Simulator Effects on Cognitive Skills and Confidence Levels

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ABSTRACT

Use of a human patient simulator (HPS) as a tool for experiential learning provides a mechanism by which students can participate in clinical decision making, practice skills, and observe outcomes from clinical decisions. The purpose of this study was to compare the effectiveness of two instructional methods to teach specific nursing education content, acute myocardial infarction, on junior-level nursing students' cognitive skills and confidence. The instructional methods included an interactive approach using the HPS method, compared with traditional classroom lecture. Results of this study suggest that use of a teaching strategy involving the HPS method made a positive difference in the nursing students' ability to answer questions on a test of cognitive skills. Confidence levels were not found to be significantly enhanced by use of the HPS method.

It is well recognized that although faculty continue to rely on lecture as the primary method for presenting clinical information, experiential learning enhances student assimilation, synthesis (Dewey, 1963; Kolb, 1984), and the application of clinical concepts to patient care situations (Nehring & Lashley, 2004; Scherer, Bruce, Graves, & Erdley, 2003). Traditional classroom lecture does not usually provide a mechanism for the experiential learning required for clinical practice. Unfortunately, due to the nature of clinical practice opportunities, students may not have the occasion to care for a patient experiencing acute myocardial infarction prior to graduation.

Adult medical and surgical course evaluations from baccalaureate nursing students reveal that students feel anxious and unprepared to treat patients experiencing acute myocardial infarction. Use of a human patient simulator (HPS) as an innovative tool for experiential learning provides a mechanism in which students can participate in clinical decision making, practice skills, and observe outcomes from clinical decisions. Human patient simulators are highly interactive, computer-driven, full-body manikins that replicate a variety of patient functions (e.g., breathing, peripheral pulses, blinking, heartbeat) and can be programmed to reflect changes in clinical condition. However, their use in traditional classroom settings is not well researched (Nehring & Lashley, 2004). It was anticipated that use of the HPS would enhance students' cognitive skills and confidence levels in caring for patients with acute myocardial infarction and, thus, contribute to a limited body of research regarding the use of simulators in nursing education.

The purpose of this article is to report findings of a study that compared the effects of two instructional methods to teach specific nursing education content (e.g., acute myocardial infarction) on junior-level nursing students' cognitive skills and confidence. The instructional methods included traditional classroom lecture, compared with use of the HPS method. We hypothesized that baccalaureate nursing students who received instruction with the HPS method regarding clinical treatment of patients with acute myocardial infarction would demonstrate greater levels of cognitive skill and confidence in their ability to provide nursing care to those patients, compared with students

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who received instruction using the traditional classroom lecture method.

LITERATURE REVIEW

Experiential learning outside the clinical setting may occur through the use of several kinds of interactive teaching approaches (e.g., the HPS, models of specific body parts, computer-assisted instruction, case studies). The goal of using these kinds of teaching methods is to achieve the appearance of realistic clinical events. There is a growing body of evidence suggesting that the use of simulators enhances clinical learning (Issenberg, McGaghie, Petrusa, Gordon, & Scalese, 2005; Lasater, 2007a, 2007b), self-efficacy (Marshall et al., 2001; Treloar, Hawayek, Montgomery, Russell, & Medical Readiness Trainer Team, 2001), confidence (Childs & Sepples, 2006; Marshall et al., 2001), motivation to learn (Cioffi, 2001), clinical performance (Peteani, 2004), and critical thinking and knowledge gains (Aronson & Squires, 2004; Carpenter & Wortham, 2008). Educational outcomes associated with use of the HPS have been evaluated in medical students (Gordon, Wilkerson, Shaffer, & Armstrong, 2001; Issenberg et al., 2005; Rosenblatt, Abrams, New York State Society of Anesthesiologists, Inc., Committee on Continuing Medical Education and Remediation, & Remediation Sub-Committee, 2002); however, it is unclear whether the study findings are generalizable to the clinical education of nursing students. Medley and Horne (2005) provided anecdotal support and descriptions of the process of teaching using HPS to enhance learning and decrease anxiety in undergraduate nursing education. Other authors discussed the use of HPS for multiple aspects of clinical teaching (Bearnson & Wiker, 2005; Henneman & Cunningham, 2005; Jeffries, 2005; Nehring & Lashley, 2004; Nehring, Lashley, & Ellis, 2002; Parr & Sweeney, 2006; Radhakrishnan, Roche, & Cunningham, 2007). However, to date, there have been few published scientific evaluations of learning outcomes associated with use of the HPS in large classes in nursing education, nor are there designs comparing traditional methods with simulation.

