Investigation of Learning Outcomes for the Acquisition and Retention of CPR Knowledge and Skills Learned with the Use of High-Fidelity Simulation

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Abstract

Background: There is currently no evidence of increased acquisition and retention of cardiopulmonary resuscitation (CPR) knowledge and skills learned with the use of human patient simulation (HPS) experiences for undergraduate nursing students.

Method: A quasi-experimental design was used to compare the acquisition and retention of CPR knowledge and skills for nursing students; the control group did not receive the simulation experience, and the experimental group did.

Results: The HPS cardiopulmonary arrest scenario had a statistically significant effect on the acquisition of both CPR knowledge and skills. The 3-month retention scores for the experimental group were also significantly higher than for the control group.

Conclusions: This information may assist health care educators to teach CPR with improved learning outcomes.

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“I can’t breathe and my chest hurts! Help!” The students gaze at each other as their patient calls out again, “I can’t breathe and my chest hurts! Help!” As one of the students quickly listens to the patient’s chest, the other says, “Where does it hurt?” The student’s voice sounds anxious as her colleague looks up and shouts out, “He’s not breathing! Quick, start CPR!”

This scenario is repeated over and over with the nursing students in small groups of three or four on the human patient simulator, SimMan®, in the nursing learning center on campus. Some of the students assess the patient, some of them call for help, some of them start compressions, and some just stand back and say, “What do we do now?” Few of them actually follow the correct steps of cardiopulmonary resuscitation (CPR) even though they completed the American Heart Association (AHA) Basis Life Support (BLS) for Health Care Professionals (HCP) training in order to practice as nursing students. During the debriefing, the students get a chance to review the scenario, what they accomplished, what could be done better, and how they felt. Many say, “I am glad we had a chance to practice this on the simulator”; others say, “I will never forget that!” The instructor agrees but wonders, “How long will they remember this lesson?”
Background of the Study

This is not a concern just for this nursing instructor. According to the AHA (2005a), hundreds of thousands of people die each year of coronary artery disease, and many are victims of ventricular fibrillation. If treated early with CPR and defibrillation, a person’s chances of survival can double or triple (AHA, 2005a). Unfortunately, there is only a 10% survival rate after CPR because of the deficient quality of performance of CPR by the public and health care providers alike (Alspach, 2005). Because of this, the AHA reviewed its standards and simplified the process of CPR in order to increase the retention of skills. It also placed an emphasis on increasing the number and depth of chest compressions to deliver oxygen to the heart and brain (AHA, 2005b, 2005c). Continuing research into teaching methods to increase the retention of CPR skills is vital to finding ways to positively influence the outcomes for patients in cardiac arrest.

The acquisition and retention of CPR knowledge and skills have been a major concern for more than 20 years (Gombeski, Effron, Ramirez, & Moore, 1982; Hamilton, 2005; Moser & Coleman, 1992). Deterioration of CPR skills occurs within weeks of training. CPR knowledge and skills do not meet the established guidelines for adequate CPR performance over time (Jacobs & Nadkarni, 2004). The AHA (2005a) has established that proper initiation of CPR and defibrillation during cardiac arrest increases both the short- and long-term outcomes for patient survival.

A variety of teaching methods have been used by various health care disciplines to try to improve the retention of CPR knowledge and skills. Many studies have looked at gaming, action cards, peer instruction, computer assisted learning, and other methods in an effort to increase the retention of CPR knowledge and skills (Broomfield, 1996; Covell, 2004; Hamilton, 2005; Martin, Loomis, & Lloyd, 1983). However, the results are not conclusive (Hamilton, 2005). Evidence suggests that a combination of teaching methods, well prepared instructors, and repetition of skills increases CPR skills retention (Broomfield, 1996; Covell, 2004; Hamilton, 2005; Martin et al., 1983).

