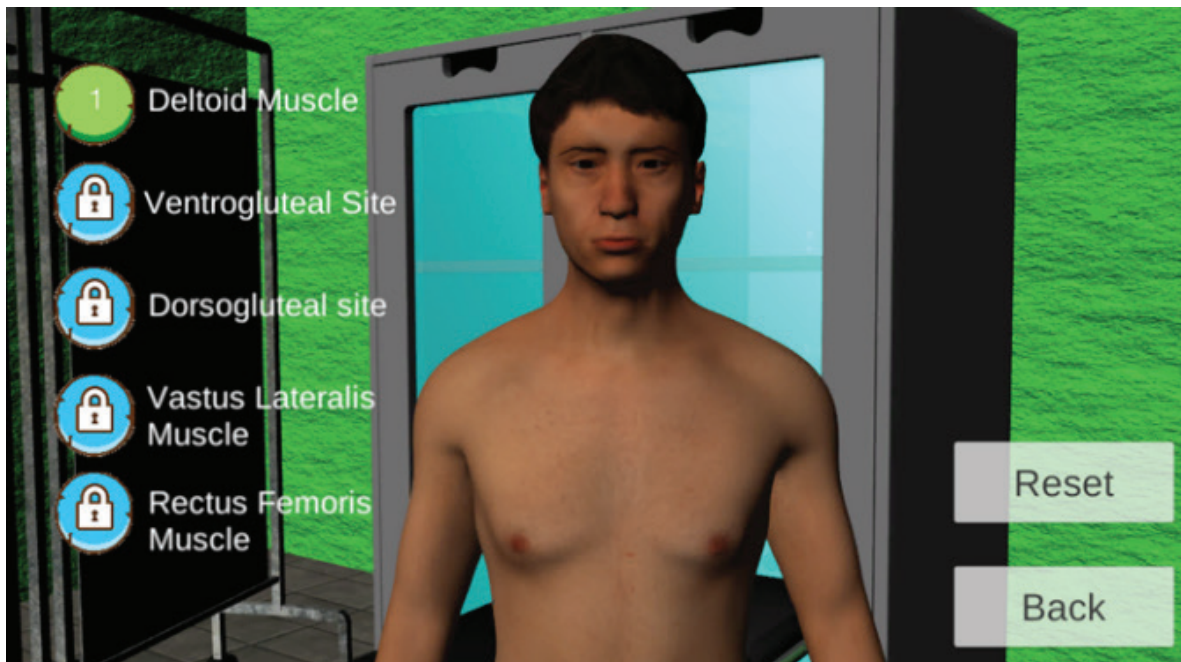


Figure 2-Muscle Selection

When using for the first time, the user is obligated to learn each muscle to access the next muscle selection. After selecting a muscle, the users can visualize the whole muscle from different angles (anterior, posterior, and lateral views) and also a virtual representation of the deltoid muscle within.

