Review Article

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Journal of Healthcare Communications
ISSN 2472-1654

2017
Vol. 2 No. 3: 24

DOI: 10.4172/2472-1654.100064

Validating the Use of High-Fidelity Simulation as a Clinical Adjunct in Undergraduate Nursing Education

Samantha Headstream-Pehl[1] and Diana Kunce-Collins[2]

1 Frontier Nursing University, Tarleton State University, Stephenville, Texas, USA
2 Tarleton State University, Stephenville, Texas, USA

Corresponding author:
Samantha Headstream-Pehl

pehl@tarleton.edu

Assistant Professor, Frontier Nursing University, 195 School Street, Hyden, Kentucky 41749, Tarleton State University, Stephenville, Texas, USA.

Tel: 254-968-9848

Citation: Headstream-Pehl S, Kunce-Collins D. Validating the Use of High-Fidelity Simulation as a Clinical Adjunct in Undergraduate Nursing Education. J Healthc Commun. 2017, 2:3.

Abstract

According to the American Association of Colleges of Nursing (AACN) the entry level enrollment for Baccalaureate nursing programs has risen 82.7% since 2002. The increased enrollment has translated into a need for clinical sites and experiences required to develop skilled, knowledgeable nurses. Nursing schools are looking at advances in technology to help maintain a high standard of education and provide needed clinical opportunities.

Current research suggests that the use of high-fidelity simulation is an effective method of preparing nursing students to care for patients. Students can develop teaching, technical, and critical thinking skills during the high-fidelity simulations that can be readily transferred to living patients in a standard care situation.

This project investigated the premise that simulation experiences are comparable in effectiveness to hospital clinicals by comparing pretest/posttest scores and semester exams scores after a four week clinical rotation. Statistical results showed no difference in scores between the test and control groups, thus supporting the literature review and the null hypothesis.

Keywords: High-fidelity simulation; Nursing; Healthcare; Education

Received: April 13, 2017; **Accepted:** April 28, 2017; **Published:** May 10, 2017

Introduction

As nursing school enrollment has increased there is increased competition among nursing schools for clinical sites making it more difficult to expose students to the variety of experiences needed for the development of clinical judgment and core competencies used in professional nursing practice. As a result, nursing students are getting limited opportunities in clinical practice sites to become proficient at basic nursing skills, communication techniques and critical thinking. Nurse educators and educational programs are seeking alternative clinical experiences to supplement the standard clinical experience now being utilized [1]. High fidelity simulation offers a safe alternative to allow students to expand their knowledge and abilities without putting patients or students at risk [2]. While simulation has been used in specific and limited situations for educational experiences among other health care professionals, high fidelity simulations are not being used, to the fullest extent possible, to expand clinical learning opportunities for nursing students at TSU (Tarleton State University).

Simulation has been utilized by nursing educators for decades, to help nursing students develop skills, confidence and critical thinking [3]. Technology has improved the functionality of human like simulators who can now talk, blink, cough, breathe and even birth a simulated infant. The life-like simulators provide the means to schedule health care learning situations from initial interviews to a variety of emergent occurrences. These experiences are not client dependent, which can facilitate wider breadth of experience for all students. Researchers have identified high-fidelity simulation as an alternative clinical experience to enhance student development while in a safe atmosphere for both the student and patient [1,2]. High-fidelity simulation allows students to obtain physical input, environmental responses and patient management experience in situations that are usually observational experiences in traditional hospital clinical rotations [4].

Methods

Students were randomly assigned to one of the three clinical groups: simulation, preceptor or faculty. Names were drawn out of a cup and then the group was drawn out of a second cup. There were 61 names and 61 numbers in two different cups. This double blind method of clinical group assignment removed bias

in the assignment phase of this project. One student who received less than a 75 semester grade the previous semester, and had to repeat the course, was enrolled in the project but the data for that student was not used as their previous exposure to the material would be a confounding factor. This resulted in the use of data from 60 project participants.

In an attempt to ensure all students had a similar knowledge base, all 61 students were required to have completed antepartum, intrapartum, postpartum and newborn patho-physiology assignments and the accompanying care plans, medication note cards, and hospital protocol assignments prior to the onset of any of the clinical activities. In addition, Computer Assisted Instruction Activities (CAI's) were required for all students to view prior to attending any of the clinical experiences. This preparatory work was available for review in all of the clinical experiences. This kept this project as life like as possible and still allowed the students a chance to prepare a mental foundation for simulation and hospital experiences.

