NURSE EDUCATORS' CONSENSUS OPINION OF HIGH FIDELITY PATIENT SIMULATION

A DISSERTATION

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

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BY

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To the Dean of the Graduate School:

I am submitting herewith a dissertation written by Rebecca Fountain entitled "Nurse Educators Consensus Opinion of High Fidelity Patient Simulation." I have examined this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy with a major in Nursing Science.

Dr. Vicki Zeigler, Major Professor

We have read this dissertation and recommend its acceptance:

Associate Dean, College of Nursing

Accepted:

Dean of the Graduate School

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ABSTRACT

REBECCA FOUNTAIN

NURSE EDUCATORS' CONSENSUS OPINION OF
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Nurse educators are presently challenged to increase nursing school enrollments while maintaining a safe environment for students and their patients. Many schools are embracing human patient simulators (HPS) as a way of enhancing and evaluating learning. There are multiple factors that may facilitate and/or hinder the use of HPS in undergraduate nursing education in the state of Texas. The major purpose of the study was to explore the opinions of Texas nursing educators regarding the implementation of HPS innovation in clinical teaching of undergraduate nursing students and to develop a consensus about the implementation of this innovation. Specifically, the major research question to be answered was "What are the opinions of undergraduate nursing educators regarding HPS implementation within pre-licensure nursing coursework?"

This study used the Delphi technique. The Delphi Panel was composed of 86 professional nurse faculty members from the state of Texas who were educators in associate, diploma, and/or baccalaureate schools of nursing. The Delphi study utilized three rounds of data collection. Round 1 contained a demographic survey along with two open-ended questions requesting opinions about what facilitated and/or hindered HPS in undergraduate pre-licensure nursing education. For Round 2, a Likert-type instrument was developed from the panel members' opinion statements from Round 1. Round 3 was a consensus and ranking survey of the facilitating and/or hindering statements.

Cain and Mittman's (2002) Diffusion of Innovation in Health Care theory with the ten critical dynamics was used to evaluate the findings. While the heterogenous panel group could not meet consensus, the homogenous baccalaureate and non/user groups were able to meet consensus on several facilitating/hindering opinion statements. Statistically significant differences were observed between faculty members who taught at either the associate and baccalaureate levels and between members who had/did not have HPS on several facilitating/hindering statements. Findings indicated the panel members believe that the presence of the dynamic characteristics of infrastructure, leadership, relative advantage, and compatibility will facilitate the implementation of HPS into undergraduate nursing education.

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CHAPTER I

INTRODUCTION

Nurse educators are presently challenged to increase nursing school enrollments while maintaining a safe environment for students and their patients. Schools are limited in the number of students they can enroll due to the shortage of qualified nursing faculty, limited clinical sites, increased patient acuity, and advances in technological interventions (American Association of Colleges of Nursing, 2010; Bremner, Aduddell, Bennett, & VanGeest, 2006; Griffin-Sobel, 2006; Jeffries, 2008; LaRocco, 2006; MacDonald, 2006; Power, 2007; Tanner 2006; Wilson, 2006). Traditional clinical placements within healthcare institutions and agencies are often not available or appropriate for novice students, yet it is the clinical component that is pivotal in developing student competence. To improve patient safety outcomes and decrease healthcare costs, nurse educators must adequately prepare novice nurses to perform competently (Wilson, Shepherd, Kelly, & Pitzner, 2005).

The use of simulation in nursing education is not a novel idea. Prior to engaging nursing students with patients in the hospital setting, many clinical course educators require their students to "practice" their nursing care with simulators in the schools' clinical skill laboratories. Increasingly, educators are using these simulator devices or products to augment students' psychomotor and cognitive skills and to impart knowledge (Cumin & Merry, 2007).

Simulator devices are classified according to how accurately they portray a realistic environment and can range from "low to high fidelity." Having students breathe through a straw for several minutes to illustrate the feeling of being endotracheally intubated is an example of a "low fidelity simulation." At the other end of the spectrum are "high fidelity" life-sized human patient mannequins, with a sophisticated computer interface, that provide opportunities for nursing students to administer nursing care and apply the nursing process as they would to a patient given various simulated patient care scenarios. While these high fidelity human patient simulators (HPS) have been used for several years in medical and graduate anesthesia curricula, increasing numbers of undergraduate nursing programs have more recently been developing simulator programs (Nehring, Ellis, & Lashley, 2001).