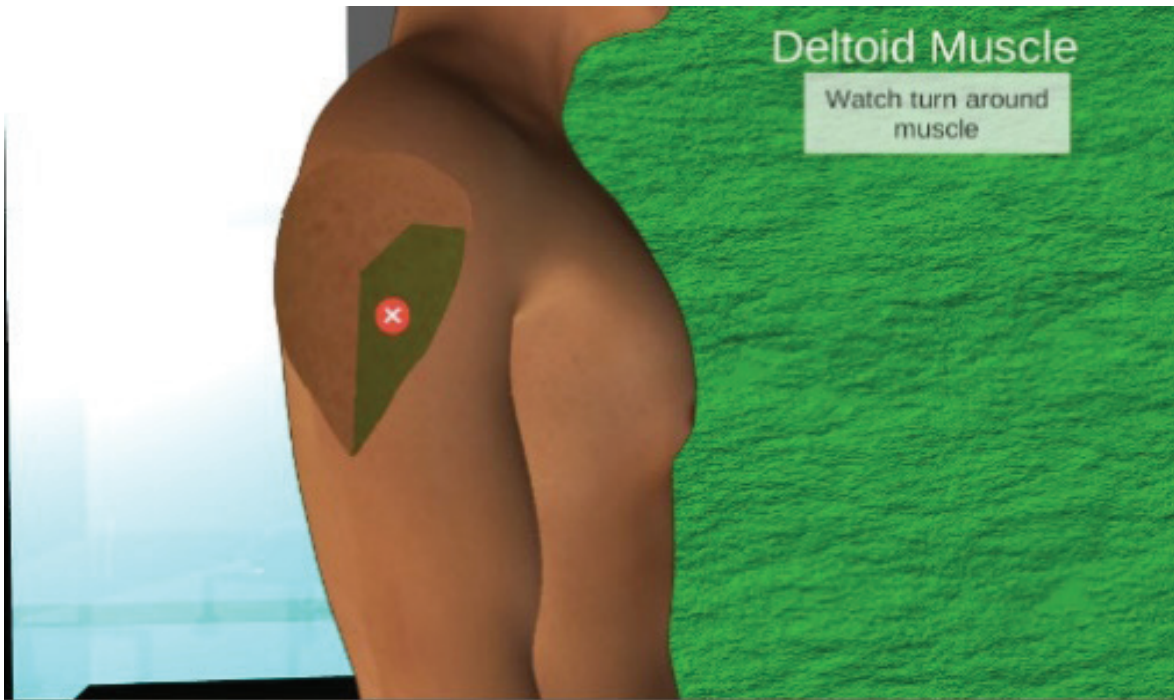


Figure 3-Wrong selection of the site of injection

At this point, the users

can notice that a virtual syringe replaces the computer mouse cursor, the user can navigate the syringe to choose the appropriate injection site. The user is allowed to administer the injection at any place within the muscle, after which the system will notify about the correct or wrong selection of the site. A red-cross mark indicates a wrong site of injection administration, and a green-tick mark indicates correct site selection. Figure (3 and 4).

