



Innovative Utilization of Augmented Reality and Simulation to Promote Nursing Practice

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Abstract

The health challenges facing the nation have shifted dramatically. The American population demographics are changing and becoming more diverse with respect to race, ethnicity, and other cultural and socioeconomic factors. Shifts in health care needs are occurring as much of health care today is associated with chronic conditions, such as diabetes, hypertension, arthritis, cardiovascular disease, and mental health conditions. Many of the modes of education for nursing that were predominant during the 20th century are no longer considered adequate to address the realities of health care in the 21st century. As patient needs and care environments have become more complex, nurses need to attain requisite competencies to deliver high-quality care. The School of Nursing program identified an innovative teaching and learning modality for nursing students to aid them in developing competency with skill acquisition. The modality used simulation and augmented reality to provide student learning for the skills of intravenous medication administration and female catheterization. The ability of the nursing student to acquire and demonstrate skill acquisition provides evidence of the efficacy. Researchers evaluated student's performance on two clinical skills against time, accuracy, and completion rates. Results concluded that the use of augmented reality and simulation could be used to independently train and evaluate nurse student's performance and, help to improve their clinical skills proficiency.

Keywords: Wearable; Augmented reality; Virtual reality

Introduction

Various problems challenge the expected level of skill proficiency of nursing students who practice clinical skills with patient manikin simulators, and inside simulated learning environments labs. These challenges include, but are not limited to, limited availability of nurse faculty to provide instruction and repetitive practice needed for nursing student's opportunities to practice outside nursing laboratories regular hours of operations. The capability of nurse faculty to address individual learning needs of nursing students during each practice session can be facilitated with use of simulation. The utilization of technology can decrease and possibly eliminate instructional and evaluation variability among nurse faculty. Technology can enhance the ability of faculty to sometimes quantifiably evaluate student-learning performance. It is vital that strategies are developed and implemented to address the challenges to facilitating practice settings that promote student learning. Augmented Reality (AR) and simulation are technology interventions modalities that can be integrated into nursing curriculum to help nursing student achieve and improve clinical skill proficiency.

Simulation as an effective teaching learning modality

Simulation helps develop competences for professional practice [1]. Students who have the opportunity to develop clinical practices in a simulated environment report an increase in confidence, as they were able to transfer significantly the knowledge learned in the classroom to the simulated environment [2]. Studies have reported improvements in the areas of critical thinking, confidence and/or knowledge/skills after participating in the simulation [3-6].

Simulation can take many forms, including human patient simulation using manikins and/or standardized patients, virtual and computer based simulations, simulation done to teach psychomotor skills, or role play (NLN). Simulation provides a rich learning opportunity for students to integrate theory with practice while making real-time clinical decisions in an environment that poses no risk to patients [7].

Schools of nursing are increasingly challenged to provide high quality clinical experiences for

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students. Educators have turned to simulation as a way to provide rich learning experiences that can replicate actual clinical experiences [7]. Simulation can standardize clinical experiences in this time of unpredictable and often unequal clinical learning opportunities. The use of High-Fidelity Simulation (HFS) in health care education has emerged as a possible solution to address limited clinical experiences related to patient, preceptor, situational, or site availabilities [2,8,9]. HFS also provides students with a safe environment to learn and make mistakes without compromising patient safety. Research studies have shown HFS to be beneficial in acquiring new knowledge in many clinical areas, including Medical-surgical, advanced cardiac life support, and acute myocardial infarction treatment [5,6,10].

Human patient simulation-based clinical nursing education has the potential to promote transformative learning and lead to a metamorphosis of students' preconceived meaning schemes. One of its major benefits is that it allows students to engage in social interactions and hone their psychomotor skills without affecting patient safety. This fact helps most students relax and increases their confidence in performing clinical skills during a simulated clinical experience [11].

Augmented reality

Augmented Reality (AR) is the ability to provide computer-generated imagery to common place objects. This allows for additional information about the object or environment to be provided to the user. Virtual reality technologies support enhanced self-learning, automated tutoring, widespread deployment and accessibility, cognitive decision making, and communication through dialogues [12]. Augmented Reality (AR) is defined as "a live direct or indirect view of a physical, real-world environment whose elements are "augmented" by computer-generated or extracted real-world sensory input [13]. Augmented Reality as a technological innovation allows computer-generated virtual imagery information to be overlaid onto a live direct or indirect real-world environment in real time [14]. Augmented reality bridges the gap between the real and the virtual in a seamless way [15].

Methodology

The equipment used included the Juxtopia[®] CAMMRAD Medic prototype goggles. Data collection was also possible from utilization of the Juxtopia[®] CAMMRAD Medic Goggles. The goggles allowed for the storage of data collected into the CAMMRAD Medic system software.

An evaluation of the efficacy of Augmented Reality with simulation was conducted at Coppin State University (CSU) School of Nursing, with junior level nursing students. The students' skill acquisition was assessed and evaluated using video instruction followed by performance of skill acquisition using augmented reality and patient simulators. None of the students had any prior experience with augmented reality as a mode of learning.

The study was comprised of 25 nursing students (Males=5; Females=20) who participated in an assessment of skill acquisition for intravenous medicine administration and female Foley catheter insertion. The participants were randomly selected into either control or experimental groups. The experimental group consisted of 11 nursing students. The experimental group participants used AR goggles to perform the procedures. The control group consisted of 14 nursing students. Prior to performing clinical skills each experimental and control group participants viewed a 30-minute video on how to

perform both the IV medication administration and Foley Catheter procedures. A purposeful 20-minute delay elapsed between watching the video and performing the two clinical skills to evaluate retention of knowledge. The Juxtopia[®] CAMMRAD Medic System was used for the Augmented Reality for the clinical nursing skills, which were to initiate an intravenous line for medication administration and female Foley catheterization. The development of a novel registration/tracking algorithm was integrated into the Juxtopia[®] CAMMRAD Medic client software to superimpose over a patient simulator anatomy, a digital landmark for intravenous access identification.

