SUMMARY REPORT

Project Title:
Designing and Implementing Models
for the Innovative Use of Simulation
to Teach Nursing Care of Ill Adults and Children:
A National, Multi-Site, Multi-Method Study

Project Sponsors
National League for Nursing and Laerdal Medical

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Project Period: June 1, 2003 to May 31, 2006

Purposes of the Project

The purposes of this national, multi-site, multi-method project were fourfold:

1) To develop and test models that nursing faculty can implement when using simulation to promote student learning,
2) To develop a cadre of nursing faculty who can use simulation in innovative ways to enhance student learning,
3) To contribute to the refinement of the body of knowledge related to the use of simulation in nursing education, and
4) To demonstrate the value of collaboration between the corporate and not-for-profit worlds.

Goals of the Research

The research goals were to explore how to design simulations, implement simulations as a teaching strategy, and evaluate selected learning outcomes using simulations. Specifically, the study was designed to:

1) Develop a teaching-learning framework incorporating simulations that nurse educators can use to help guide the development, implementation, and evaluation of the use of simulations in nursing education.
2) Describe and test a design that is theoretically based and can be used to develop nursing simulations that promote good learning outcomes.
3) Explore relationships among the theoretical concepts of the simulation framework to assess the existence and importance of these concepts.
4) Test and analyze selected outcomes when implementing a nursing simulation based on the proposed theoretical concepts using an experimental design.

Project Phases

Phase I: June 2003 to December 2003

The aim of this phase was to organize the eight Project Coordinators and one Project Director to discuss the project and set specific directions for the study. Specifically, Phase I was designed to clarify the purpose of the study; discuss the nature of participating in a national, multi-site study; conduct a review of the simulation literature; apply for IRB approval at each institution to conduct the research study there; develop a research design for each institution's specific simulation study using the research design, parameters, and essential elements defined by the project group; and discuss the specific and overall project goals and research with the Project Director during individual site visits.

Activities during the first six months of the project began with the selection of the Project Director and eight project sites (see Appendix A), followed by a kickoff meeting to clarify goals and responsibilities, explore the theoretical framework for the research design, and explain the process for implementing the research over the three years of the project. After completing a comprehensive literature review to identify gaps in the simulation literature, a simulation framework (see Appendix B) was developed and the 4-phase research design was formulated. Since existing measurement tools were determined to be inadequate for the purposes of this study, new research instruments were developed during Phase I.

Phase II: January 2004 to June 2004

Phase II was designed to allow each Project Coordinator and her faculty colleagues to have first-hand experience designing a simulation within the parameters of the framework, implementing that simulation, and evaluating its effectiveness. As a result of these efforts, study participants were able to assess what worked well, define ideal timeframes for various components of the learning experience, obtain reliability and validity data on the instruments constructed to measure the concepts in the simulation teaching-learning framework, and develop a medical-surgical simulation that would be implemented across all eight sites during Phases III and IV.

Each Project Coordinator implemented a small simulation study at her school, with six sites using SimMan® , one site using an IV simulator, and one site using a low-fidelity mannequin. All sites used the Educational Practices in Simulation Scale (EPSS) and the Simulation Design Scale (SDS) to gather data about the experience.

The Project Director reviewed the curriculum at all eight sites and determined that every school taught basic care of the post-operative adult patient in the first clinical course. This content was selected, therefore, for the scenario that was designed for implementation across all sites during Phase III of the study.

Phase III: July 2004 to July 2005

Phase III consisted of two parts. Part 1 focused on obtaining baseline data about students' understanding of post-operative content before the teaching simulation was integrated. Part 2 focused on learning outcomes at the project sites when three different types of simulations were incorporated.

During Phase III, Part 1 (July to December 2004), baseline data about current practices and learning outcomes in medical-surgical courses where postoperative content is taught were obtained prior to implementing the study's simulation. The study design was then

pilot tested at one site. This activity helped the group refine the simulation scenario, refine the research design, and obtain additional reliability and validity data on the instruments.

