Creating a Nursing Simulation Laboratory: A Literature Review

Marcia K. Rothgeb, MSN, RN

ABSTRACT

Currently in nursing education, active student participation, discussion, observation, and reflection are paramount for successful learning. Simulation is one of the up-and-coming tools that can be used across the nursing curriculum to replicate experiences in nursing practice. This interactive experience immerses students in patient health care scenarios in a safe environment. Simulation experience reinforces the development of skills in assessment, psychomotor activity, critical thinking, problem solving, decision making, and collaboration with others. Experiential learning through simulation affects patient care, health, and safety. These interactive experiences engage students through participation, observation, and debriefing. As preparation for establishing a simulation laboratory, a review of the purpose of simulation, learning theories, advantages and challenges, regulatory viewpoints, budgetary needs, and educator training will be discussed.

Simulation is the reproduction of essential features for the purpose of study or training; it is the imitation of something or an enactment of an experience (*Dictionary.com Unabridged*, n.d.) and the process of illustrating an action (*Mosby's Medical*, 2001). Historically, simulation in nursing education included tools used by nursing faculty to guide students in learning the skills needed for clinical practice: role-playing, games, use of models and manikins, case studies, and multimedia presentations. (Tuoriniemi & Schott-Baer, 2008). Currently, simulation also describes a method to guide students through an interactive experience to reflect or parallel patient encounters (Li, 2007; Tuoriniemi & Schott-Baer, 2008). The simulator is the tool used to produce the interactive clinical scenarios through the use of computer programs.

The level of simulator can be defined as low fidelity, medium fidelity, and high fidelity regarding the accuracy or exactness of the interaction. Low-fidelity simulators are used to learn, practice, and achieve a designated skill; high-fidelity simulators are used to develop critical thinking skills (Jeffries, 2007). Low-fidelity simulators are static, without motion, and demonstrate few features with realism. Medium-fidelity simulators provide more realism, including heart or breath sounds. High-fidelity simulators present a realistic depiction of the human body in look, feel, and response to the provided care. The more expensive high-fidelity simulators physiologically respond appropriately to the provided care, medications, and oxygen (Seropian, Brown, Gavilanes, & Driggers, 2004b).

PURPOSE OF SIMULATION LABORATORIES

Simulation experiences are needed in nursing education as a result of the lack of clinical site availability, low census in clinical areas, and nursing faculty shortage (Jeffries, 2008a, 2008b). The simulation laboratory cannot correct all of these education issues; however, the simulation experience enhances the learning environment by providing similar knowledge, skills, and practice for all students (Medley & Horne, 2005). Along with this, providing a safe environment for practice and promotion of patient safety are additional factors that contribute to the need for such innovative educational experiences (Jeffries, 2008a; Larew, Lessans, Spunt, Foster, & Covington, 2006;

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Ms. Rothgeb is Assistant Professor in the Associate of Science in Nursing and Practical Nursing Faculty, Ivy Tech Community College, Fort Wayne, Indiana.

Address correspondence to Marcia K. Rothgeb, MSN, RN, Assistant Professor, Ivy Tech Community College, 3800 N. Anthony Boulevard, Fort Wayne, IN 46805-1489; e-mail: mrothgeb@ivytech.edu.

Tuoriniemi & Schott-Baer, 2008). Nursing education exists for the purpose of acquiring the knowledge and developing the skills students need to function as competent nurses. Educational resources that enhance learning and allow students to have immediate feedback are vital tools for this process. Simulation scenarios provide students with cognitive, psychomotor, and affective learning experiences, which enhance development of their skills in assessment, critical thinking, problem solving, decision making, and data analysis (Childs & Sepples, 2006; Feingold, Calaluce, & Kallen, 2004; Jeffries, 2005; Jeffries, Dobbs, & Sweitzer, 2004; Nehring, Lashley, & Ellis, 2002; Rauen, 2004; Willford & Doyle, 2006). The simulation laboratory contributes to the transfer of knowledge from the classroom and clinical settings to clinical practice as a graduate. Variations on clinical experiences can be created in the simulation laboratory to represent the breadth of clinical situations and disease processes seen in real life (McGaghie, Issenberg, Petrusa, & Scalese, 2006; Nehring & Lashley, 2004; Nehring et al., 2002; Tuoriniemi & Schott-Baer, 2008).