Military, medical, and nursing educators have used high-fidelity simulation for teaching and practicing responses to emergency situations. High-fidelity simulators are particularly useful in simulating rapidly deteriorating clinical situations (Atlas et al., 2005; Beyea & Kobokovich, 2004; Eaves & Flagg, 2001; Spunt, Foster, & Adams, 2004). Many nursing educators have developed and implemented simulation experiences with students and found that the use of simulation supported knowledge learned in the classroom, confidence building, and team work (Feingold, Calaluce, & Kallen, 2004; Goldenberg, Andrusyszyn, & Iwasiw, 2005; Haskvitz & Koop, 2004; McCausland, Curran, & Cataldi, 2004; Medley & Horne, 2005; Nehring & Lashley, 2004). However, only a few research studies have measured learning outcomes with simulation experiences in nursing education, and some of these studies actually showed improved outcomes when simulation was added as a learning method (Childs & Sepples, 2006; Schumacher, 2004). This led to the exploration of the acquisition and retention of CPR knowledge and skills for junior-level baccalaureate nursing students using a high-fidelity simulation experience as the learning method.

Purpose of the Study

The purpose of this quasi-experimental study was to compare the effects of two teaching methods on the initial acquisition and the 3-month retention of CPR knowledge and skills for nursing students. The two teaching methods were the standard AHA CPR for adults review and a combination of the standard CPR review and an additional high-fidelity simulation experience using a cardiopulmonary arrest scenario. A test acquisition of knowledge and skills indicated the participants’ performance immediately following the teaching methods during this study. Acquisition of knowledge and skill was necessary to determine the retention of knowledge and skills 3 months later. The retention of knowledge and skills indicated what learning was retained during the 3 months following the acquisition phase of the study. All of the students came to the study with some knowledge and skill because they had received the AHA BLS for HCP training within the past 2 years. The purpose of the study was also to investigate the impact of variables such as accelerated versus traditional nursing students and the experience with CPR on a living person.

Research Questions

Are there any differences in the acquisition of CPR knowledge and skills for junior-level nursing students receiving the two different teaching methods?

Are there any differences in the retention of CPR knowledge and skills for junior-level nursing students receiving the two different teaching methods?

Are there differences in acquisition and retention of CPR knowledge and skill between the accelerated and traditional junior-level nursing students?

What is the relationship between the demographics of previous experiences and participation in CPR and the acquisition and retention of CPR knowledge and skills?
The first two questions explored the effects of human patient simulation (HPS) on the acquisition and retention of CPR knowledge and skills. The third question addressed differences between the two different undergraduate baccalaureate nursing programs, accelerated and traditional. The fourth question concerned the experiences the students may have had in working in the health care arena and/or performing CPR on a real patient.

Method

Participants

The participants were all junior-level baccalaureate nursing students from a small liberal arts college in the northeast United States. These students were enrolled in at least one junior-level nursing course and were either in the traditional, 4-year undergraduate program offered during the day or in the accelerated, evening and weekend undergraduate program for second degree, second career, or older students. The students were all volunteers in the study. During the initial enrollment, 67 students signed consent forms and provided demographic information, including age, nursing program, ethnicity, educational background prior to entering a nursing education program, experience working in the health field, and whether they had performed CPR on a real person (see Table 1). Power analysis was done to determine sample size using the G-power® program. Using an effect size = 0.5, alpha = .05, and power = .80 for a two-way analysis of variance, the total sample size indicated for this study was n = 34 per group. Once the study began, 65 students participated in the acquisition phase. The students were randomly placed into either a control group or an experimental group. In all, 49 of these students returned 3 months later to participate in the retention phase of the study.

Instruments

This study concentrated on adult CPR and the use of an automated external defibrillator (AED). For the purposes of this study, the pre- and postevaluations for CPR knowledge were performed with a 14-item multiple-choice test extrapolated from the AHA exam for BLS (AHA, 2005c). Items addressing stroke, infant CPR, child CPR, and foreign body airway obstruction were removed, and only items on adult CPR and AED were used from the AHA multiple-choice test (AHA, 2005c). Cronbach’s alpha for the multiple-choice test for CPR knowledge in this study was used to determine reliability (α = .799).

