Software Development for Virtual Teaching of Medical Laboratory Skills

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Abstract This paper presents the development of software for virtually teaching of medical laboratory skills based on instructional model. This initial study focuses on the assessment models developed by Borg and Gall; Dick, Carey, and Carey. The sample of this study is 887 students of the 2007 to 2011 academic year. The surveys were conducted by requiring all participants to complete the questionnaire that has been prepared. The data were analyzed using descriptive statistics. The findings of this survey are: (1) From 34 medical skills, hematology laboratory skills is the most difficult (19,73%), (2) Twenty-seven medical skills are indicated as moderate skills to learn (0.11-17.25%) (3) Six skills which include glucometer, catheter, Ear-Nose-Throat examination, Visus examination and Thyroid examination are categorized as simple skills to learn. Based on the findings, a software application for virtual teaching of hematology laboratory skills for medical students is developed.

Keywords: software development, virtual teaching, medical laboratory skills

1. Introduction

Educational method for medical student has changed dramatically recently because of the dynamic shift in the attitude of patients and learners. The use of technologies has been increased in many aspects of today's society. Therefore, a human-computer interaction has become increasingly important to help people to learn new skills accordingly in medical education.

A learning process is throughout in human life. Learning is also a need for people to be able to survive as a fundamental change. Changes in learning are settled in terms of skills, attitudes, beliefs, knowledge, mental models, and skills of human. The changes should be planned in advance. In the planning and implementation phase of learning, there are many improvements occur every year. These changes occur as a result of discoveries and advances in information technology and communication and so on. The new technology opens up new opportunities for to improve teaching and learning [1].

Along with the innovation of new technologies, there are also changes in learning by utilizing these technologies [2,3]. Technologies are designed to increase engagement and learning of students from high school to college [2,4].

The use of computer technology, especially in medical skills education in Indonesia is still limited. The most popular medical simulation equipment is in the form of a mannequin that generally aims to imitate the form of real patients and specific anatomical condition. The simulation is run by the healthcare services that reflect the real world or situation [5,6].

In medical school education, students should experience to cure patients, so that medical students can acquire the needed skills. There is also an obligation to provide optimal treatment and procedure to ensure patients' and healthcare safety and well-being. Furthermore, medicine is a discipline that is a science as well as an art and a continue exposure with augmented experience will help improving the skills and confidence.

In this paper, we focus to assess the needs to develop a software simulator that can help medical student to improve their ability to perform a medical procedure in the practice of medicine. Thus, a software simulator on hematology laboratory procedure such as blood smear and differential count skills is developed. In section 2, the methods used for developing an instructional design are described. The discussion of data collections and a draft model for the software simulator model are presented in section 3, while the conclusion is stated in section 4.

2. Methods

This study uses a qualitative approach using the Research and Development Method (R&D) by Dick, Carey, and Carey. According to Borg and Gall (1983), Borg, and Gall W.R, M.D. (2007), the R&D model by Dick, Carey, and Carey are the most widely used. In this study, the researcher uses a combination of both concepts by Dick, Carey & Carey, and Borg and Gall. Figure 1 shows the stage of Research and Development (R & D) according to Borg, WR and Gall, MD (2007), which is adopted from Dick, Carey & Carey (2009) [7,8].
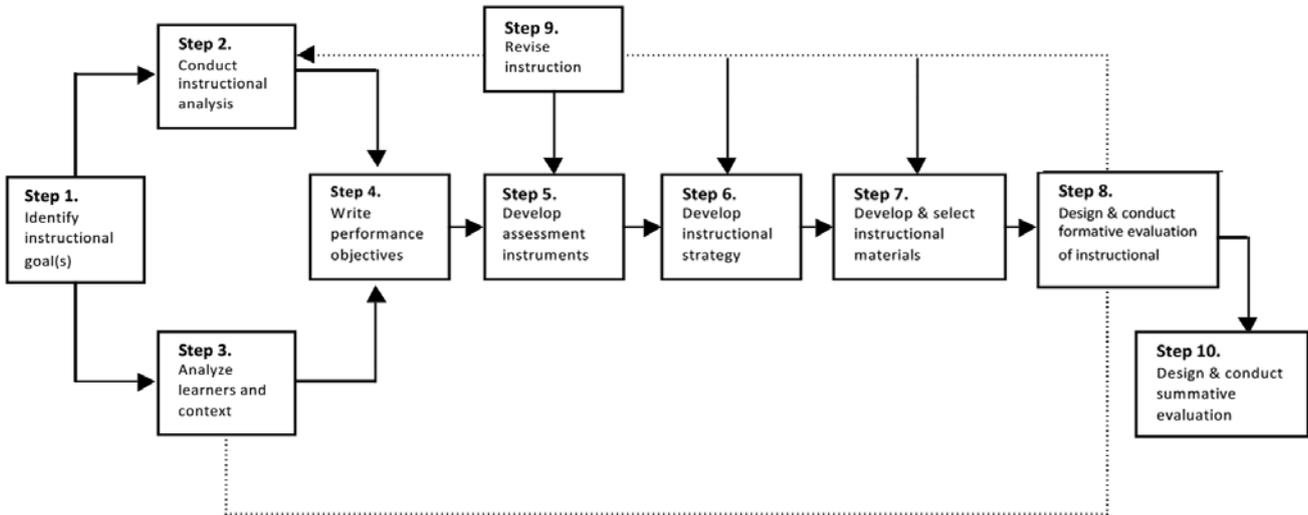
Figure 1. Instructional Design Model Dick, Carey and Carey