Many schools are embracing HPS as a way of enhancing and evaluating learning in many nursing content areas including health assessment, medical-surgical, management, military combat, and anesthesia (Farrar, French, Hamlin, Robertson & Baumann, 2007; Hravnak, Beach, & Tuite, 2007; Nehring et al., 2001). The simulators are available in infant, child, or adult sizes. A bedside touch screen monitor, similar to that found in an intensive care unit (ICU), displays pre-programmed cardiac rhythms, blood pressures, respiratory rates, and oxygen saturations. Cardiac arrhythmias have synchronized distal pulses and heart sounds (Laerdal, 2006). Other physiological findings (e.g., seizure activity, bleeding wounds, and bodily secretions) can be duplicated on the newest models of HPS (Laerdal, 2010b).

Students can choose to implement a wide variation of nursing interventions and pharmacological choices based on the information provided by the evidence-based simulated case study along with their own assessment and management. HPS mannequins respond physiologically and/or verbally to the students' interventions with appropriate assessment changes similar to the way in which an actual patient would respond in the clinical setting. In one type of HPS, a drug and event recognition system registers the amount, speed, and type of drug the student pushes through the vascular access system; thereby analyzing the appropriateness of the medication administration for the patient's condition (Laerdal, 2010b). Students are able to see whether or not the interventions provided helped or hindered the patient's outcome. It is an intense, active learning experience (Giddens et al., 2008).

Three vendor companies (i.e., Gaumard, Laerdal, and Medical Education Technology, Inc.) presently offer various models of HPS mannequins, with each mannequin having strengths and weaknesses. The price varies between the different mannequins as well as the required components to operate each one. One HPS mannequin geared more toward use in teaching medical-surgical nursing costs approximately $65,000 (Laerdal, 2010b), while a different mannequin that is more appropriate for obstetrical nursing costs about $38,000 (Gaumard, 2010). By the time a simulation laboratory is planned and developed, a nursing school could easily experience a $250,000 expenditure (Bezyack, 2007; VanSell & Johnson-Russell, 2006).

Many educators value HPS as a powerful learning tool that allows students to gain hands-on experience in a safe environment (Cioffi, 2001; Hravnak, et al, 2007, Jeffries & Rizzolo, 2006; Nehring et al., 2001). However, the opinions of nursing faculty in Texas regarding the implementation of HPS innovation in the clinical teaching of undergraduate nursing students have not been explored. Specifically, the purpose of this research study was to determine the consensus opinions of undergraduate nursing educators in Texas regarding facilitators and hindrances of HPS implementation within clinical nursing coursework.

Problem of the Study

There are multiple factors that may facilitate and/or hinder the use of HPS in undergraduate nursing education in the state of Texas. While many faculty members value the student's outcome from learning with HPS, implementation of high fidelity simulation mannequins can be expensive and time-consuming for the schools, faculty members, and the students. Standardized materials were not available for faculty members to teach with clinical simulations until recently; educational software packages are now making their way onto the market at an additional cost for students and nursing schools, i.e. the Simulation Learning System package for the 7th edition of the Medical-Surgical Nursing text edited by Lewis and colleagues (Lewis, Howard, Schumacher & Weberg, 2010). Financial expenses, the increased time required to learn how to operate HPS simulations, and the need for increased availability of standardized materials are only a few issues that faculty members may perceive as facilitators and/or hindrances of HPS simulation. The perceived value of the use of HPS in nursing education by the faculty in these programs becomes an extremely important factor in the teaching-learning process.

The problem addressed by this study was the lack of knowledge regarding the opinions among Texas undergraduate nurse educators about what facilitates and/or hinders the implementation of HPS mannequins in undergraduate clinical nursing coursework. Information is needed to assist in the process of program development by those responsible for the delivery, evaluation, and funding of nursing education programs. The Delphi methodology was used in this study to gain the most reliable consensus of opinion of this group of experts.