In addition to individual training, simulation laboratories can be used to enhance team performance, including developing and expanding the ability of team members to collaborate and communicate effectively with each other to refine care management (Jeffries & Rizzolo, 2006; Larew et al., 2006; McGaghie et al., 2006; Willford & Doyle, 2006). Patient safety and the reduction of errors is a primary focus in health care and nursing practice; simulation laboratories provide a place for students to demonstrate, practice, and develop skills in an environment where there is no risk to actual patients. Simulators can be programmed to respond to errors in judgment, medication administration, or skill performance to allow students to witness the consequences of such an error to a real patient (Harris & Jelesiewicz, 2004; Nehring et al., 2002; Van Sell, Johnson-Russell, & Kindred, 2006). Student remediation can be enhanced via simulator scenarios that require mastery of clinical skills that may have been deficient (Greenawalt & Brzycki, 2007; Haskvitz & Koop, 2004). Simulation experiences encourage the development of higher learning and help students become more competent in the care of complex patients (Lasater, 2007; McGaghie et al., 2006).

LEARNING THEORIES

A variety of education learning theories support the use of simulation in nursing. Rodgers (2007) identified six theories:

- *Constructivism learning theory* is based on the premise that a student actively participates in a learning experience, creating an avenue for reformatting knowledge based on the new experience.
- *Adult-learning theory* supports lifelong learning, and identifies adult learners as being generally self-motivated, goal oriented, and relevancy oriented.
- *Brain-based learning theory* relates to the active processing of experiences, along with expanding from basic to complex experiences.
- The importance of interactive learning is supported by the *social-cognitive learning theory*, which is based on the interrelationship between behavior, environment, and personal factors, with each factor dependent on the other.
- *Experiential learning theory* is based on the use of repetition to improve outcomes and create permanent new behavior. This theory suggests that reflective thought is important in the development of critical thinking and to improve comprehension and performance.
- *Novice-to-expert theory* describes the pattern of knowledge growth from beginner-novice to the expert level (Waldner & Olson, 2007).

REGULATORY VIEWPOINT

A study is being conducted by the National Council of State Boards of Nursing (NCSBN) to determine whether supplementing simulation time for clinical time is beneficial; these results currently have not been published (Spector, 2008). Nehring (2008) conducted a survey of the State Boards of Nursing in 2006 to determine the regulation and use of simulation in nursing programs. Forty-four states plus the District of Columbia and Puerto Rico responded. Puerto Rico and five states changed their regulations to accept clinical hours from simulation experiences. In Florida, schools of nursing have been given a designated percentage of clinical simulation hours that may be substituted toward the total clinical hour requirement. Of the 44 states responding to the survey, 16 states have given nursing schools permission to use simulation hours in place of clinical time on a case-by-case basis (Nehring, 2008). Currently, research in the use of simulation is not sufficient to support the substitution of simulation for clinical experiences with actual patients (Rauen, 2004).

The National League for Nursing (NLN) conducted a national, multisite, multimethod study in three phases, beginning in June 2003 and ending in May 2006, for the use of simulation in nursing education. As summarized by Jeffries and Rizzolo (2006), simulation is an important tool to help facilitate student learning. The experience encourages students to use analysis and synthesis while problem solving and decision making during participation in patient scenarios. Experience occurs in a safe environment, and no harm can come to the "patient" when failure to make the correct decision would occur. A time for reflection is used to discuss the experience, including what was learned, and to determine what changes would be made. The debriefing experience is an essential part of the learning process and cannot be eliminated.

SIMULATION PROGRAM DEVELOPMENT

Seropian et al. (2004a) stated that many institutions take a three-step approach to setting up a simulation laboratory. The first step includes an assessment of interest in simulation and faculty research on how simulation would enhance learning. The second step is selection of equipment. The third step includes assembly of administrative

and ancillary support for the equipment and the program. Often, when the institution progresses to step three, they find that no plan was developed for how the equipment is going to be used, such as what level of students will use the simulation laboratory and how it will be integrated into the curriculum. Seropian et al. (2004a) recommended eight steps to institute a simulation program:

- Develop a vision to show what is to be achieved, who will be involved, and how the laboratory will be used.
- Generate a business plan to outline initial and annual fiscal obligations.
- Identify and seek support from stakeholders.
- Construct the facility or laboratory, as defined in the vision and the business plan, including the equipment purchase.
- Provide training for all individuals who will be involved.
- Develop the curriculum.
- Faculty training.
- Determine policies and procedures.

An adjustable time line is approximately 12 months from the planning phase to completion.