Three hundred ninety five students (female=350; male=45) completed a 12-item multiple choice pretest, and viewed a 38-minute videotaped lecture presented by an experienced master teacher who included a simulation of care of a postoperative adult patient. Following the lecture, students completed a 12-item parallel form posttest on postoperative care, the EPSS, the SDS, an instrument that measured their satisfaction with the instructional method, a self-confidence scale that measured their perceptions of their confidence in caring for a postoperative client, and a self-perceived judgment performance measure that provided information about students' perceptions of their clinical performance in the simulation.

In Phase III, Part 2 (January to July 2005), project sites implemented the standardized simulation focusing on care of a post-operative adult patient, using randomized control and experimental groups. Each then assessed the simulation design and process, using the SDS and EPSS; each evaluated selected learning outcomes for students experiencing three different types of simulations; and each assessed student satisfaction with the use of simulation as a teaching/learning strategy. Specific research questions addressed during Phase III, Part 2 of the study were as follows:

1) Will students who participate in the simulation as part of the teaching/learning experience related to care of an adult post-operative patient have better learning outcomes (knowledge, self-confidence, satisfaction, judgment performance) based on the type of simulation experienced (paper/pencil case study simulation, static mannequin, or high-fidelity patient simulator)?

2) Will there be differences regarding learning outcomes (knowledge, self-confidence, judgment performance, and learner satisfaction) based on the role assigned to a student in the simulation?

Four hundred three students who were enrolled in their first medical-surgical nursing course participated in this phase. These students were largely female (87%) and Caucasian (77%, with 8% self reporting as African American and 6% self reporting as Asian), and their average age was 29. Sixty-two percent were enrolled in baccalaureate programs, and 38% were students in associate degree programs. All participants completed the 12-item pretest on postoperative care and viewed a 38-minute videotape that included (a) a lecture by an experienced master teacher on the care of the postoperative adult patient and (b) a simulation demonstrating care of such a patient. Students were then randomly assigned to one of three types of simulation groups, each of which focused on care of a post-operative adult patient.

- One group was given a paper/pencil case study simulation. Students worked in groups of four to answer the questions and solve the problems presented.
- A second group participated in a hands-on simulated experience using a static mannequin.
- The third group also had a hands-on experience, but they used a high-fidelity patient simulator.

All three groups were provided the same simulation, worked in groups of four, and each group's simulation was conducted for 20 minutes. All students then participated in a 20-minute reflective thinking session immediately following the simulation that was either audio taped or videotaped. This guided reflection session was facilitated by the instructor who had observed the simulation, using specific scripted questions. Students then completed the EPSS and SDS as well as a test of their knowledge, the self-confidence scale, the judgment performance scale regarding their participation in the simulation, and a satisfaction survey.

In all instances, data collection took no longer than 30 minutes. Finally, in order to ensure that no students were disadvantaged because of the group to which they were assigned, all had an opportunity, prior to completion of the unit/module that included post-operative care of the adult surgical patient, to participate in the two types of simulations they had missed; none, however, took advantage of this opportunity.

Phase IV: August 2005 to June 2006

After analyzing data obtained in Phase III, the project team realized that since students only participated in one of the three types of simulations, their responses on data collection instruments were limited to the learning context they experienced (i.e. paper/pencil case study simulation, static mannequin, or high-fidelity patient simulator). Phase IV was designed, therefore, to expose all participating students to two different types of simulations, namely paper/pencil case study simulation and high-fidelity patient simulator, so they could compare the experiences. The same post-operative adult patient simulation that had been designed for Phase III of the study was used in Phase IV, and an alternate paper/pencil case study simulation was designed to parallel the high-fidelity patient simulator experience as much as possible and reflect similar content and levels of decision making. All other procedures and evaluation measures were the same as in Phase III, Part 2.

Two of the eight study sites participated in Phase IV. Half of the participating students (N=55; 86% female) worked with the paper/pencil case study simulation first and then worked with the high-fidelity patient simulator. The other half of the students (N=55; 86% female) participated in the simulation using the high-fidelity patient simulator first and

then worked with the paper/pencil case study simulation. The following research questions guided this phase of the study:

1) Is there a difference in learner satisfaction when two different types of simulations are used by learners rather than when each student uses only one type?