Rationale for the Study

It is critical that nursing students graduate with the ability and knowledge to care for patients. In response to concerns voiced by his constituents, the Honorable Bob Duelle, Texas State Senator, introduced Senate Bill (S.B.) 1397 during the 2009 Texas Legislative session (Duell, 2009). This bill was successfully passed through the legislative Senate process and was referred to the legislative House and to its Public Health Committee. As authorized by S.B. 1397, the Texas Higher Education Coordinating Board (THECB) and the Texas Board of Nursing Education (BNE) were charged with studying alternative ways to assure clinical competency of graduates of nursing educational programs, including supervised clinical simulation laboratories. The study is to be completed no later than June 30, 2014, with a report submitted to the office of the governor, the Senate Committee on Health and Human Services, and the House Committee on Public Health. The reports required by this Bill, with recommendations from THECB, will greatly influence the path of professional nursing education in the

State of Texas for the foreseeable future. The results of this dissertation study will be shared with THECB and the Texas BNE as appropriate.

The position of the National Council of State Boards of Nursing (NCSBN) is that pre-licensure nursing education experiences should include clinical experiences with actual patients supervised by qualified faculty who provide feedback and facilitate reflection (National Council of State Boards of Nursing, 2005). In addition, the NCSBN recommends that the clinical experience could also include "innovative teaching strategies to complement clinical experiences (p. 9).

According to Jeffries (2008), the "best ways of incorporating simulations into nursing courses, substituting simulations for clinical practice, and using faculty to incorporate simulations into the curricula have not been determined" (p. 71). In California, the Board of Registered Nursing is allowing schools to use up to 25% of clinical rotation time in simulation scenarios with students demonstrating application of the entire nursing process (Minato, 2006). Florida allows 10% of clinical time to be done through simulation (Nehring, 2008). Similar to what is happening in California and Florida, the Texas BEN recently allowed simulation activities to augment the clinical education experience. These experiences must be designed to demonstrate procedures and teach decision-making and critical thinking skills; they may be used to prepare students prior to actual patient care experiences with human patients (Texas BEN, 2008).

The most recently released position statement from the Texas BEN on the use of simulation in pre-licensure nursing education was related to percentage of simulation versus actual clinical learning education (Texas BEN, 2010). While the Board recognized that the use of simulation in nursing education is supported by research, their position offers no percentages or ratios for its use. It states, "nursing education should be based on sound educational principles, and accordingly there should be a reasonable balance between simulation and direct patient" (p. 3). A further recommendation was made that additional research needed to be conducted on the use of simulation in pre-licensure nursing education and clinical competency. The results of this study will provide needed information about how nursing schools in Texas are using HPSs in their clinical laboratories as well as nursing faculty consensus opinion on what facilitates and/or hinders the implementation of HPS.

Research related to the use of HPS is in its early stages (Nehring & Lashley, 2004). Nehring and Lashley (2009b) identified only 26 published nursing research studies pertaining to high fidelity simulators. In a recent review of the Cumulative Index of Nursing and Applied Health literature and Proquest Dissertation, only 20 empirical reports of high-fidelity simulation were identified from 1989 to 2009 which used theory to inform understanding of high fidelity simulation use in nursing education (Rourke, Schmidt, & Garga, 2010). Two survey studies were identified in the literature that illustrated faculty members' opinions of the use of simulation in undergraduate nursing education. These studies are discussed below.

The first study was an international survey design and specifically addressed how HPSs produced by Medical Education Technology, Incorporated (METI) were being used in nursing programs and at simulation centers (Nehring & Lahley, 2004). The purpose of the study was to examine which specific nursing courses utilized HPS, the percentage of HPS use, the training of faculty and staff, and how HPS was being used to evaluate clinical competencies and student opinions. Results indicated that most schools used HPS to teach in advanced medical-surgical, basic skills, and maternal-newborn courses. Community colleges utilized the simulators more often than universities. Most of the respondents (57.1%) used HPS as part of required clinical hours as a component of a clinical course, while the remainder (42.9%) rarely used the simulators as part of clinical hours. Over half of the faculty members (58.1%) were receptive to using the technology in their courses; however, 29% thought that HPS was suited only for certain courses. Ten percent of the schools were not receptive to the technology. Reasons for lack of acceptance identified were change in methodology, the technology itself, and the relatively small number of students that can use HPS at one time (Nehring & Lashley, 2004).