METHOD

Design

A prospective, quasi-experimental, pretest and posttest comparison group design was used. The independent variable was instructional method (i.e., classroom lecture versus use of the HPS method). Dependent variables included levels of cognitive skill and confidence in treating a patient with acute myocardial infarction.

Participants and Setting

The single eligibility criterion for the study was enrollment in the adult health nursing course as a matriculated baccalaureate nursing student in the fall or spring semester. Students adhered to the same admission and retention criteria and engaged in the course as a function of when they matriculated into the nursing program.

A total of 107 baccalaureate nursing students were enrolled in the junior-level adult health courses for fall and spring semesters at WellStar College of Health and Human Service, Kennesaw State University. Group 1, comprising 53 students enrolled in the fall adult health course, received the traditional lecture method of instruction. Group 2, comprising 54 students enrolled in the spring adult health course, received instruction using the HPS method. Prior to undergoing the designated instructional method, both student groups completed pretesting, which included the Acute Myocardial Infarction Questionnaire: Cognitive Skills Test (AMIQ) (i.e., form A for group 1 and form B for group 2), the Confidence Level tool (CL), and the Demographic Data Form. The same AMIQ and CL tools were also administered as posttests after completion of the instructional method.

Instruments

The investigators developed parallel forms of the AMIQ to measure students' level of cognitive skills in nursing care of acute myocardial infarction. Each version of the AMIQ was a 20-item multiple-choice questionnaire, with scores ranging from 0 to 20. Higher scores indicated higher levels of cognitive skill in nursing care of a patient with acute myocardial infarction. Questions were developed from each of the four major content domains reflecting conventional standards of care for nursing care of a patient with acute myocardial infarction:

- Diagnostic evaluation of patients suspected to have acute myocardial infarction and coronary artery disease.
- Pathogenesis and prevention of acute myocardial infarction.
- Nursing care of acutely ill acute myocardial infarction patients.
- Nursing care of patients with acute myocardial infarction during early recovery and discharge teaching.

There was agreement between two raters regarding the categorization of the four content areas for the patient with acute myocardial infarction. These individuals were experienced educators and experts in care of patients with acute myocardial infarction and confirmed the content validity of the two test versions.

Prior to initiation of this study, forms A and B of the AMIQ were pilot tested in a single cohort of 16 nursing students to assess reliability and agreement between the two forms (Bartz, 1988). Half of the students were randomly selected to complete form A of the test followed by form B, whereas the other half of the students completed form B followed by form A. To assess reliability of the parallel forms, the total number of correct responses recorded from both form A and form B were compared using the Pearson r correlation coefficient ($r = 0.59$, $p = 0.02$). On the basis of use of the split-half method to assess agreement between the parallel forms, the Spearman-Brown reliability coefficient of 0.74 indicated that the forms were internally consistent. In light of these favorable results,

TABLE 1

Sample Items on Acute Myocardial Infarction Questionnaire (AMIQ) Cognitive Skills Test and Confidence Level (CL) Tool

AMIQ Form A	AMIQ Form B
A 62-year-old man arrives in the emergency department complaining of severe chest pain. The physician orders a serum myoglobin level as part of the workup. An increased myoglobin level suggests which of the following?	To evaluate muscle injury in a client experiencing a heart attack, the following laboratory test would be ordered:
a. Liver disease	a. Hemoglobin
b. Muscle injury	b. Immunoglobulin G
c. Hypertension	c. Beta globulin
d. Cancer	d. Myoglobin