2) Is there a difference in students' perceived presence and importance of educational practices when two different types of simulations are used by learners rather than when each student uses only one type?

3) Is there a difference in students' perceived presence and importance of simulation design factors when two different types of simulations are used by learners rather than when each student uses only one type?

4) Is there a difference in student self confidence when two different types of simulations are used by learners rather than when each student uses only one type?

5) Is t here a difference in students' judgment of their performance when two different types of simulations are used by learners rather than when each student uses only one type?

The outcome measure of knowledge, using a multiple choice pre and posttest was eliminated in this phase since non-significant findings were obtained in the previous study using this measure.

Instruments*

The instruments used in the project included several questionnaires, some of which were specifically designed for the study and some of which were already in existence. Each instrument is described, and content validity and reliability determined during Phase III of the study are provided for each.

The Simulation Design Scale (SDS), a 20-item instrument using a five-point scale, was designed to evaluate the five design features of the instructor-developed simulations used in this study. The five design features include objectives/information, support, problem solving, feedback, and fidelity. The instrument has two parts: one asks about the presence of specific features in the simulation, and the other asks about the importance of those features to the learner. Content validity for the SDS was established by ten content experts in simulation development and testing. The instrument's reliability was tested using Cronbach's alpha, which was found to be 0.92 for presence of features, and 0.96 for the importance of features.

The Educational Practices in Simulation Scale (EPSS), a 16-item instrument using a five-point scale, was designed to measure whether four educational practices (active learning, collaboration, diverse ways of learning, and high expectations) are present in

*Information on how to request instruments used in the study can be found at www.nln.org/research/toolsandinstruments.htm

the instructor-developed simulation, and the importance of each practice to the learner. The educational practices were derived from the work of Chickering and Gamson (1987). Reliability was tested using Cronbach's alpha and was found to be 0.86 for the presence of specific practices and 0.91 for the importance of specific practices.

The Student Satisfaction with Learning Scale is a 5-item instrument designed to measure student satisfaction with five different items related to the simulation activity. Content validity of the instrument was established by nine clinical experts validating the content and relevance of each item for the concept of satisfaction. Reliability was tested using Cronbach's alpha and found to be 0.94.

The Self-Confidence in Learning Using Simulations Scale is an 8-item instrument measuring how confident students felt about the skills they practiced and their knowledge about caring for the type of patient presented in the simulation. Content validity was established by nine clinical experts in nursing, and reliability, tested using Cronbach's alpha, was found to be 0.87.

Cognitive Gain or Knowledge was measured by comparing scores on multiple choice tests related to caring for a post-operative adult patient. Two parallel forms of the test were designed by test development expert to mimic NCLEX-RN® type questions. One form of the test was given prior to students' participation in any simulation, and the other form was given after completion of the simulation. Content validity of these tests was established by three experienced faculty.

The Self-Perceived Judgment Performance Scale is a 20-item-scale modified from the Judgment Performance Scale (Facione & Facione, 1998) used to measure higher order thinking in individuals during a performance. This scale was based on students' self-perception of their performance in the simulation as scored on a 5-point Likert Scale. The higher the score, the better the student perceived her/himself as performing appropriately and effectively within the simulation. Content validity of the modified scale was determined by nine clinical experts, and Cronbach's alpha established a 0.90 reliability for the scale.

Findings

Data from Phase II revealed that the prominent educational practice embedded in the simulations was that of collaboration. The most important simulation design feature was found to be feedback/debriefing.

Data from Phase III, Part I indicated that knowledge was gained by students in the traditional learning environment. Using a paired t-test, there was a significant difference ($p < .0001$) between the pre and posttest scores, indicating learning took place. The educational practices found to be embedded in the traditional instruction were active learning, collaboration, diverse ways of learning, and high expectations. High expectations was the

educational practice that received the highest rating by students indicating they perceived this educational practice to be most present in the classroom experience. Overall, students were satisfied with the traditional approach to learning about caring for a postoperative adult patient, and they indicated that this experience helped them gain confidence in their ability to care for a postoperative patient.