The second study utilized online surveys to explore current HPS resources purchased by associate degree nursing programs in Washington State and faculty members' use of HPS (Adamson, 2010). This study examined faculty perceptions of barriers and facilitators for integrating HPS into the nursing curriculum. Barriers included lack of time, lack of support, and lack of appropriate equipment. Facilitators included training, individual initiative, and support from colleagues and administrators.

Since only one simulation lab in Texas responded to the international study by Nehring and Lashley (2004) and the second study by Adamson (2010) only explored ADN faculty members in Washington State, it was imperative to obtain a more inclusive sample of Texas university and community college nursing education faculty to discern their opinions on using HPS in pre-licensure nursing education clinical coursework. Faculty opinions on what hinders and/or what facilitates the use of HPS can be instrumental in providing needed information on planning and developing simulation programs within pre-licensure programs across the state. Implementing changes into nursing education curricula could be difficult without a prior exploration of faculty members' opinions.

Theoretical Prospective

Cain and Mittman's Diffusion of Innovation in Health Care (2002), which is based on Everett M. Rogers' (1995) Diffusion of Innovation Theory, provided the theoretical perspective for this study of faculty members' opinions of what facilitates and/or hinders implementation of HPS in pre-licensure nursing education in Texas professional nursing education programs. The Diffusion of Innovations in Health Care (DIHC), as defined by Cain and Mittman (2002), contains 10 *critical dynamics* including: (a) relative advantage, (b) trialability, (c) observability, (d) communication mechanisms, (e) faculty characteristics, (f) reinvention, (g) social network, (h) opinion leaders, (i) compatibility, and (j) infrastructure. These dynamics served as a reference framework for the literature review and the response analyses of this study.

Rogers (1995) defined *diffusion of innovations* as a process of communication by which "an innovation is communicated through certain channels, over time, and among the members of a social system" (p. 5). Diffusion is regarded as a special communication where individuals share information with each other in order to reach a mutual understanding about an innovation. A new innovation triggers social change within the system as the spread of the new idea introduces a new outcome of uncertainty.

Rogers (1995) defined an innovation as "an idea, practice, or object perceived as new by an individual" (p. 11). For the purposes of this study, the innovation was considered to involve a new practice for undergraduate nursing education clinical coursework incorporating HPS technology. Technological innovations are composed of a hardware feature (i.e., physical object) and a software feature (i.e., information base for the object). Technological innovations are designed to reduce the uncertainty in the cause-effect relationships involved in achieving a desired outcome while providing some degree of benefit for its potential adopters (Rogers, 1995). HPS is a relatively new technological innovation which has the potential to shift nursing educators' ideation of clinical education.

While all innovations are considered new, assimilation of innovations into any social system occurs at different rates. The characteristics of the innovation strongly influence its adoption by a social system (Minishi-Majanja & Kiplang, 2005). The ten critical dynamic properties of healthcare innovations are the most important characteristics that explain the rate of adoption and diffusion (Cain & Mittman, 2002). Each of these qualities will be described and discussed in relation to the current curricular challenges of Texas professional nursing education programs.

Relative Advantage

Relative advantage is the degree to which an innovation is perceived as better than what it replaces, or whether the benefit of using the innovation outweighs the risks of using it (Cain & Mittman, 2002). The greater the perceived relative advantage of an innovation by the adopting social system, the more rapidly it will diffuse and the quicker the innovation will be adopted. Relative advantages could include economic profitability, social prestige, convenience, or satisfaction. While evidence-based research on the objective advantage of HPS is somewhat limited in the literature, there is an increasing amount of perceived relative advantage opinions information found in the literature (Bearnson & Wiker, 2005; Beyea & Kobokovich, 2004, Beyea, von Reyn, & Slattery, M., 2007; Bruce, Bridges, & Holcomb, 2003, Hammond, 2004; Haskvitz & Koop, 2004; Strouse, 2010).