To measure CPR skills during this study, the investigator conducted mock codes in which the students were asked to

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Demographic Information for Acquisition Phase and 3-Month Retention Phase (acquisition phase N = 65, retention phase N = 49)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program/Ethnicity/Experience/Highest Level Of Education</td>
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</tr>
<tr>
<td></td>
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</tr>
<tr>
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</tr>
<tr>
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<tr>
<td>Mixed race</td>
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</tr>
<tr>
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</tr>
<tr>
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<tr>
<td>Nursing assistant/tech</td>
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<tr>
<td>Licensed Practical Nurse</td>
<td>1</td>
</tr>
<tr>
<td>EMT/Paramedic</td>
<td>2</td>
</tr>
<tr>
<td>Other nursing/medical experience</td>
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</tr>
<tr>
<td>High school</td>
<td>20</td>
</tr>
<tr>
<td>Technical school/diploma</td>
<td>3</td>
</tr>
<tr>
<td>Associate degree</td>
<td>6</td>
</tr>
<tr>
<td>Nonnursing bachelor's degree</td>
<td>4</td>
</tr>
</tbody>
</table>
respond to a full-body CPR manikin lying on the floor. Their responses were recorded on the AHA BLS for Healthcare Provider Course Final Evaluation Skills Sheet for Adult CPR, which was reproduced with permission from Fundamentals of BLS for Healthcare Providers © 2001 Version A, AHA (see Figure 1). For this study, Cronbach’s alpha was determined for reliability ($\alpha = .74$).

**Organizing Framework**

The organizing framework for the study was Patricia Benner’s expansion on the Dreyfus Model of Skill Acquisition, commonly known as Novice to Expert (Benner, 1984). Benner’s research studied the exemplars of practicing nurses; however, it has provided the basic organizing framework for numerous educational programs in nursing as well as research in nursing education, including the use of simulation (Feingold et al., 2004; Larew, Lessans, Spunt, Foster, & Covington, 2005). Benner identified the notion that competent decision making is a result, not only of knowledge and skill, but also of experience (Benner, 1984; Benner, Tanner, & Chelsa, 1996).

Nursing students gain the knowledge and skills they need to learn from experiences in the classroom, the clinical setting, and the learning resource center. Using simulation in nursing education is one way to provide a safe environment where students can learn and practice the knowledge and skills needed for the clinical situation (Larew et al., 2005). Simulation can provide a bridge between learning basics and practicing skills with actual patients. Actual patient situations can be created within the safe environment of the simulation laboratory with a simulator that can respond to the nursing students’ decisions and actions.

**Procedure**

The design for this study was quasi-experimental, organized with a pretest for previous CPR knowledge of both groups, CPR review for both groups, simulator experience for the experimental group, a posttest for acquisition of CPR knowledge and skills for both groups, and a second posttest after 3 months to assess retention of CPR knowledge and skills for both groups (see Figure 2). Once institutional review board approval was obtained for this study at the university where the principal investigator (PI) was enrolled as a doctoral student and at the college where the study was to be conducted, the students were recruited by the PI during visits to the junior-level classes. Approval and written permission from the division of nursing chairperson and junior-level course instructors were obtained for this study. The study was explained to the students, and packets were distributed with a demographic form, consent form, and self-addressed envelope. Most of the students in the junior classes responded by completing...
the demographic information and consent forms (N = 67). In the acquisition phase of the study, 65 students participated, and 49 of these students returned 3 months later to participate in the retention phase of the study. To maintain confidentiality, only those directly involved in the study, the PI, a research assistant, and the participants themselves were aware of the students’ identities.