When comparing data obtained from the 403 students during Phase III, Part 2, responses on the Simulation Design Scale (SDS) revealed the following:

- The group that used the high-fidelity patient simulator reported a greater sense of reality than did students in the other two groups, and the paper/pencil case study simulation group reported the least sense of reality
- The group that used the paper/pencil case study simulation was less likely than the other two groups to report they received feedback, but there was no significant difference on this aspect of the simulation design in the other two groups indicating those two types of simulations (static mannequin and high-fidelity patient simulator) provide similar feedback from the instructor to students.
- The groups that used the static mannequin simulation or high-fidelity patient simulator reported more opportunities to problem-solve and make decisions in the simulation than did the paper/pencil case study simulation group
- Feedback was viewed as less important to the paper/pencil case study simulation group than it was to the other two groups

When comparing data obtained from the 403 students participating in Phase III, Part 2 of the study, responses on the Educational Practices in Simulation Scale (EPSS) revealed the following:

- The group that used the high-fidelity patient simulator reported a greater sense of being involved in diverse ways of learning than did students in the other two groups, and they valued this educational practice more than did students in those other groups
- The group that used the paper/pencil case study simulation agreed, more so than the other two groups, that collaboration was part of their simulation
- The group that used the paper/pencil case study simulation perceived higher expectations to perform well in the learning situation than did the group that used the static mannequin simulation
- Students who participated in either simulator group (static mannequin or high-fidelity patient simulator) perceived a greater presence of active learning and rated active learning as being more important in their learning experience than did the students who worked with the paper/pencil case study simulation

When comparing data obtained from the 403 students during Phase III, Part 2, responses on the 2-item, multiple choice, NCLEX-RN ® type exam revealed that there were no significant differences in knowledge gains among the three groups as measured by pre and post testing, using Kruskal-Walis non-parametric tests (non-parametric version of the ANOVA) between each pair of groups. This is not a surprising finding, however, since students were not expected to acquire new knowledge during this experience. The simulations were designed to give them an opportunity to apply their knowledge, as learning with simulations should be directed toward synthesis and application of knowledge, rather than toward new knowledge development.

When comparing data obtained from the 403 students during Phase III, Part 2 of the study, responses on the Satisfaction Scale revealed that the group using the high-fidelity patient simulator had a significantly higher level of satisfaction with their learning experience than did students in the two other groups.

When comparing data obtained from the 403 students during Phase III, Part 2 of the study, responses on the Self-Confidence Scale revealed that students in the high-fidelity patient simulator and static mannequin simulation groups reported significantly greater confidence about their ability to care for a postoperative adult patient than did students in the paper/pencil case study simulation group.

When comparing data obtained from the 403 students during Phase III, Part 2 of the study, responses on the Self-Perceived Judgment Performance Scale revealed no significant difference among the three groups regarding their performance. It appears that students self-evaluate based on the context of the learning situation. If they achieved the stated objectives, and felt good about their participation, then they rated themselves as performing well.

Students who worked with the high-fidelity patient simulator or the static mannequin were randomly assigned to one of four roles: Nurse 1, Nurse 2, significant other, or observer. Students who participated in the paper/pencil case study simulation were not given roles. Data obtained during Phase III, Part 2 of the study revealed the following about the roles played:

- Regardless of the role they assumed during the simulation, there were no significant differences in knowledge gain among students
- Regardless of the role they assumed during the simulation, there were no significant differences in satisfaction or self-confidence regarding caring for a postoperative adult patient among students
- Students who assumed the Nurse 1 role rated themselves significantly higher on their judgment when caring for a postoperative adult patient when compared to those who assumed the Nurse 2 role

- Students who assumed the significant other role rated themselves significantly higher on their judgment when caring for a postoperative adult patient when compared to those who assumed the Nurse 2 role
- Students who assumed the observer role rated themselves significantly lower on their judgment when caring for a postoperative adult patient when compared to those who assumed the Nurse 2 role
- There were no significant differences on judgment when caring for a postoperative adult patient between those who assumed the role of Nurse 1 and those who assumed the role of significant other

When comparing data obtained from the 110 students (86% female; mean age of 26) who participated in Phase IV, responses on the Educational Practices in Simulation Scale (EPSS) and the Simulation Design Scale (SDS) revealed the following:

- Students in the high-fidelity patient simulator group reported active learning to be present and important significantly more often than did students in the paper/pencil case study simulation group
- Diverse ways of learning was rated higher by students in the high-fidelity patient simulator group than by those in the paper/pencil case study simulation group
- The paper/pencil case study simulation group rated collaboration and higher expectations significantly higher than did the high-fidelity patient simulator group
- The high-fidelity patient simulator group rated the importance of fidelity, presence of feedback, support, and objectives significantly higher than did the paper/pencil case study simulation group
- Overall, students in the high-fidelity patient simulator group were significantly more satisfied with their learning activity than were students in the paper/pencil case study simulation group
- The high-fidelity patient simulator group rated themselves significantly more confident and satisfied with the instruction than did the paper/pencil case study simulation group
- The paper/pencil case study simulation group judged their performance significantly higher than did the high-fidelity patient simulator group

Conclusions

Based on findings that the paper/pencil case study simulation group did not perceive as many problem-solving features or opportunities to problem-solve in their learning experience as the other two groups did, one can conclude that the more active the learning experience, the more important feedback is to the learner. Feedback facilitates the decision-making/problem-solving process; thus, paper/pencil case study simulations may be less effective than other types of simulations in helping students develop these skills that are critical for clinical practice. Perhaps the difference can be attributed to the fact that a case study provides information about a patient while active involvement in a simulation requires students to discover and make sense of that information for themselves.

Based on findings that students in both simulator groups (i.e., static mannequin and high-fidelity) placed higher value on diverse ways of learning and active learning than did students in the paper/pencil case study simulation, one can conclude that students' judgments about the importance of various educational practices are influenced by the learning context in which they are placed. If learners are not exposed to diverse and active educational practices, they do not know what they have missed and may not value those practices.

Based on the findings that the group using the high-fidelity patient simulator had a significantly higher level of satisfaction with their learning experience than did students in the two other groups, one can conclude that high-fidelity patient simulator experiences incorporate more of the principles of best practice in education as described by Chickering and Gamson (1987).

Based on the findings that there were no significant difference among the three groups regarding their perceived performance, one can conclude that students evaluate themselves based on the context of the learning situation, not on the objectives to be attained. In other words, if they achieved the stated objectives and felt good about their participation, then they rated themselves as performing well.

Based on findings related to knowledge gain, confidence, satisfaction, and various roles assumed in a simulation (i.e., Nurse 1, Nurse 2, significant other, or observer), one can conclude that role assignment does not affect overall student learning outcomes. It is important to note that since those assigned to the observer role did not rate collaboration highly on the EPSS, faculty may need to structure the learning experience to provide some mechanism for students in this role to engage in collaborative work.

Based on findings relates to student satisfaction with their learning experience, one can conclude that high-fidelity patient simulator experiences incorporate more of the principles of best practice in education as described by Chickering and Gamson (1987).

Based on findings related to self-confidence, one can conclude that learning through paper/pencil case study simulation is not as effective in promoting confidence in students since

that experience lacks realistic, timely opportunities for students to "test" themselves in providing care to patients.

Based on the findings related to performance, one can conclude that paper/pencil case study simulations may help students perceive a greater level of performance because they are more experienced with the case study method of learning.

Students who participated in paper/pencil case study simulations believed that their instructors had high expectations of them and their experience promoted collaborative learning. However, this approach provided less fidelity, fewer opportunities for problem solving, and fewer opportunities for providing feedback to students.

Overall, students who worked with the high-fidelity patient simulator were more satisfied with the instructional method and reported greater confidence in their ability to care for a postoperative adult patient. More than other students, this group believed that their experience provided for more fidelity and feedback, and they rated those design features as the most important ones. With regard to educational practices incorporated into a simulation experience, students whose experience incorporated the high-fidelity patient simulator perceived significantly more active learning and diverse ways of learning than did other students, and they rated active learning as the most important educational practice. Furthermore, these students seemed to learn and be satisfied even when they played roles other than that of "nurse" in a simulation.