The relative advantage of HPS perceived by educators might be exemplified by their noted satisfaction with the student's opportunity to practice advanced skills in a safe environment as opposed to their concerns with patient safety when practicing skills with human beings. The use of HPS is presently consistent with nursing educators' values of maintaining patient safety as simulation allows multiple learning objectives to be taught in evidence-based scenarios (Wilford & Doyle, 2006). Other perceived relative advantages could include the student's ability to demonstrate clinical competency, opportunities to participate in team exercises, and increased student satisfaction.

Trialability

Trialability is the ability to try out an innovation without total commitment and with minimal investment (Cain & Mittman, 2002). If new innovations are allowed to be tested, anxiety and uncertainties about the risks and benefits will be reduced, and the innovation could be adopted faster. The use of HPS in nursing education requires training before it can be successfully implemented and managed and, thus, is not very "triable" by faculty with students. Vendors of HPS have assisted in the trialibility of their high fidelity mannequins by providing face-to-face interactive demonstrations with faculty members at various professional association conferences.

The vendor representatives of the high fidelity mannequins are playing an essential role in HPS diffusion through vigorously acting as change agents through the promotion of their products (Cain & Mittman, 2002). A change agent influences clients' innovation-decisions in a direction deemed desirable by the change agency, by actively persuading and influencing the school's decision to purchase their products (Rogers). Cain and Mittman, (as cited in Hodges, 2008) believe a change agent's success is determined by how well the innovation is compatible with the user's needs and values (Hodges, 2008). While there may be a few schools in the state of Texas whose simulation centers were partially funded with vendor support, most schools will not be recipients of these same benefits. Schools that are currently deciding whether to purchase and implement HPS simulation as part of their clinical coursework can benefit from the information obtained from this study of what facilitates and/or hinders the use of HPS in pre-licensure nursing education.

Observability

Observability is the degree to which the results of an innovation are visible to others (Cain & Mittman, 2002). Watching and learning how early adopters used HPS and then acknowledging how safe or beneficial the technology is determined through the dynamic characteristic of observability. A social system is more likely to adopt the innovation if relative advantage results are seen. Opportunities for first-hand observations are important precursors to adoption of the innovation. Through some of the vendors' discriminate partnerships with national nursing organizations.(e.g., the recent three-year National League for Nursing study of student satisfaction with Laerdal's high fidelity simulation mannequin), the perceived relative advantages of this innovation is increasingly being demonstrated (Jeffries & Rizzolo, 2006).

Communication Mechanisms

The diffusion of HPS has also been a social process that has depended on the information of the innovation being communicated between at least two individuals, i.e., individuals who have knowledge of the innovation or experience with using it and individuals with limited knowledge and no experience (Cain & Mittman, 2002). Communication mechanisms are an important dynamic characteristic and are how the message moves. Mass media outlets such as the Internet, television, peer-reviewed journals, and education summits are useful for transmitting knowledge and awareness of the innovation. Active user forums can also be found on the different vendor web sites.

Most individuals do not evaluate an innovation on the basis of scientific studies of its consequences (Rogers, 1995). Instead, most people depend upon the subjective evaluation of the innovation from other individuals who have previously adopted it (Rogers, 1995). Individuals who are considering adopting a new innovation like to see the process role modeled by the earlier adopters. One-on-one interpersonal channels between educators are used to persuade late adopters to look at adopting the innovations.

Faculty Characteristics

Rogers (1995) believed that it was important that the two or more individuals who interact be homophilous or similar in certain attributes (e.g., beliefs, education, and social status). Communication is more "effective when the source and receiver share common meanings, beliefs, and mutual understandings" (Cain & Mittman, 2002, p. 15). Heterophily is the opposite of homophily and has been defined as the degree to which two or more individuals who interact are different in attributes of subcultural language, sharing of common beliefs and social status (Rogers, 1995).