CL Tool Sample Item				
Confidence is a belief in one's own abilities to successfully perform a behavior. For each of the nursing behaviors on the questionnaire, please circle the number that best describes your level of confidence for each of the nursing care behaviors listed.				
1 = *Completely lacking in confidence.*	Indicates that you believe that you cannot complete the behavior.			
2 = *Partly lacking in confidence.*	Indicates that you believe you might be able to complete the behavior.			
3 = *Confident.*	Indicates that you believe you are generally able to complete the behavior.			
4 = *Very confident.*	Indicates that you strongly believe you can complete the behavior.			
Assessment[a]:				
How confident are you that you can perform the following nursing behaviors during the initial nursing assessment of a patient with acute myocardial infarction?				
1. Assess patients' learning needs.	1	2	3	4
2. Conduct a thorough and accurate physical assessment.	1	2	3	4

[a] *Questions 3-34 follow on instrument.*

the researchers were confident that equitable forms had been achieved to measure cognitive skills.

The CL tool was originally developed by Madorin and Iwasiw (1999) to measure the effects of computer-assisted instruction on the confidence level of baccalaureate nursing students in skills specific to surgical nursing practice. This 34-item questionnaire comprised four subscales according to the nursing process (i.e., assessment, planning, implementation, evaluation). The CL tool used a Likert scale format ranging from 1 (*completely lacking in confidence*) to 4 (*very confident*). Scores ranged from 34 to 136, with lower scores indicating lower confidence. The authors of the instrument reported a reliability coefficient of 0.89 for the total scale. With permission, the instrument was adapted for the purposes of this study. Examples of the AMIQ and CL tool questions are provided in **Table 1**.

Instructional Teaching Methods

The lecture content script and the HPS method were each developed using the four major content domains of nursing care of a patient with acute myocardial infarction. Two experienced adult health nurse educators confirmed equivalency of the content presented in each method. Both instructional methods covered the same content areas (i.e., diagnostic evaluation, pathogenesis and prevention, nursing care during the acute phase, nursing care during recovery) for care of the patient with acute myocardial infarction. At the beginning of each semester, the researchers encouraged all students in both semesters to read the textbook and use their study guide as preparation prior to coming to class.

Students participating in group 1 received a 2-hour traditional lecture presentation from the researchers. During the 2-hour period, students were given an opportunity for questions and discussion with the educators.

All students who participated in the interventional group (group 2) received no lecture. These students were divided into groups of 8 to 10, given flow sheets of their rotation and time schedules, and then rotated through five stations during a 2-hour period. The HPS method consisted of an evolving vignette (case study) with clinical decision making questions that were used in four of the five stations to direct the students' experience with the acute myocardial infarction content (**Table 2**). Students were informed that timing was crucial and that completion of the objectives for each station was required during

TABLE 2

Human Patient Simulator (HPS) Method

The students were divided into groups of 8 to 10 and rotated through 5 different learning stations. The students remained at each station for approximately 20 minutes.

Station	Content
1	Pathogenesis and prevention of acute myocardial infarction
2	Diagnostic evaluation of patients suspected of having acute myocardial infarction and coronary artery disease
3	Nursing care of acutely ill patients with acute myocardial infarction
4	Nursing care during early recovery from acute myocardial infarction and discharge planning
5	HPS simulation

The following was the process that was used in the development of the HPS simulation. The objectives of the simulation were to: (a) integrate knowledge of anatomy and physiology along with the pathological alterations of a myocardial infarction into the nursing care of these clients; (b) perform assessment and integrate diagnostic data; and (c) implement nurse's role in managing and providing care to the patient with myocardial infarction.

The HPS simulation was created on paper and included:

- Case study with background information and physician orders.
- States and events to be simulated by the HPS.
- Expected student behaviors during each of the states and events.
- Questions for students during each of the states and events.

the allotted time. One faculty member remained present to guide the students in the various stations (one through four) where students worked on the vignettes.