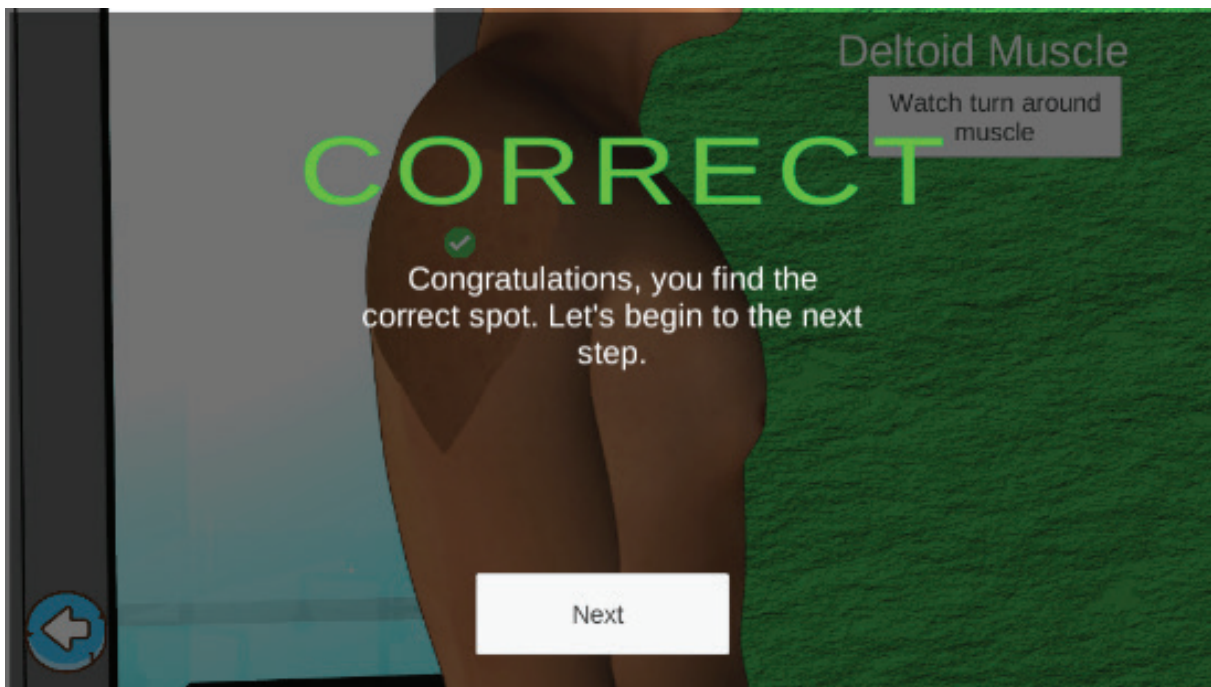


Figure 4-Correct injection site

The second stage is the syringe angle of IMI. The user can notice three different angles from which the user can choose one. Upon selecting the wrong angle, the system notifies by displaying the “WRONG” message. Upon correct selection of angle, the system automatically proceeds to the third stage to determine the depth of IMI. Figure (5)

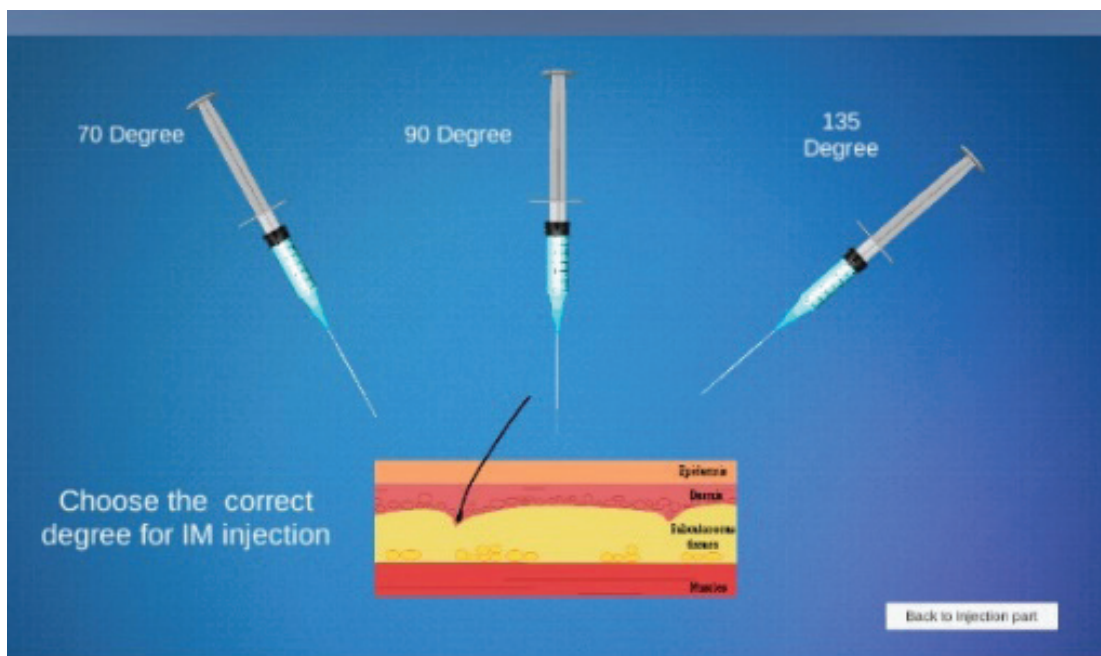


Figure 5-Syringe angle selection

The user can notice and visualize different skin layers (epidermis, dermis, subcutaneous, and muscle layers) and is allowed to choose the depth at which the injection should be delivered by clicking on the corresponding tabs next to the different layers. figure (6).