Two methods that can be used to examine the need for a simulation laboratory are the SWAT method of analysis (Strengths, Weakness, Opportunities, and Threats) (Loyd, 2004) and the Nursing Process (assess, diagnosis, plan, implement, and evaluate) (Jeffries, 2007). After the simulation laboratory is opened for use, it is important to remember key components of its integration as an educational tool. These include "1) simulation specialist; 2) debriefing facilitator; 3) curriculum development; 4) curriculum integration; 5) scenario writing; 6) scheduling; 7) equipment; [and] 8) audiovisual" (Seropian et al., 2004a, p. 173).

Seropian et al. (2004a) discussed the simulation experience by first identifying how simulators of each level of fidelity are used. According to their study, low-fidelity simulators are used for practice and demonstration of skills. Medium-fidelity simulators provide more realism, with the addition of heart sounds and lung sounds. These simulators can be used to develop a broader understanding of more complex skills. Medium-fidelity simulators usually model a portion of the torso or an extremity. High-fidelity simulators present the most realistic depiction of the human body in look, feel, and response to provided care. The more expensive high-fidelity simulators have physiologic responses to care, medications, and oxygen that are administered to the "patient."

Education progresses from the basic to the complex. Simulation exercises can be programmed with increased complexity for each advancing course requirement, allowing students to demonstrate competence at each level of instruction (Medley & Horne, 2005; Nehring & Lashley, 2004). Simulation creates a venue where important teaching-learning principles can be applied in a standardized learning experience. The simulator allows faculty to work with a student one-on-one or in a group for demonstration, repetitive practice, or observation of students' participation in the scenario. The simulator can be programmed with single-focus or multiple-focus, reality-based clinical situations. Identified clinical competency and standardized learning expectations can include experiences such as provision and management of safe care, administration of pharmacological therapy, identification and reduction of risk potential, transfer of care from nurse to nurse, and collaboration with health care professionals (Jeffries, 2005; Nehring & Lashley, 2004; Nehring et al., 2002; Rauen, 2004). Students learn in three ways: through participation in the simulated experience, observation of the experience, and debriefing, which strengthen student's progression and mastery of learning (Seropian et al., 2004b).

According to Decker (2008) and Jeffries (2005, 2008a, 2008b), each scenario should have an outline that summarized the teaching-learning goals and objectives of the simulation. Scenarios come in a package purchased from the manufacturer or can be created by the nursing faculty, and they can be adapted to various levels of expertise to meet the needs of the students and the curriculum. After the scenario is selected or created, the "patient" history is entered into the program along with health care provider orders. The program is set with a time limit; expectations of clinical changes that should occur at various points within the experience are also programmed into the simulation time line. The times spent experiencing the simulated scenario and in debriefing should be equal. It is important to stay within the time frame designated (Childs & Sepples, 2006).

Prior to the simulation experience, students will be assigned various roles such as primary and secondary nurse, note taker, nurse responsible for making phone calls to the physician or laboratory, and observers. Faculty members or guest actors (usually staff and other nursing faculty) play the parts of visitors, family, and health care professionals. Students should never play the role of an individual above their expected level of expertise, such as a nurse practitioner or physician. The faculty member responsible for the course being taught often will observe at a distance to deter students looking to the instructor for advice or reassurance in decisions being made (Jeffries, 2007).

According to Jeffries (2007), simulation design should incorporate five features:

- A specific objective.
- Level of fidelity.
- Problem solving.
- Student support.
- Debriefing that includes reflective thinking.

The objectives are a guide for the learning experience, which reflects the intended outcomes of the experience, the expected behavior, and participation of students. Fidelity is created to imitate reality by setting the scene in the room to look like a clinic, hospital room, or room in the home. The actors and the manikin should be dressed as the person being portrayed. The manikin can be programmed to speak and to ask questions, and a voice overlay can be used to respond to questions asked by nursing students. The manikin should be dressed to fit the part,

with wounds, incisions, or drains that depict the scenario presented. The choice for the kind of problem solving to occur should be set within the students' level of expertise. The problem solving should be challenging, yet attainable, and demonstrate prioritization. It is important that the experience always begin with the assessment of the patient. On the basis of the assessment obtained, students will decide what care needs to be completed next. Student support is provided by cues throughout the experience. It is important to determine in the planning phase how much cuing will take place. Cues can be very subtle and can progress in intensity if the students do not respond, but they should allow the students to make decisions independently. Examples of several cues are the manikin or actors asking questions to lead the student toward the expected task, a phone call, manikin-initiated clinical change, and the student receiving results from diagnostic studies to determine whether a physician needs to be called. Finally, reflective thinking and debriefing are used to examine what happened during the experience and to provide immediate feedback to students. The debriefing and reflective thinking is conducted by faculty guided by the objectives and expected outcomes for the experience. Debriefing is one of the most important parts of the simulation experience because it ties everything together for the students (Childs & Sepples, 2006). According to Jeffries (2005) and Willford and Doyle (2006), debriefing involves an in-depth discussion and review of the videotape. The focus of the debriefing and reflection should be discussion of any misconceptions, correction of any errors, and, most important, emphasis on what was correct, appropriate, and safe during the experience. The videotape documents the achievement of outcomes and readiness for progression to the next level.