The initial phase of the study consisted of a pretest for adult CPR knowledge (the 14-item multiple-choice test), followed by a review of adult CPR and AED sequences. The review used the AHA BLS for Healthcare Providers and Renewal Course DVD, which incorporates scenario viewing with practice. It is important to note that all the students had received training in AHA BLS for HCP, so this process was a review only. The participants were divided into groups of seven or eight to practice adult CPR and the use of an AED on four half-torso CPR manikins. Infant and child CPR, foreign body obstruction, and management of stroke were not included during this review, which took approximately 30 to 40 minutes per group. All the participants participated in this process. These participants were then randomly placed into either the control group or the experimental group. The control group was evaluated by means of the 14-item multiple-choice test for acquisition of CPR knowledge and a one-on-one evaluation by the PI during the mock codes for acquisition of CPR skills. The experimental group participated in a 20- to 30-minute cardiopulmonary arrest scenario with Laerdal’s high-fidelity patient simulator, SimMan®, including a 10- to 15-minute debriefing period (see Figure 3). This was followed by the same evaluation as the control group received: the 14-item multiple-choice test for acquisition of CPR knowledge and evaluation during the mock codes for acquisition of CPR skills.

The mock codes included a short encounter with Laerdal’s Resusci-Anne® manikin. The research assistant brought the participants, one at a time, to a small room where the PI was standing beside the Resusci-Anne® manikin on the floor. A bag-valve-mask device was beside the manikin. The PI said to the participant, “I don’t know what happened. My friend just collapsed and I don’t know what to do! Please help me!” The PI stood back and observed the sequence of actions included on the skills checklist. The PI brought the AED trainer to the participant after one cycle of CPR and said, “Someone told me to bring this to you.” The PI provided no other cues to the participants, who received 1 point for every item on the checklist performed correctly in the proper sequence. They received a score of zero on the CPR checklist for any item not performed, performed out of sequence, or performed incorrectly. The highest possible score on the skills checklist was 14 correct items. Each mock code took approximately 5 minutes per participant.

During the retention phase of the study 3 months later, the students were asked to return for evaluation of CPR knowledge retention with the same 14-item multiple-choice test and evaluation of CPR skills retention with the same mock code scenarios that were used during the acquisition phase of the study.

Results

The results of the pretest for CPR knowledge indicated no statistically significant difference in the mean scores between the control and experimental groups (p = .902) or between the traditional and accelerated groups (p = .900). These results provided an essentially equal starting ground for the study. The only statistically significant differences were found when the mean results on the pretest of those students who had performed CPR on a living person prior to the study were compared with those of the students who had not. The students with this prior experience had significantly higher scores than did those students who did not have this prior experience (p = .012). However, because these students were included in both the control and the experimental groups, this difference did not affect the group means.

The CPR knowledge scores for the control group during the acquisition phase of the study ranged from 9 to 13 correct responses, with a mean of 11.52 (SD = 1.149). Comparing these scores with the pretest found that there was a significant (p = .000) increase in CPR knowledge scores.

The CPR knowledge scores for the experimental group during the acquisition phase of the study ranged from 9 to 14 correct responses, with a mean of 12.25 (SD = 1.218). These data for CPR knowledge for the experimental group using F tests found a significant (p = .001) increase when compared to the pretest for CPR knowledge.

When comparing the acquisition scores for CPR knowledge, the students in the experimental group, who received both the standard CPR review and the simulated cardiopulmonary arrest experience, demonstrated significantly higher scores (p = .015), measured by the first posttest for acquisition of CPR knowledge than the students in the control group, who received only the standard CPR review.

The tests for CPR skills were completed by the PI by observing the students individually during the mock codes. All the students were evaluated in the same mock code situation and with the same evaluation tool. Each student received 1 point for each of the 14 skills that they performed correctly and in correct order and no points for either not performing the skill, performing it incorrectly, or performing it in the incorrect order. The possible range of scores for CPR skills was 0 to 14 correct responses.