The fifth station involved interaction with the HPS manikin. The HPS was programmed to replicate the distinct physiological changes (e.g., blood pressure, oxygen saturation, respiratory rate) that occurred in each of the stations. To assure that the simulation experience was consistent throughout each group of students, each encounter with the simulator was preprogrammed to follow the same patient illness progression. The scenario moved the patient situation from baseline or admission, onset of angina, increasing angina, and acute myocardial infarction, to improvement of the patient. During the session, students had access to stethoscopes, patient monitors, oxygen, and a chart that included patient background information and physician orders. Participants were able to consult with each other or ask questions of the two faculty in the room. Following the simulation experience, faculty engaged each group of students in a 10-minute debriefing session to further refine the concepts learned through the experience. The faculty facilitated the structured debriefing session focusing on the clinical aspects of the scenario and patient condition changes to encourage reflective learning among the participants.

Data Analysis

Statistical analyses were performed using SPSS version 10.0 for Windows. The significance level was set at an alpha level of 0.05. Descriptive statistics were used to describe sample characteristics. Internal consistency of the CL tool ranged from a Cronbach's alpha of 0.95 to 0.97 across both groups for pretesting and posttesting. Study hypotheses were tested using multiple linear regression to control for pretest scores and to evaluate whether group assignment was significantly associated with posttest scores (SPSS, 1999).

RESULTS

As described in **Table 3**, demographic and educational characteristics were similar for both groups of participants. Although group 1 reported a higher frequency of prior nursing experience, no statistically significant group differences were identified for any of the variables that described the sample.

Hypothesis 1 was supported by the study. Students who received the HPS instructional method achieved significantly higher AMIQ posttest scores than did students who received the traditional lecture teaching approach (t = 2.0, df = 79, p = 0.05). Although the comparison of AMIQ mean pretest scores between the groups indicated a significantly higher pretest score among the intervention group (t = –2.5, df = 96, p = 0.01), the use of regression methods allowed control of AMIQ pretest scores to determine that participation in the intervention group solely made a difference in AMIQ posttest scores. **Table 4** provides AMIQ pretest and posttest scores by group.

Hypothesis 2 was not supported. Confidence level among students who participated in the HPS instructional method was not found to significantly differ from those students who received the traditional lecture teaching approach (t = –1.74, df = 81, p = 0.09). Based on paired samples t testing of pretest and posttest CL tool subscale scores (i.e., assessment, planning, implementation, evaluation), group 1 posttest confidence levels significantly improved across all four subscales. Group 2 students also experienced significantly improved confidence levels for assessment, planning, and implementation subscales. Although confidence among group 2 participants to evaluate acute myocardial infarction patients was lower than group 1 at posttesting, this was not statistically significant. **Table 4** provides pretest and posttest mean scores on the CL tool by group.

TABLE 3

Demographic and Educational Characteristics by Instructional Group (*N* = 107)

Descriptor	Group 1, Lecture (*n* = 53)	Group 2, HPS (*n* = 54)
Ethnicity		
African American/Black	8 (15%)	12 (22%)
European American/White	40 (75%)	36 (67%)
Latino/Hispanic	2 (4%)	1 (2%)
Asian	0 (0%)	2 (4%)
Other	2 (4%)	2 (4%)
Gender		
Female	51 (96%)	50 (93%)
Male	1 (2%)	3 (6%)
Age (y)	28.3±7.2	28.6±8.4
Prior nursing experience		
Yes	19 (36%)	13 (24%)
No	28 (53%)	32 (59%)
Prior cardiac nursing experience		
Yes	8 (15%)	4 (7%)
No	39 (74%)	41 (76%)
Grade in first nursing course		
90 to 100	17 (32%)	17 (31%)
80 to 89	35 (66%)	36 (67%)

Note. Due to missing data, some percentages do not equal 100. All group comparisons were statistically nonsignificant. HPS = human patient simulator.