FACULTY TRAINING

Educators need training to adequately prepare them for this equipment use and simulation experience. Each faculty group should have at least one individual who believes in and will take on the challenge to champion the use of the technology, and who has an infectious attitude and desire for this technology to be incorporated into the nursing curriculum (Childs & Sepples, 2006; Jeffries, 2008a, 2008b; Medley & Horne, 2005).

In a study conducted by King, Moseley, Hindenlang, and Kuritz (2008), the conclusion was that most faculty received little or no training in the use of the simulator and had little direct experience in using the simulator. The end result was a lack of positive feelings relating to the use of the simulators. Most faculty thought they would use the simulator more often if there were a simpler user guide available, additional training and time to prepare for the simulations, and additional personnel support. Faculty understood that with more frequent experience, confidence in the use of the equipment would increase.

Jeffries (2008a) also stated that nurse educators frequently are not prepared for innovations in nursing education. Educators are often expected to learn to use the equipment and the computer program scenarios on their own without any formal training. Much of this new innovation is a paradigm shift and new pedagogy for faculty. Jeffries (2008a) shared a tool for faculty called:

> S.T.E.P.: Simulations Take Educator Preparation. The S. = standardized material, T. = teacher trainer, E. = encourage the development of a simulation design and integration team and P. = plan to coordinate the simulation development and implement activities. (pp. 71-72)

Creating and participating in a simulation center takes extensive time, preparation, and follow up by faculty. After the initial learning curve, the time spent by faculty can be decreased. The best ways to become familiar with simulation include reading the literature and attending nursing education conferences, instructional meetings, or vendor-sponsored conferences and training sessions, along with networking with individuals and groups knowledgeable in the use of simulation in educational experiences. In addition, the NLN has a grant funded by Laerdal Medical for the purpose of creating nine education modules on simulation for nurse educators (Jeffries, 2008b).

BUDGET FOR EQUIPMENT AND LABORATORY SPACE

Simulation laboratories can be extremely expensive. Included in the cost are the manikin(s), designing and remodeling of the room(s), providing the equipment and props needed to make the simulation as real as possible, training for faculty, information technology or ancillary staff needed to run the laboratory, and possibly salary for faculty and other staff. Additional costs can include purchase of scenarios; maintenance warranty for manikin(s); computer equipment; sound and video equipment; video recording equipment; equipment for the hospital room, such as chairs, beds, linen, curtains, bedside tables, and suction equipment; and medical supplies, such as bandages, sterile supplies, tubes, drains, and catheters (Jeffries, 2005; Rauen, 2004).

Loyd (2004) suggested that simulation laboratories or centers need designated space, determined by the number of simulation rooms and equipment to be used. One-way mirrors are suggested to divide the room from the patient care area and the computer program operator. Gas and vacuum piping may be needed for comprehensive functioning manikins versus compressors for portable high-fidelity simulators, along with an adequate electrical system to allow for the increased electricity use. Props are needed to make the simulation authentic. Phones, video equipment, and microphones are needed in the room to allow for communication with students during the simulation and for recording the experience (Larew et al., 2006). To create an authentic atmosphere, it is important to have clothing for manikins, supplies such as replaceable skin, artificial body fluids, and medical supplies such as bandages, syringes, and hospital beds (Greenawalt & Brzycki, 2007). Other needs that are easily overlooked include office space

for support individuals and teaching staff, storage space for the expensive manikins, computer equipment and programs, Internet and Intranet access, and audiovisual equipment for analysis and feedback (Bradley & Postlethwaite, 2003).