During the acquisition phase of the study, the scores for CPR skills for the control group ranged from 9 to 14 correct responses, with a mean of 11.36 (SD = 1.270). The scores for the CPR skills for the experimental group during the acquisition phase ranged from 11 to 14 correct responses, with a mean of 13.19 (SD = 7.80). These scores for the control and experimental groups were analyzed for variance of means using an F test. The students in the
1. Objectives:

By the end of this session the nurse/student will be able to:

- Identify signs and symptoms of cardiopulmonary arrest
- Provide initial management of the presenting patient condition
- Determine possible etiologies of presenting condition
- Provide appropriate interventions for presenting condition
- Evaluate the patient’s response to the interventions provided
- Document accurately the patient scenario
- Discuss their feelings and reactions to the session

Equipment needed:

- Sim man and computer
- Patient’s chart
- Nasal cannula and flow meter
- Bag/valve/mask device and a pocket mask
- Code cart with back board
- AED trainer on top of code cart near the bedside

2. Patient:

The nurse/student will be given the following report:

Mr. Jones a 48 year old man was admitted last evening for chest pains of new onset. He was admitted to your unit from the ER. Upon arrival to your unit he is chest pain free having received nitroglycerin and ASA in the in the ER. He was placed on Telemetry which is NSR, and given O2 at 2L via nasal cannula. A heparlock was in place from the ER. Vitals signs as reported from the night shift 110/60 HR 70 normal sinus rhythm, RR 14. He was chest pain free throughout the night. Mr. Jones is pending a cardiac catheterization today, time is unknown, and he is NPO for the procedure.

The patient rings his bell and the nurse is to enter the room.

- The patient is complaining of pain “my chest hurts and I am having trouble breathing”
- BP 150/72
- HR 112 sinus tachycardia
- RR 22
- SpO2 94%
- Oxygen cannula is on 2L
- Lungs sounds clear

3. Interventions:

- Assess the patient
- Call for help
- Check O2

*As the nurse/student is checking the patient, he will go into cardiopulmonary arrest with no breathing, no pulse, and no blood pressure. Ventricular fibrillation will be noted on the monitor.

- Follow the steps for basic life support outlined on the skills checklist including correct application of AED trainer and one “defibrillation”. If CPR is not started or more than five minutes of CPR is done without use of AED, the patient remains in Ventricular Fibrillation and cues may be given by the instructor as to use of AED.

If the nurse completes these tasks:

- Patient starts breathing at 14 breaths per minute
- BP 104/62
- HR 100

Adapted from scenario created for the Bridge to Practice Program at Vassar Brothers Medical Center, Poughkeepsie, NY

Figure 3 Simulator case scenario program, Mr. Jones, Room 534, window, cardiopulmonary arrest.
The experimental group demonstrated a significant increase in CPR skills \( (p = .000) \) during the acquisition phase of the study (see Table 2).

During the retention phase of the study, 3 months later, the students were asked to return to take the multiple-choice test to measure retention of CPR knowledge and to participate in one-on-one mock codes to measure retention of CPR skills. These were evaluated by the same investigator using the same method as during the acquisition phase.

The CPR knowledge scores for the 25 participants in the control group who returned for the retention phase of the study ranged from 8 to 13 correct responses, with a mean of 10.68 \( (SD = 1.282) \). Of the participants in the experimental group, 24 returned for the retention phase of the study, and their CPR knowledge scores ranged from 9 to 14 correct responses, with a mean of 11.83 \( (SD = 1.239) \). Three-month retention of CPR knowledge means were significantly \( (p = .002) \) higher for the experimental group than for the control group.

The scores for the 25 students in the control group for the second CPR skill evaluation during the retention phase of the study ranged from 8 to 14 correct responses, with a mean of 10.96 \( (SD = 1.541) \). When the means of the first and second CPR skills tests for the control group were compared, a significant \( (p = .038) \) decrease in the scores from immediate acquisition to 3-month retention of CPR skills was found, indicating a loss in CPR skill during the 3 months.

For the experimental group, the 24 student scores for retained CPR skill ranged from 10 to 14 correct responses, with a mean of 12.50 \( (SD = 1.180) \). The mean scores for the skill evaluations for the control and experimental groups were analyzed by an \( F \) test for variance of means. Although the experimental group scores were lower than during the acquisition phase, the students in the experimental group demonstrated a significantly \( (p = .000) \) higher retention of CPR skills than the control group did.