The combination of these two methods, strengthen the proposed research in accordance with the needs of the field. Prior to the instructional design phase of Dick, Carey, and Carey, the first step begins with a preliminary investigation to determine the need and the appropriateness of the research objectives.

The study was conducted by means of a survey via questionnaire. The questionnaire was used to obtain data on the most difficult skills in student perceptions and also the problems encountered during the process of medical skill learning in the Faculty of Medicine, Tarumanagara University.

The participants of this research were the students of Medical Faculty, Tarumanagara University. They are undergoing a module in the 1st – 7th semester. The subjects are young adults, aged between 17-21 years old.

Figure 2 shows the distribution of the questionnaire results. The questionnaire has been circulated to the entire class of medical students (2007-2011). There are 34 skills in the curriculum of medical school. Those skills include Psychiatric anamnesis, Ante Natal Care, Ankle-Brachial Index, Anthropometry, Musculosceletal Sprain & Strain; Minor Surgery, Hand Hygiene, ElectroCardioGraphy, Glucometer, Vena Access, Injection, Intubation, Catheter, Communication, Hematology Laboratory, Naso-Gastric Tube, Normal Delivery, ENT examination, Visus, Counseling, Gram staining, Abdomen examination, Cardiac examination, Neurological examination, Thoraxic-Lung examination, Thyroid examination, Public Speaking, Vena Punction, Medical |Record, Cardio-Pulmonary Resuscitation, Geriatrics medical record, Gloves, Speed Reading, and Vital Sign.

A total of 887 students from the class of 2007 comprised of 32 students, class of 2008 comprised of 171 students, class of 2009 comprised of 191 student, class of 2010 comprised of 242 students and the class of 2011 comprised of 251 students.

Based on the survey results, we then conclude the perception of students. The most difficult medical skill is in hematology laboratory. Therefore, this research is focused on learning the medical skills of the blood laboratory.
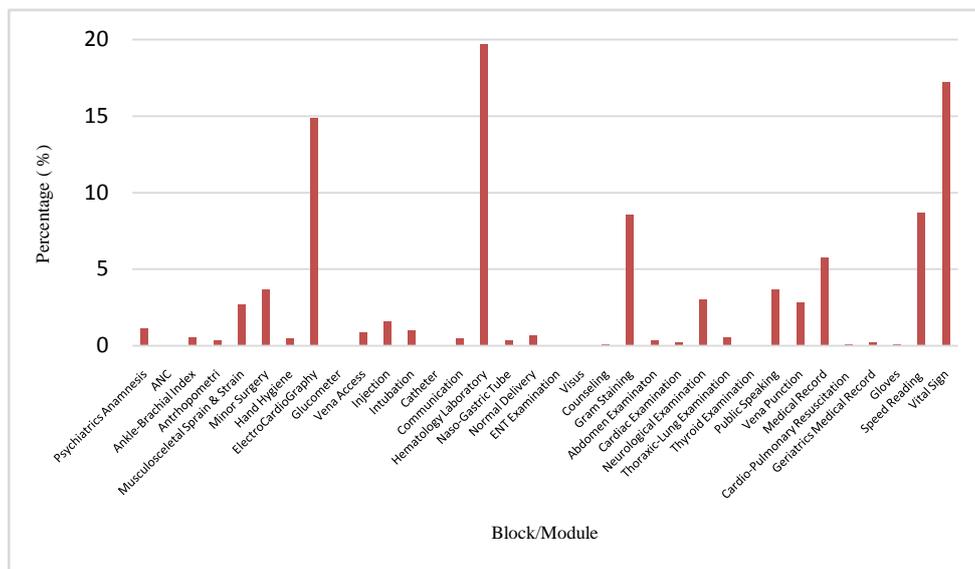