There are three manufacturers of high-fidelity simulators. Medical Education Technologies, Inc., (METI) is located in Sarasota, Florida, and manufactures iStan®, a battery-powered and wireless manikin, adult human patient simulator, PediaSIM®, and BabySIM®. Laerdal is from Stravanger, Norway, and manufactures SimMan® 3G, a wireless manikin, as well as SimMan®, SimBaby®, and SimNewB™ (neonatal). Gaumard Scientific is located in Miami, Florida, and manufactures HAL®. The prices for these high-fidelity simulation manikins start at approximately $22,000 each and can cost a great deal more depending on the kind and capability of the simulator. The Laerdal and METI Web sites have a link to a user network or forum for discussion on simulation, including questions about products, equipment, education, and scenarios. Laerdal also has a discussion link for non-English-speaking participants. Laerdal has a link to a "Design a Lab," which helps users create a simulation laboratory, including determining the number and kind of equipment and space required.

ADVANTAGES

The advantages to using simulation are many. Simulation provides a means to improve skills and reduce errors. Simulation is an innovative tool that can be used in all levels of nursing education. This tool provides educators with a standardized way to have students work as a team, collaborate with others, problem solve, make decisions, and use critical thinking in a safe environment. Students can perform procedures, administer medications and treatments, and visually observe clinical changes in the manikin as a result of the care provided. In the debriefing and reflection time, students are given an opportunity to discuss the experience and identify what they see as the accomplishments and concerns that occurred during the scenario. Students are also given the opportunity to discuss what should have happened during the clinical scenario. Students learn no matter what role they play, whether active participation or observer (Jeffries, 2005; Rauen, 2004).

CHALLENGES

The simulation manikin is a very expensive mechanical device run by computer equipment and often a compressor. Space is at a premium at most colleges and universities, and allocation for a room or group of rooms is often not feasible. Simulations work best when there are 5 to 10 students participating in the experience. Most education settings involve larger numbers of students involved in a classroom activity at one time. Faculty must be willing to take extensive time for preparation, set-up, practice, and take-down of equipment and props. Students often will have high anxiety related to their performance in the presence of faculty and student peers, along with the event being recorded and critically evaluated. The paradigm shift from a teacher-centered role to a student-centered role is often uncomfortable for both faculty and students. Finding enough individuals to role-play various multidisciplinary or interdisciplinary team members and family members can also be a challenge (Jeffries, 2005; Rauen, 2004). Faculty need to be trained in the use, upkeep, and repair of the manikin, compressor, and computer programs. Mechanical devices need upkeep and potential repair through the manufacturers' support team. These services, along with the need for individuals with information technology expertise, add to the challenges in the use of the manikin along with the need for computer literacy for the faculty and students using the equipment (Seropian et al., 2004a, 2004b). As a result of the extensive amount of faculty time investment needed to create a worthwhile simulation experience, simulation equipment can end up being used infrequently. This constitutes a waste of available resources and lost opportunities to teach in an innovative manner (Medley & Horne, 2005).

WHERE DO WE GO FROM HERE?

Preparation for a simulation laboratory takes substantial time commitment, comprehensive planning, energy, faculty ownership and participation, and institutional support including start up and ongoing fiscal responsibilities. It is essential to conduct library and Internet searches to develop an understanding of simulations, their purpose, the equipment necessary, the training needed for faculty and staff, and the preparation required for each simulation experience. It is important to review the NLN Core Competencies for nurse educators, the NLN/Laerdal study on Simulation in Nursing Education from Conceptualization to Evaluation, and the NCSBN recommendations and individual state regulations on the use of simulation in nursing. Attendance at national and regional conferences and workshops on simulation, along with networking with other nursing programs to discuss ideas and concerns with simulation, will provide information to guide practice. Attendance at the 1.5-day NLN Simulation Workshop: Getting Started would be beneficial in obtaining a firsthand look at how simulation laboratories can be set up and used along with discussions on the new simulation pedagogy.

CONCLUSION

Students represent a wide variety of ages, life stages, talents, and experiences. Many students are accustomed to rapid sensory stimulation as a result of computer use, fast-paced television programs, personal digital assistants, MP3 players, the Internet, and simulated computer games and programs. Students expect to have hands-on, rapidly paced challenges and modern tools to facilitate their learning. Educators cannot teach in the same man-

ner that was taught in the past. For nurse educators in the 21st century, it is important to find ways to integrate these innovative tools into practice. Simulation is one innovative and effective teaching and learning tool that fits into the rapidly changing world of nursing education and modern health care. Simulation can be used across the span of nursing education to model clinical events in a safe environment. Such experiential learning provides a venue for development of skills in critical thinking, problem solving, decision making, and interdisciplinary collaboration. These experiences affect the key outcomes of quality patient care, health, and safety.

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