Nursing educators are a relatively homophilous group, with rules and guidelines in place that form faculty characteristics, yet may still retain a certain amount of heterophily. Educators share common beliefs, yet may have different attributes, i.e. Bachelor of Science in nursing (BSN) educator verses. Associate Degree in Nursing (ADN) educator. To be a faculty member, each educator must possess certain competencies.

Competencies have been identified that reflect the knowledge, skills, and abilities needed by nurse educators regardless of where they practice (Billings & Halstead, 2005; National League for Nursing, 2005; Southern Regional Education Board, 2002). The Council on Collegiate Education in Nursing, an affiliate of the Southern Regional Education Board, has identified statistical significance between ADN and BSN identification and ranking of educator competencies (2002), demonstrating heterophily between groups. Competency skills within the nurse educator role include the application of learning theories and instructional strategies; use of technology, curriculum and program development; use of evaluation tools; and knowledge of legal standards and incorporation of professional nursing and nursing education values, including accountability and competency (Davis, Stullenbarger, Dearman, & Kelley, 2005).

In addition, state laws governing professional nursing education programs may have other requirements for faculty members. Specific qualifications for nursing faculty to teach in professional nursing education programs in the State of Texas are found in the Texas Administrative Code, Rule 215.7(c). The Texas BNE enforces this rule for all professional nursing education programs. This rule requires that each nurse faculty member shall:

> (A) Hold a current license or privilege to practice as a registered nurse in the State of Texas; (B) Show evidence of teaching abilities and maintaining current knowledge, clinical expertise, and safety in subject area of teaching responsibility; (C) Hold a master's degree or doctorate degree, preferably in nursing. (D) A nurse faculty member holding a master's degree or doctorate degree in a discipline other than nursing shall hold a bachelor's degree in nursing from an approved or accredited baccalaureate program in nursing; and (i) if teaching in a diploma or associate degree nursing program, shall have at least six semester hours of graduate level content in nursing appropriate to assigned teaching responsibilities, or (ii) if teaching in a baccalaureate level program, shall have at least 12 semester

hours of graduate-level content in nursing appropriate to assigned teaching responsibilities. (Texas Administrative Code, n.d.)

Although it may be clear that many faculty characteristics make the group somewhat homophilous, there may be a certain amount of heterophily as well, such as comfort level with HPS or teaching at different levels of professional nursing education.

Faculty members may be persuaded to accept HPS if they are taught by other faculty members. In a recent study by Starkweather and Kardong-Edgren (2008), the diffusion theory was used to guide the "embedding" of HPS into the nursing curricula at a Washington State university. A research faculty member experienced with HPS, along with an identified early adopter engaged in teaching the medical-surgical curriculum, ignited interest among faculty who were not using HPS. Through simulation retreats, the two faculty members who were early adopters of the innovation were able to demonstrate the strength of HPS to faculty who were later adopters. A steady increase in the usage of simulation was observed (Starkweather & Kardong-Edgren).

Reinvention

Reinvention is defined as the degree to which an innovation is changed or modified by a user in the process of adoption and implementation (Rogers, 1995). Increased use of an innovation drives the need for greater capabilities from the innovation (Thompson, 2005). User modifications can lead to outcomes that are improved over those intended (Shih & Berliner, 2008). While the innovation of HPS has remained relatively stable, the mannequins have been modified since their original inception to become more realistic and user friendly. While the original HPS mannequins were computer driven, they were attached with cables to the computers containing the software required to run the scenarios. Newer models are wireless to increase their versatility and maneuverability, have increased true-to-life articulation of joint motion, have improved skin that acts and looks like human skin, and allow for increased physical findings (METI, 2010).

Complexity is the degree to which an innovation is perceived as difficult to understand and use (Rogers, 1995). New innovations that are simple to understand are rapidly adopted compared to innovations that require the adopter to develop new skills and ways of thinking (Rogers, 1995). Introducing HPS into nursing education has caused increasingly complex problems for the nurse educator. Preparing software scenarios for use, understanding the maintenance and care for the multiple technological hardware components that comprise the HPS, and developing the increased computer skills required to facilitate a learning situation, are just a few of the complex tasks the educator must address. For a nurse educator to use HPS, new knowledge and skills must be attained (Jeffries, 2008). This factor alone could deter adoption of the innovation, especially when there is no infrastructure available to support its use. In partial response to this need, two commonly used nursing textbook publishers are presently publishing textbooks with the availability of additional case scenarios for HPS simulation use (Lewis, et al., 2010; Smeltzer, 2010) as well as the

HPS vendors (METI, 2010 & Simulation Innovation Rescource Center, 2010) at an additional cost (Nehring & Lashley, 2009).