Summary

The findings of this national, multi-site, multi-method study on *Designing and Implementing Models for the Innovative Use of Simulation to Teach Nursing Care of Ill Adults and Children* support those reported in the literature on simulations, even though that literature base is somewhat limited. It is clear that the educational practices and simulation design characteristics in the simulation framework are relevant and important to incorporate into simulations in order to provide a quality learning experience for students. In addition, the simulation framework has been found to be valuable as a guide for conducting systematic, organized research on simulations.

While more research is needed, it appears that immersion in a simulation provides the opportunity to apply and synthesize knowledge in a realistic but non-threatening environment. Active involvement and the opportunity to apply observational, assessment, and problem-solving skills, followed by a reflective thinking experience, leads to increased self-confidence in students. In addition, when students are more active and immersed in a learning situation, the feedback they receive regarding what they did correctly and incorrectly can greatly facilitate their learning. It is expected that the expanded use of simulation in nursing education will facilitate increased learning and skill transfer when students care for patients in today's complex, health care environment.

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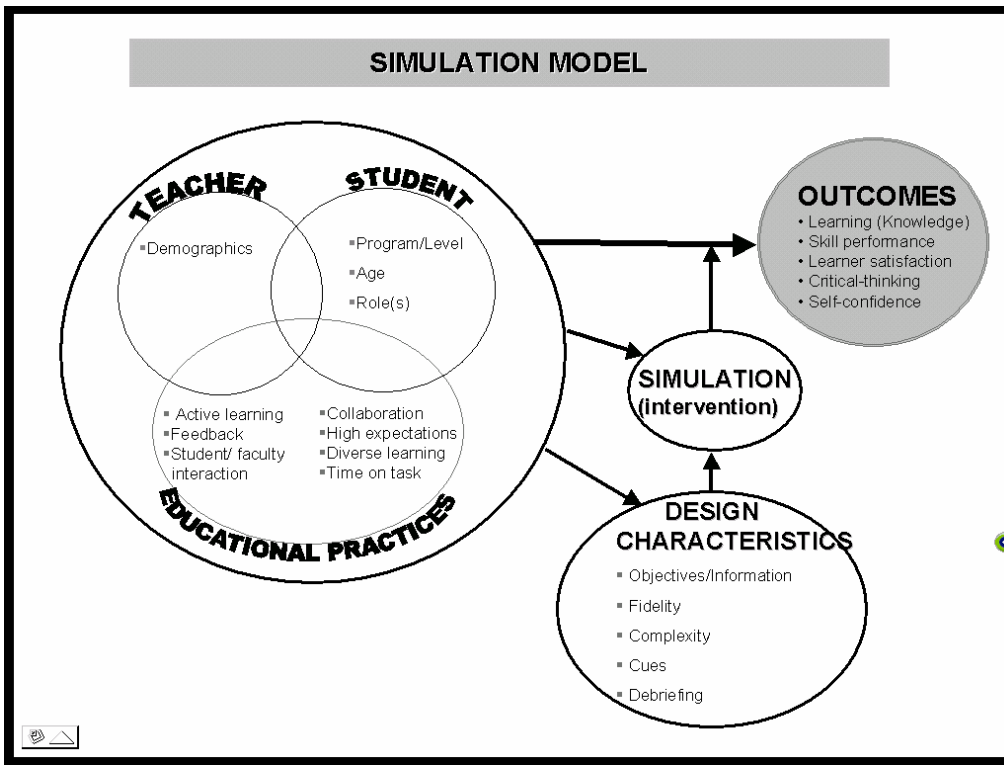
Appendix A


SIMULATION MODEL
TEACHER
STUDENT
Demographics
Program/Level
Age
Role(s)
Active learning
Feedback
Student/ faculty interaction
Collaboration
High expectations
Diverse learning
Time on task
EDUCATIONAL PRACTICES
OUTCOMES
• Learning (Knowledge)
• Skill performance
• Learner satisfaction
• Critical-thinking
• Self-confidence
SIMULATION (intervention)
DESIGN CHARACTERISTICS
Objectives/Information
Fidelity
Complexity
Cues
Debriefing

Appendix B

NLN /LAERDAL SIMULATION STUDY

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Appendix C

Publications by Project Personnel

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