The results of this study found that there were no statistically significant differences between the junior-level students in the accelerated and traditional classes (see Table 3). The only significant difference was found in the level of participation in CPR on living people prior to the study. Students who had this prior experience scored higher on the pretest than did those who had not performed CPR on a real person (see Table 4).

### Table 2: Comparison of Means for Acquisition and Retention of CPR Knowledge and Skills for Control and Experimental Groups (pre and post)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Group</th>
<th>No. of Participants</th>
<th>M</th>
<th>SD</th>
<th>p</th>
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</thead>
<tbody>
<tr>
<td>Pretest for knowledge</td>
<td>Control</td>
<td>33</td>
<td>10.36</td>
<td>1.58</td>
<td>.902</td>
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<tr>
<td></td>
<td>Experimental</td>
<td>32</td>
<td>10.31</td>
<td>1.77</td>
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<tr>
<td>Acquisition of knowledge</td>
<td>Control</td>
<td>33</td>
<td>11.52</td>
<td>1.15</td>
<td>.015*</td>
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<tr>
<td></td>
<td>Experimental</td>
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<td>12.25</td>
<td>1.22</td>
<td></td>
</tr>
<tr>
<td>Retention of knowledge</td>
<td>Control</td>
<td>25</td>
<td>10.68</td>
<td>1.28</td>
<td>.002**</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
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<td>11.38</td>
<td>1.24</td>
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<tr>
<td>Acquisition of skills</td>
<td>Control</td>
<td>33</td>
<td>11.36</td>
<td>1.27</td>
<td>.000**</td>
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<td>Retention of skills</td>
<td>Control</td>
<td>25</td>
<td>10.96</td>
<td>1.54</td>
<td>.000**</td>
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<tr>
<td></td>
<td>Experimental</td>
<td>24</td>
<td>12.50</td>
<td>1.18</td>
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</tbody>
</table>

* \( p < .05 \).
** \( p < .01 \).

### Table 3: Comparison of Means for Acquisition and Retention of CPR Knowledge and Skills for Accelerated and Traditional Nursing Programs

<table>
<thead>
<tr>
<th>Activity</th>
<th>Group</th>
<th>No. of Participants</th>
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<tbody>
<tr>
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* \( p < .05 \).
Discussion

One significant observation in this study is that there were statistically significant decreases in both CPR knowledge and skills for both the experimental and the control groups during 3 months. This is consistent with the findings reported by the AHA of lack of retention of CPR knowledge and skills. However, this study indicates that the students who had an additional simulation learning experience demonstrated statistically significant higher scores for CPR knowledge and skills for both immediate acquisition and 3-month retention than did the students who did not have the simulation learning experience. This study also indicated that the students who had the additional experience of performing CPR on a live person demonstrated higher scores for CPR knowledge and skills than did students who had not.

The results of this study are consistent with Benner’s notion that competence is a result of experience (Benner, 1984; Benner et al., 1996). Also, the students who had experienced and applied CPR knowledge and skills in a real situation came into the study with a higher level of CPR knowledge than did those students who had not. Benner, Hooper-Kyriakidis, and Stannard (1999) stressed that understanding comes from contextual experiences of the patient. This raises the questions of whether simulated experiences can provide a similar level of learning, and if they can, why we are not using simulation consistently in order to improve life-saving knowledge and skills.

This study indicates that the additional teaching methodology of the HPS program had a positive effect on both acquisition and 3-month retention of CPR knowledge and skills. This is consistent with Benner’s model of skill acquisition. It was found that the additional experience following the standard CPR review allowed the students to apply, in a simulated situation, what they had learned in the standard CPR review. This was an expected result of the acquisition of CPR knowledge and skills because the students in the experimental group had additional practice prior to testing. However, the level of 3-month retention of both CPR knowledge and skills was a significant result of using high-fidelity simulation when teaching CPR to these students.