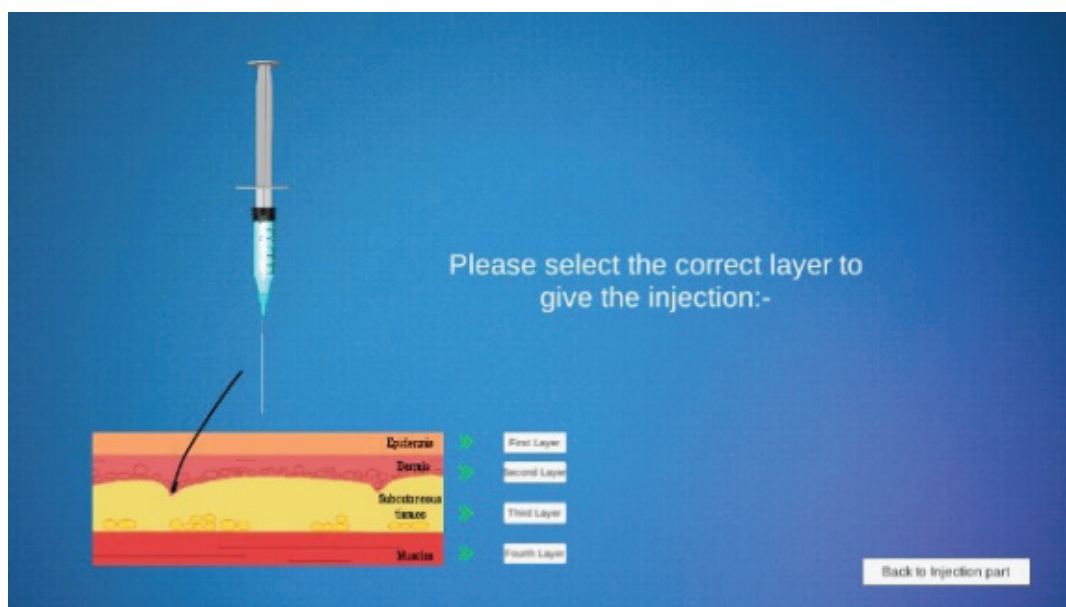


Figure 6-Layers selection/ Depth

The users can repeat the exercise as many times as they require to practice. Once the users are registered on the webpage. Some users found it an amusing way of learning and considered it as an interactive learning-based game that facilitates them in providing the freedom to continue learning at their own pace and convenience.

Validity and Reliability

The objectives-based evaluation was performed by measuring the learning outcomes through Objective Structured Clinical Examination (OSCE) and pre-post test of knowledge IMI gain, which was primarily tested with a pilot group and then administered for both intervention and control group.

Regarding testing of knowledge gain, all participants of the pilot group were examined using Multiple Choice Questions (MCQs). This test was done before they enrolled in the program, and another one was done after the educational program finished. A pre-post test was done to measure IMI knowledge gain. Pilot group results were: clinical OSCE (mean = 90.45, SD = 11.34); this estimated the clinical performance and, an MCQ test was employed to measure IMI knowledge gained with test reliability using Kuder-Richardson 20 equal to .776 showing acceptable reliability score in 15 items MCQ.

Discussion

Meeting current challenges put the academicians and universities in confusion, how to deliver proper information and guarantee at the same time that the students understand what they are learning. In other words, how to close universities and stop face to face learning to prevent the spread of COVID-19 and be assured that the students are doing well in their academic matters.

The development of this LMS enabled the students to read and practice about IMI virtually which will help the student to expand their comprehension abilities and use their critical thinking to be able to perform IMI without the need to do real-life practice in the nursing lab, some studies like ^(16, 17) found an enhancement in students' capability presentation, next simulation classes. Simulation brings enhancements to increasing knowledge ⁽¹⁸⁾. And they can practice virtually administering of IMI using virtual simulation available in 3D.

This LMS had gone through a series of validity and reliability tests to assure its validity, before that a conceptual theory was used to support it alongside with theoretical framework which used The Kirkpatrick Model ⁽¹⁹⁾ and Millers' assessment pyramid ⁽²⁰⁾ to assure

that this LMS was created according to the proper scientific teaching-learning methods.

On the other hand, although hundreds of colleges are providing online courses on entrepreneurship, two problems emerge. Firstly, from a macro-perspective viewpoint, very little is understood regarding the effects and efficacy of online learning ⁽²¹⁾ and much less established in the field of entrepreneurial schooling. Secondly, the capacity to teach entrepreneurship successfully digitally is likely to differ, considering the wide variety of learning goals that guide our teaching and pedagogical considerations ⁽²²⁾. This is why this LMS hoped to replace IMI traditional learning method and to be effective during this movement control orders.

Conclusions

It was found that this LMS can replace the traditional IMI teaching method which has many faults before and now with COVID-19 it become a necessity to move to online learning.

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