Procedure

After watching the video and after the 20-minute delay, the participants performed hands-on clinical procedures for the intravenous access identification and catheterization of a female the participants were provided the opportunity to review the process for the Intravenous access identification and administration of medication and for Foley catheter insertion. The time allocation was a maximum of 10 minutes. Records were kept of the time required for completion of each clinical procedure. All participants completed a survey instrument Student Assessment of Learning Gains (SALG) in Nursing Survey. The SALG was developed using guiding principles outlined by [16] for gathering valid student-self assessment data. Reliability is addressed through cognitive interviews of students and expert review of content specialists. The discriminative power and reliability of the scale have yet to be formally tested. However, high and low scores on particular items compare favorably with the percentages of positive and negative comments on the same items offered by students in the initial study.

The SALG is comprised of Interest and Attitudes, Understanding Class Content, Skills, Integration of Learning areas. 34 items are Likert scale and identified as a great deal, a lot, somewhat, just a little, not at all and not applicable. The SALG is comprised of four sections Interest and Attitudes, Understanding Instructional Content, Skills, Integration of Learning and how much did each of the following aspects of the course help your learning? The data was analyzed using SPSS statistical software. In which Means comparisons were run to observe the average time to task completion and gender differences in IV task.

Results

As it relates to completion of performance, the control group completed the procedures at a faster pace than the experimental group. The average time of task performance for the experimental group was 6 minutes and 13 seconds and 4 minutes and 38 seconds for the control group. In comparing gender differences, the males completed the IV task slightly faster than the females. The average time of task performance for the males was 5 minutes and 5 seconds and 6 minutes and 39 seconds for females.

The average time to complete the Foley catheter task for the experimental group was 4 minutes and 44 seconds. In both groups, all participants completed each step except for one participant who went over the 10-minute time limit to complete the IV task. Responses on the SALG on average, nursing students reported they gained a lot of understanding in the main concepts of clinical practice ($M=2.20$, $SD=1.41$) as well as the relationships between the main concepts used in clinical practice ($M=2.20$, $SD=1.35$). Nursing students expressed gains they have made in basic nursing practice skills as a result of the augmented reality using Juxtopia CAMMRAD Goggles. Students

reported feeling they attained competence with Intravenous access and administration of medication (M=2.44, SD=1.66) and with Foley catheter (M=1.88, SD=1.16).

Student responses were obtained regarding comprehension of content, ease of understanding, comfort level with nursing skills and application of identified nursing skills. On average, students reported feeling somewhat confident in understanding the material (using the Juxtopia CAMRRAD goggles while performing task) (M=3.56, SD=2.06). Group differences show that the experimental group had a lot of confidence in understanding the material (M=2.73, SD=0.905) while the control group reported just a little confidence (M=4.21, SD= 2.47). Students expressed having a lot of comfort in working with complex tasks and applying their skills in actual situations as a result of the study. Students also reported a lot of enthusiasm for practicing in clinical settings and taking additional nursing classes. In terms of their integration of learning, students reported that their nursing course somewhat contributed to their nursing skills becoming proficient, as well as increase their accuracy, and proficiency in applying skills and procedures. 32% (n=8) reported the course improved their visual clarity to successfully complete procedure and treatments. 44% (n=11) said the course help them a lot in increasing efficiency in completing procedural tasks. 36% (n=9) said the course somewhat decreased their time toward task completion. On average, students reported gaining a lot from using technology to perform nursing skills and procedures.

The student's performance and responses on the SLAG provided meaningful insight about augmented reality and its applicability to nursing course content in collaboration with the Juxtopia CAMMRAD goggles. Nursing students did benefit in ways such as increasing their skills in performing IV access identification and administration of medicines and female Foley catheterization. The majority of responses were positive which suggest the course did help students increase their basic nursing skills with or without the Juxtopia CAMMRAD goggles.

Applicability to Practice

Simulation as a mode of teaching and learning in health care and in nursing has become an important part of the education of students and practicing healthcare providers. The Institute of Medicine's report on nursing work environments recommends simulation as a method to support nurses in the ongoing acquisition of knowledge and skills [17]. In the Future of Nursing report [17] simulation is mentioned as a strategy to support inter professional education [18].

The Carnegie Foundation for the Advancement of Teaching report; Educating Nurses, highlights simulation as an effective strategy for the education of nursing students [19]. Knowledge gain and retention are important outcomes of experiences of student who participated in this study. The students who will become future practicing nurses will obtain content and experiential knowledge about health conditions and modes of care for clients with diverse health care needs. The ability to provide meaningful, safe, and individualized care requires cognitive ability and psychomotor abilities for procedures to be performed accurately and safely.

Knowledge gained from experiences with simulation and augmented reality can significantly influence student learning. The utilization of technology to enhance and improve some areas of student learning is a valuable adjunct for nursing education. Lecture, discussion clinical experiences, and laboratory practice are

fundamental in nursing education. The inclusion of technology as a teaching and learning modality can be a valuable adjunct in nursing education and help to increase efficacy in skill acquisition for clinical skills that are requisite for patient care.

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