Social Network

A social system is defined as "a set of interrelated units that are engaged in joint problem-solving to accomplish a common goal" (Rogers, p. 23). Formal professional organizations such as the NLN, the National Council of State Boards of Nursing, and the Commission on Collegiate Nursing Education (CCNE) accredit schools of nursing and enhance the social networks between nurse educators. As part of their professional obligations, these social networks influence the diffusion of innovations. It is through these professional and social networks that potential adopters of an innovation can learn about its adoptability, learn about the perceived risks, and observe innovation outcomes (Greenhalgh, Robert, Bate, Macfarlane, & Kyriakidou, 2005). Diffusion of technology is accelerated when people are interconnected (Rogers, 1995). An example of how a HPS vendor has formed a collaborative alliance with a formal professional organization to assist faculty members to develop and integrate simulation into their curriculum can be observed at the Simulation Innovation Resource Center (SIRC) that is located on the Internet (SIRC, 2010). The endorsement by the professional nursing education society will hopefully speed the diffusion and help establish the practice of HPS simulation into nursing education practice.

Opinion Leaders

Rogers (1995) provided a classification system that identifies specific stages that an individual adopts at any given time with respect to the new innovation. Based on the timeliness of accepting an innovation, adopters are either known as innovators, early adopters, early majority, late majority, or laggards. Common characteristics are shared by each group. Innovators are members of the social system who adopt innovations earlier than other members of the system. Innovators actively seek new ideas and technological advances and can become opinion leaders. Opinion leaders and change agents can work together and become instrumental in adopting a new innovation. Dr. Pamela Jeffries from Indiana University and Dr. Wendy Nehring from East Tennessee State University have been opinion leaders for the use of simulation in nursing education. Both of these opinion leaders have led the way through publishing many articles, as well as textbooks, regarding the use of HPS in nursing education (Jeffries, 2007; Nehring & Lashley, 2009).

Compatibility

Compatibility is the degree to which an innovation is perceived as being consistent with existing values, past experiences and needs of potential adopters (Rogers, 1995). The innovation must be compatible with the value system of the adopters' existing environment and behavior for it to have a successful adoption and diffusion into the system (Cain & Mittman, 2002). One of the most important strengths of integrating HPS into a nursing program is how it allows students to receive feedback on their clinical decisions through debriefing that follows the simulated case (Childs & Sepples, 2006; Haskvitz & Koop, 2004; Nehring & Lashley, 2009).

Infrastructure

The successful implementation of HPS into a nursing program depends on the presence of an existing infrastructure that can support its adoption. Infrastructure has been defined as the basic physical and organizational structures needed for the operation of the innovation (Infrastructure, n.d.). Maintenance of the technological infrastructure for the successful adoption of the innovation can be expensive and requires continuous upgrading and investment, with some facilities faced with capital budget challenges (Glaser, 2009). Many adopters of HPS simulation may have purchased the mannequins and supportive equipment without thought to the space required for a successful simulation center. Space is needed to accommodate equipment, as well as for areas for teaching, practice, observation, debriefing and other activities.

Clark (2008) advocates that it is crucial to develop a humanizing learning environment in nursing education for professional development which places educators in a helping relationship with the student. In managing the classroom of learners, the nurse educator must assess student learning styles, preferences, and problems and from there, develop a host of learning exercises to use, set the climate for learning, and offer explicit goals and directions for classroom behavior (Clark, 2008). Instead of just being a "lecturer," creative methods must be developed for teaching students so that they are allowed opportunities to fuse the cognitive, affective, and perceptual-motor skills into a holistic experience. This is especially true with younger generation students who embrace technology. Hawranik and Thorpe (2008) maintain that students born between 1980 and 2000 consider technology an essential part of their lives, since digital technologies have always been available to them. These students expect the use of technology in their education. The technology provided by HPS assists these students with their learning experiences.