Figure 2. Data of Medical Skills That are Considered Difficulty by Students Participating in The Entire Block/Module
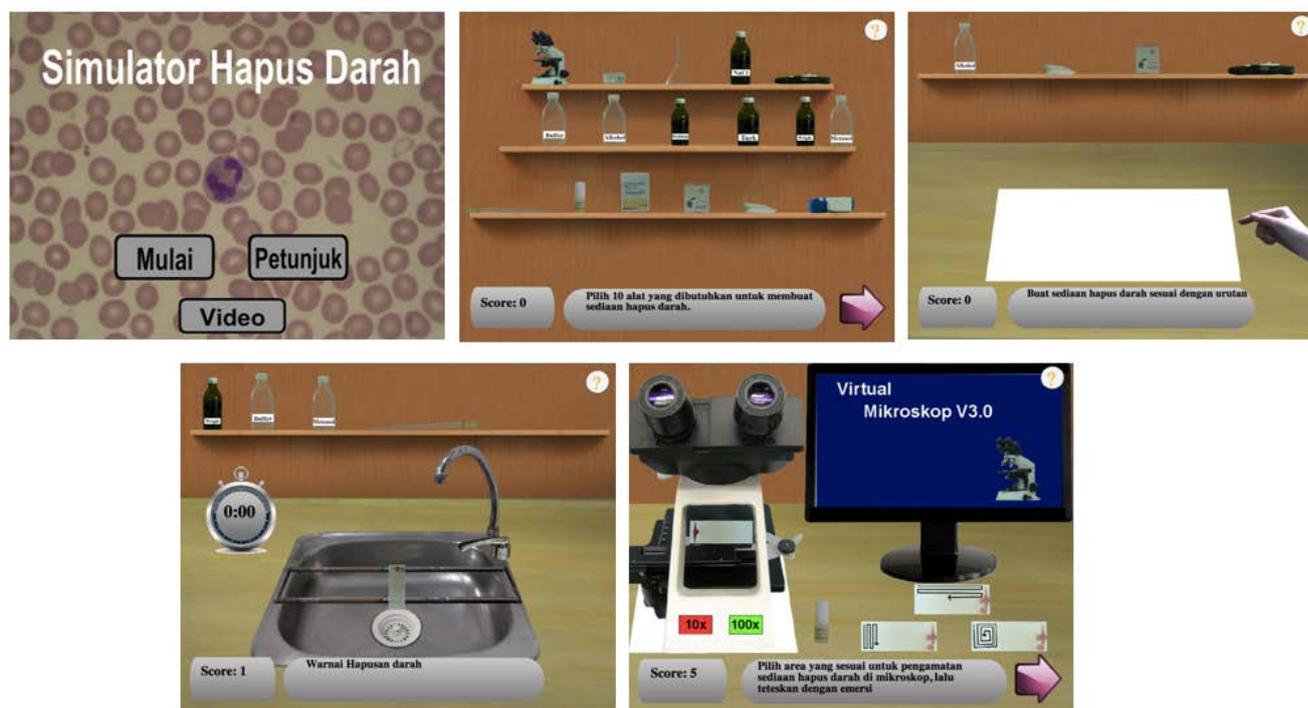
Figure 3. Draft Model of Software Simulator

Based on the survey results, the researcher proposed a draft design of software development for the hematology laboratory skills. The software design development has 5 scenes. Every scene consists of various skills on blood smears to the calculation of white blood cells. Figure 3 shows the draft model of software hematology laboratory simulator.

3. Discussion

One important concept in medical safety is the paradigm of how student learns. Traditionally, medical study works on the apprenticeship model. Trainees begin doing the skills in laboratory and caring for patients on their first days of clerkship under the supervision of more experienced faculty to provide a safe care and minimize errors.

Despite their knowledge about medical care, before conducting the responsibility of their first patient, the medical students must pass their examination skills for the high-risk procedures laboratory.

Software simulation provides a learning model to supplement traditional learning in medicine. The use of the software also allows lectures to teach and test skills that are taught to the students. For the performance of procedures, it is shown that the volume of experience decreases procedural errors rates. Simulators allow the increment of experience prior to performing live procedures on patients.

One of the advantages of the use of computer-based simulation with virtual environment is the ability to perform some of the risky procedures. In addition, students can also practice independently in virtual clinical settings. Costs incurred also can be reduced because many facilities are not required, and students can learn without limitation of time and place while sustaining the quality of skills [5,9].

4. Conclusions

Software for virtual teaching has open up a new learning method in medical school. Procedural-based practices can be put into action by means of protocols and algorithms, which can be practiced via software. With this new technology, there are potentials to save cost, time, and energy in designing a curriculum. The simulated environment also offers some benefits to the traditional didactic instruction, such as performance enhancement and possibility to reduce errors.

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