All three NUR 302 rotation groups will complete all three clinical experiences during the 2012 fall semester. Each rotation group will attend 4 weeks of clinical instruction in the hospital with a clinical instructor, in the hospital with a preceptor and in the simulation lab with a clinical instructor. The only difference in the experiences will be the timing of the clinical experience. For the purpose of this project only the initial rotation information was evaluated and compared. It was important that all students have the same opportunity for rotational experiences, but due to time constraints, data was collected for the first clinical rotation of the fall 2012 semester only. Project leaders continued to compile data for the remaining two clinical rotations. This will allow statistical analysis and comparison among all three clinical groups at a later time.

All of the simulation experiences were conducted by the investigator following a strict teaching plan to decrease the chance of information bias among the 3 simulation groups. The same clinical instructor also conducted all of the hospital clinical experiences. The preceptor led students were assigned to one of two sites. There were 6 different nurses that these students could be assigned to follow at both faculties. The preceptors used were required to have a minimum of 5 years maternal-child experience and have been a preceptor prior to this experience.

Simulations for this project were selected from the instructor and student simulation guide written by Zerbe and Gamlin [5]. This manual contains 9 standardized simulation scenarios that are pre-programmed into the Noelle maternal simulator (Gaumard, Scientifc Co., Inc.). The decision was made to utilize these simulation scenarios based on the limited programming experience of the lead project investigator and the quality of the scenarios readily available for use. These pre-programmed 30 min scenarios have accompanying learning objectives, discussion questions, student evaluation rubrics and post scenario test questions. These simulation tools have proven beneficial in enhancing knowledge and skill building [6].

The simulation group participated in 4 different simulations during the four week rotation. The first week focused on assessment and care techniques for antepartum, intrapartum, postpartum and newborn patients. A care station was set up for each of these patients. Initially the instructor/investigator performed bedside modeling at each of the stations for the students to emulate. Specific care objectives and skills instructions were reviewed with the students prior to attempting simulation. Students were aware that they would be working with an antepartum, intrapartum, postpartum or newborn patient prior to attempting the simulation just as the instructor led clinical.

Subsequent simulations involved caring for both maternal and newborn patients during a precipitous delivery, shoulder dystocia and postpartum hemorrhage. The simulation day would begin with a review of specific assessment techniques, skills, medications, assessments and care activities appropriate for that specific simulation patient. New skills were demonstrated by the instructor on the simulator with return demonstration by the students. Technique was critiqued by the instructor and corrected immediately in order to build confidence and perfect technique.

Students were required to communicate with the simulator asking questions and confirming information. Students would practice appropriate language such as asking permission to perform a cervical exam, Leopold's maneuvers or checking the patient's perineum. Communication and language skills were confirmed or corrected immediately in order to ensure students practice appropriate techniques. These practice sessions allowed students knowledge of the criteria for evaluation during simulation.

All three simulations began with report by the off going RN. Students would then begin patient care according to the assessment of the patient, physician's orders and simulators responses. Students were required to manage medications, IVs, pain management, patient teaching, labor support, delivery preparation and anticipatory management.

Students were assigned a simulation role: These roles involved being either charge nurse, primary nurse or newborn nurse. Each student played a different role each week. All students were given the opportunity to play all three roles. The student charge nurse would assist in the care of both the maternal and newborn patients. The primary nurse was in charge of the maternal patient. The newborn nurse assisted the primary nurse in addition to preparing for the delivery of the infant. Students from groups not participating in the simulation would volunteer to be family members. Not all students got an opportunity to be a family member.

Students not directly participating in the simulation would view the simulation in real time in the control room. They were required to observe and critique the ongoing simulation. The students would then switch positions. The groups would alternate who went first so that they could all experience having to perform the simulation first. This time was originally designated for computerized charting after the simulation but technical difficulties made this an unreliable activity so the observation experience was substituted in this project just prior to the implementation of the simulation clinical rotation.

Should one group not perform to the level expected during the simulations, that group was required to repeat the simulation af-

ter the other groups had finished and before the debriefing period. The repeating group was given an opportunity to discuss its simulation deficits with the instructor and lab support personnel, restructure the care team's assignments and review care plans, medication cards, patho-physiologies and doctor's orders. None of the simulation groups failed to satisfactorily complete the simulation on the second attempt.

TSU students were required to come into the clinical setting with 20 generic modifiable obstetrical care plans. Since the care plan was already completed, during Path A students were able to use that time to modify their existing work. Students not involved in simulation activities were positioned in the observation/control room and charged with finding both positive and negative actions which occurred during the simulation. Then the two groups would switch positions keeping with the simulation pathways idea of continuous activity and learning activities [2]. Initially students were going to utilize a computerized charting system for the documentation portion of the simulations. Due to multiple system difficulties, including consistent student access issues, this portion of the pathway B was deleted from the project. Students were not required to document as many of them did not retain adequate specifics of the simulation events to chart accurately once the system was operational. Students were given opportunities to document during their hospital and preceptor experiences so as to continue to develop that skill in a less stressful, accurate and effective manner.