The students’ scores in the acquisition and retention of CPR knowledge improved when learning was supported by the active group experiences using the HPS.

The study found that there was a decrease in both CPR knowledge and skills over time for both the students receiving the standard CPR and review and those students receiving both standard and HPS learning experiences in CPR. This is consistent with studies done on CPR retention (Broomfield, 1996; Madden, 2005). However, this study indicated that the additional cardiopulmonary simulation experience had a greater effect on the acquisition and retention of CPR skills than on the acquisition and retention of CPR knowledge. These results support and add to the evidence that experience, in this case a simulation experience, enhances skill acquisition.

Implications

Nursing programs are purchasing simulators and working to incorporate simulation into their curricula. It can be a challenge to find faculty, finances, time, and space to establish a simulation learning center. Providing evidence of positive learning outcomes can assist these educators in deciding whether the cost and effort are worth the benefit of this form of teaching. This evidence may also be used to help nursing programs obtain funding for the equipment and training. Fortunately, there is an increase in support and training available, but only a few studies have been conducted to support learning outcomes from this form of teaching (Childs & Seppes, 2006; Schumacher, 2004).

Hands-on learning, active participation, and reflection can provide a rich learning environment for nursing students. The simulation laboratory provides a safe environment where student have a chance to perform an assessment and make a decision without harming a human being (Larew et al., 2005). It is also important to note that the simulation experience in this study also included guided reflection on the experience during the debriefing session. The impact of this portion of the study was not investigated and indicates a need for further research on the effect of debriefing on CPR learning outcomes.

This is a critical time in simulation education. There are more learning opportunities for faculty, more sophisticated simulators being developed, and more acceptance of simulation learning as a vital component of nursing education. In the simulated environment, students can be exposed to a wide variety of clinical circumstances.
Although the students are not with a real patient, they are given situations that can mimic real life. Incorporating this form of clinical learning into a curriculum requires evidence that it enhances learning outcomes. Learning outcomes and the benefits of this methodology must be studied to help educators provide evidenced-based teaching.

Another factor to consider is that nursing students come in contact with real patients during their education. Emergency situations such as cardiopulmonary arrest can happen at any time in any location. Because the student may be the one to discover this emergency, ways to teach students to acquire and retain CPR knowledge and skills must be found in order to improve patient outcomes in an emergency situation. Using high-fidelity simulation assisted students in this study to acquire and retain a higher level of CPR knowledge and skill.

Recommendations for Future Study

The limitations of this study are that the sample during the retention phase of the study was small. This was because of a number of reasons, such as illness, family emergencies, students leaving the nursing program, and unknown reasons. This attrition presents a challenge to researchers needing to get participants to return voluntarily for subsequent phases of a study. The sample was also limited to baccalaureate nursing students. However, because of the significant findings, it is recommended that this study be replicated on a larger scale to ascertain whether these results can be supported with a larger sample.

In this study, retention of CPR knowledge and skills was tested at only 3 months. It is also recommended that retention of CPR knowledge and skills be tested beyond 3 months. It is suggested that a study involving multiple nursing education sites with a variety of nursing programs can provide insight into learning outcomes in a more generalized sample. Replication with professional nurses as the participants may also provide more evidence that this form of learning would be beneficial in staff development (Ackermann, Kenny, & Walker, 2006). Simulation may also be studied with individuals outside nursing because CPR training is provided not only for health care professionals but also for the general public.

It is also recommended that educators explore ways to increase the acquisition and retention of CPR knowledge and skills with a variety of teaching approaches, such as computerized virtual reality. Increasing the frequency of CPR review can be investigated to determine how health care professionals and lay persons alike can be prepared to give CPR effectively when it is needed.

Future research to measure other learning outcomes using simulation is recommended. This form of learning is used in a variety of emergencies, practicing and evaluating skills, and teaching various concepts in nursing. Studies to support the learning outcomes for all these areas can enrich our nursing programs and support simulation in nursing education.

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