TABLE 4

Comparison of Pretest and Posttest AMIQ and CL Tool Mean Scores by Instructional Group (*N* = 107)[a]

Questionnaire	Group 1, Lecture (*n* = 53) Mean±*SD*	Group 2, HPS (*n* = 54) Mean±*SD*	*p*
AMIQ pretest	11.31±3.01	12.62±2.34	0.014
AMIQ posttest	14.17±1.86	15.58±2.13	0.002
CL tool pretest	100.88±20.36	98.72±16.74	NS
CL tool posttest	113.51±17.87	106.29±19.71	NS

Note. AMIQ = Acute Myocardial Infarction Questionnaire; CL = confidence level; NS = not significant.
[a] Results are based on t testing for independent samples. Group differences for AMIQ pretest were controlled for during multiple regression procedures.

DISCUSSION

The HPS method resulted in gains in knowledge of acute myocardial infarction content among junior-level baccalaureate students in this nursing program. There were no significant outcome differences in confidence levels between the two groups, although considerable gains were obtained by both methods of teaching. The lack of significant findings related to confidence levels was not a surprising result. Students' confidence levels were measured from only one context, either after traditional classroom learning or after the HPS method. Students' confidence after any teaching would naturally be higher if they perceived they met the learning objectives for the class. The study findings suggest that there is validity in the use of such a teaching method to help students in the acquisition of complex concepts, such as care of the acute myocardial infarction patient. These results contribute to the developing nursing literature that supports the use of the HPS to more fully engage students in learning (Bearnson & Wiker, 2005; Jeffries, 2005; Jeffries & Rizzolo, 2006).

Bearnson and Wiker (2005) noted that a limitation of using the HPS was the need for small groups in a simulation experience, thus limiting its use as a traditional lecture substitution. In contrast, the HPS method demonstrated that using simulation in combination with an evolving case study could accommodate large groups of students in the same amount of classroom time as that designated for a traditional lecture. These findings indicate that use of the HPS method (in combination with a paper-and-pencil case study) is an efficient and effective alternative to traditional lecture for students. Jeffries and Rizzolo (2006) also noted that paper-and-pencil case studies alone may not be as effective as other simulations to develop critical clinical skills. They concluded that:

> a case study provides information about a patient while active involvement in a simulation requires students to make sense of that information for themselves. (p. 11)

The HPS method involves a vignette (case study), use of the simulator, and more opportunity for teacher-student dialogue. The HPS method is an example of yet another approach to teaching with interaction and involvement that engages the students with the complex content, with a result of increased cognitive gains. Traditional lecture methods allow student-teacher interaction, but, as is typical for most classrooms, questions from students are more limited.

Successful infusion of this kind of technology into other areas of the nursing curriculum is another important goal based on the outcomes of the study. Although generalizability to other nursing programs is limited, the design of the scenario—a patient with acute myocardial infarction—can serve as a template for further development of case scenarios. Although this particular simulator is primarily useful for adult care situations, there are other models that can be acquired that simulate pediatric and obstetric patients. Successful outcomes for one situation

are expected to lead to requests from students for other practice situations in other content areas.

LIMITATIONS

A limitation of the study was that students were not randomly assigned to the intervention group. Although randomized assignment was not feasible within this academic setting, the groups were found to be similar. Replication of the study is needed with similar groups that can be randomly selected. In addition to random selection of participants, measuring confidence levels after students actually care for patients with acute myocardial infarction in the context of the clinical area might reveal whether confidence among the intervention group is significantly increased from their pretest level.

CONCLUSION

The use of more effective teaching methods to help students in understanding the practice of nursing is a continuing quest of faculty. Results from this study can orient faculty to additional valuable and efficient methods of facilitating teaching and learning. The use of lecture and discussion will continue to be grounded in all aspects of pedagogical practice. There are indeed positive components of traditional teaching methods. This study reveals that learner-centered strategies that actively engage students and involve decision making and realistic patient responses may be more useful for students learning complex content. However, the development and implementation of simulation experiences requires substantially greater use of faculty resources in terms of time, compared with traditional pedagogical approaches. After the HPS method is developed, it may be effectively and conveniently used by other faculty for a variety of content areas. More research is needed to determine best practices and use of the simulator to achieve optimum learning outcomes.

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