TSU students were required to participate in a debriefing session in which students were required to comment on the positive and negative aspects of their performances. This group activity was led by the investigator but students were to use their observation notes to critique simulation actions. Students were also required to write a one page journal reflection on the simulation experience. The journaling required the students to explore their strengths and areas that need improvement. It also made the students consider how they appeared and presented themselves as professionals. Students were able to reflect on their professional speech patterns, mannerisms, appearances and patient interactions.

After each days simulations students were required to view the simulation videos from that day. All students viewed all the videos from that day in order to practice reflection and constructive peer evaluation led by the simulation clinical faculty. Discussion questions provided in the Guamard instructor's manual were utilized to help guide the activity. The debriefing period lasted 60-90 min. Students received feedback from both their peers and their clinical instructor. Students were also required to journal their impression concerning the simulation process each evening and share those impressions with their clinical groups prior to the next simulation experience. This allowed students to reflect on their feelings during both the simulation experience and the debriefing process. These reflections proved helpful to the instructor during subsequent simulations and debriefings. Students received feedback back after the instructor read the journal entrees in an attempt to acknowledge and encourage the students in the learning process. This process incorporated steps 4 and 5 of the FIRST 2ACT model **(Appendix A).**

Students were evaluated at several junctures. Students were given a pretest on August 28th, 2012 prior to attending the clinical activities. At the end of the 4th week clinical rotation, on October 11th, 2012, a posttest was administered to the entire class during scheduled class period by the course leader and investigator. The test questions were chosen from the Elsevier test bank which accompanies the textbook [7] Murray & McKinney. There was an expectation for improvement of posttest scores. Students were assured that the pretest/posttest grade was not used in there didactic grade average.

Also on October 11th, 2012, students were evaluated using a semester exam review test. Students were not given prior notice of this review test. As a result, they did not spend time studying for this exam which allowed for a more accurate assessment of knowledge gained through clinical exposure. This was a 50 question exam which again was not reflected in the students' didactic grade. The test questions for this exam were selected from the Murry & McKinney [7] textbook test bank published by Elsevier. These test questions have been statistically evaluated and stored in the Par testing and scoring system at TSU over several years. Only questions that have been determined as reliable were used for this capstone project.

Ethics

The TSU faculty has discussed the balance required in educating task oriented nurses verses caring nursing professionals. Nurses must be proficient in tactile skills while demonstrating caring and intuitive behaviors. The art of nursing care is a philosophical thread that runs through the underpinnings of the TSU nursing program. The faculty agrees that the use of simulation can be an effective adjunct but will never be a replacement for actual clinical patient care.

Simulation experiences allow students to gain the tactile skills, which may inflict pain, introduce infection or could be physically dangerous without putting a live patient in jeopardy.

The use of the high-fidelity simulators can allow the simulation operator to respond with verbal and physiological changes that mimic a live patient. Students gain cognitive, psychomotor and affective skills involved with developing procedural memory without potentially harming a living person [8].

The Internal Review Board reviews (IRB) for Frontier Nursing University and Tarleton State University were, submitted and the project was exempt. No potential jeopardy was identified for study participants. Participation in the study was voluntary.

Statistics

Univariate and multivariate techniques were employed to obtain descriptive statistics and analyze the impact of group membership on the dependent variable [9]. A multivariate analysis of variance was conducted to determine if a statistically significant difference exists on the three dependent variables based upon assigned clinical experience group. A MANOVA was used to decrease the risks of causing a Type 2 statistical error [9].

The age range of 80 % of those participating in this project was from 18-25 years of age. 82 % of the study participants had no children nor had attended childbirth education classes. There was an even distribution of the age ranges and not having children across all groups. The 8 males participating in this study were evenly distributed among the clinical rotation groups and made up 13% of the sample pool.

Prior to conducting the MANOVA and following a recommendation by the American Psychological Association (APA), the data set was also analyzed for the potential presence of outliers (Wilkerson & Task Force on Statistical Inference APA Board of Scientific Affairs). First, standardized residual and predicted values for each of the three test scores were obtained, plotted, and visually inspected for possible spurious cases. This inspection revealed one case from the semester exam results which was found lying more than 3 standard deviations away from the group centroid **(Appendix B).** Further review indicated that case 51 from the preceptor group had a value of 10, which was abnormal considering the mean of the group. This case was eliminated from further consideration. Final analysis involved a total N of 18 in the simulation group, a total N of 20 in the preceptor group and a total N of 21 in the instructor led group.

Box's Test of Equality of Covariance Matrices produced a non-statistically significant coefficient indicating sufficient covariance equality across the independent variables, or groups. However, a review of the omnibus MANOVA output indicated there was no statistically significant difference in the dependent variables based upon group membership F, (6, 108)=1.071, p=0.384; Wilk's λ=0.891, partial ε^2=0.056 **(Appendix C).**

Simple mean scores for the three groups pretest/post-test results show: 23.81% increase for the instructor led group, 20.47% increase for the simulation group and 18.80% increase for the preceptor led group. This translates into a 5.01% difference between the three groups **(Appendix C).** The exam means scores for the three groups reflects a 8% higher score for the simulation group when compared to the instructor group, 7% higher score for the simulation group when compared to the preceptor group and a <1% difference in scores for the instructor group and the preceptor group. 100% of the 18 students wrote positive reviews of the simulation experience in their simulation reflection journals.

The statistical analysis supports the null hypothesis presented by the PICO question for this project. Will nursing students who attend 24 h in hospital with preceptors or 24 h in hospital clinical with instructor or 24 h in high-fidelity simulation based clinical hours improve their obstetrical knowledge equivocally when comparing test results? The data has demonstrated the validity of simulation use in undergraduate nursing education when compared to established methods of clinical teaching.

Results

Project designer anticipated the mean change between pre and post test scores would be equivalent or higher in the simulation groups than the instructor or preceptor led groups. It was also expected that the exam scores for the simulation group would be as high as or higher than the exam scores for the preceptor or instructor led clinical groups. While this did not completely hold true, simulation has proven to be an equivocal valuable learning experience for nursing students.

Research clearly shows a perceived benefit for nursing students who attended simulation scenarios [10-12]. These perceived benefits were reflected in the students debriefing journals. They frequently verbalized appreciation for the opportunity to develop skills and make mistakes while learning to care for simulated labor, postpartum and newborn patients prior to attending hospital clinical. Neither educators nor students are endorsing the replacement of clinical patient care with simulation but the combination of the two should potentiate the learning effect [1-3,10].

Students reflected in their debriefing journal apprehension about being video- taped, but seemed to adjust to the taping as they were welcomed into the observation/control room and saw what occurred there. Students were able to peer evaluate in a positive and supportive manner as they witnessed the instructors coaching the simulation students from behind the glass. The observation students emulated these behaviors, which helped them learn from each other's mistakes, as well as created a positive team atmosphere. The teamwork observed during the simulation experiences was an added benefit of the simulation experiences but was not an anticipated outcome of this project.

This project has proven beneficial in stimulating TSU student interest in educational research and simulation as study participants have shared their enthusiasm for the project with other students and faculty. The students were also excited to release their journal statements and outcome data in order help to form the educational experience for subsequent nursing cohorts. The success of this project has created an increased interest in establishing purposeful research projects geared towards proving statistically significant educational outcomes.

Fortunately no negative outcomes were noted. This was an unexpected outcome as there were negative aspects during the spring 2012 pilot study inappropriate time allotments for simulation, large group sizes, inadequate technical support and unreliable simulators. All of these factors were addressed and minimized during the planning of this project.

Discussion

TSU like many other nursing programs was experiencing difficulties locating adequate clinical experiences for its nursing students. This project was conceived and designed to develop simulation as a teaching methodology and establish data to support its use at TSU and other undergraduate nursing programs. Various simulation frameworks were considered for use and a combination of a simulation pathway **(Appendix D)** and FIRST2ACT **(Appendix A)** education model were used to develop a functional algorithm for this projects use. The simulation lab instructional team utilized this pathway/framework to organize and conduct the simulation scenario clinical days. Student feedback from two

pilot projects was used to design this simulation project for maximum consideration of student learning needs as well as to create buy-in by student participants.

All 61 students enrolled in NUR 302 consented to participate in this project. Students consistently participated in the simulation learning activities and the effort was reflected in the test results and journal entries. The investigator and other simulation instructional staff noted skill improvement regarding antepartum, intrapartum, postpartum and newborn assessment and care provided by students during the simulations.

Through the equivocal test and exam scores noted between the simulation and usual clinical rotation groups, the findings of this capstone project on validating the use of High-Fidelity Simulation as a Clinical Adjunct in Undergraduate Nursing Education support the use of simulation as a teaching methodology. It is clear that simulation experiences require careful planning, preparation and training [13]. With adequate time, flexibility and guidance, students benefit from simulation experiences in knowledge expansion, critical thinking development and confidence building [14,15].

Acknowledgements

Dr. Tia Andrighetti, Frontier Nursing University without you I would have been lost in a maze of words. Thank you for being a kind and patient committee chair.

Dr. Elaine Evans, Tarleton State Nursing Department Head, your encouragement and vision inspired me to complete this journey.

Keri Lindsey and Nicole Hively, Tarleton State University, thank you for your dedication and energy.

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