Assumptions

The following were assumptions of the study:

1. Opinions of undergraduate nursing educators regarding the implementation of HPS in clinical teaching exist and can be elicited.

2. Expert panel members will express their honest opinions about implementation of HPS as part of clinical nursing coursework.

3. Use of the Diffusion of Innovation Theory as a guiding perspective for the study will assist in explaining most of the factors or concepts identified by the nurse educators as affecting HPS implementation.

Research Question

The major purpose of the study was to explore the opinions of Texas nursing educators regarding the implementation of HPS innovation in clinical teaching of undergraduate nursing students and to develop a consensus about the implementation of this innovation. Specifically, the major research question related to the purpose was "What are the consensus opinions of undergraduate nurse educators in Texas about what has facilitated and/or hindered HPS implementation within pre-licensure nursing coursework?"

Definition of Terms

Professional Nursing Education Programs

Conceptual: Professional nursing education programs are nursing schools that are approved by the Texas Board of Nursing Education (BNE) and prepare students for the professional role of RN and licensure. Professional nursing schools teach students to perform acts that require substantial specialized judgment and skill based on knowledge and application of biological, physical, and social science principles (Texas Board of Nursing Education, 2007). Approved professional nursing education programs include diploma, associate, and baccalaureate schools of nursing.

Operational: Schools identified as approved professional nursing education programs by the BNE during the 2008-2009 year (Texas Board of Nursing, 2008).

Nurse Educator:

Conceptual: Nurse Educator is the individual who teaches and prepares pre-licensure student nurses for the professional role of RN and licensure and for entry into practice.

Operational: Faculty member identified from an approved pre-licensure professional nursing education program's Internet site.

Consensus

Conceptual: Consensus is defined as an opinion or position reached by a group as a whole (Consensus, n.d.).

Operational: Consensus was operationalized as response statements that fell within 1 standard deviation around the mean, representing 68% of faculty members agreeing with the statement.

Limitations and Delimitations

The limitations of the study were as follows:

1. Self-selection. Faculty members who choose to participate may be different from those who do not.

2. Generalizability. The study findings can be generalized only to undergraduate nursing education programs in Texas who participated in this study

The delimitations of the study were as follows:

1. The study was conducted in only one geographical area. i.e., Texas.

2. The sample was limited to nursing faculty members who are registered to practice nursing in the State of Texas and have taught in an associate, diploma or baccalaureate nursing program for at least 1 year.

Summary

The use of HPS can provide a valuable adjunct to traditional clinical nursing education for the younger generation students who have embraced technology. All of the student's theoretical learning through textbooks, videos, and conversations with instructors is ultimately demonstrated in how the student cares for a patient in the real-world setting. Using HPS as model patients in simulated scenarios allows the nurse educator to evaluate whether the students are really learning what is needed to be successful before working with actual patients.

While the Texas code now provides the educator with the opportunity to use simulation, little is known about the opinions of nurse educators about its use and how it is being used within the State. The purpose of this study was to determine the consensus opinion of faculty members regarding implementation of HPS innovation in clinical teaching of pre-licensure nursing students in the state of Texas. Interpretations of the findings were guided by the Diffusion of Innovation Theory in Health Care (Cain & Mittman, 2002). This chapter included the problem and rationale for the study, theoretical framework, assumptions, the research question, definition of terms, and limitations and delimitation for the study.

CHAPTER II

REVIEW OF LITERATURE

This chapter includes a literature review as it relates to simulation. Not only are the definitions of simulation reviewed, but the different types and uses of simulation in nursing education are examined. What has facilitated and/or hindered high-fidelity simulation (HPS) in the nursing educational setting will also be reviewed. The following discussion of the literature review has been deconstructed into the following components: (a) stimulation defined, (b) the history of simulation, and (c) the types of simulation, including case study applications, standardized patients, computer-based systems, software programs, virtual reality and haptic systems, part task trainers, and integrated high fidelity systems. The section on literature pertaining to facilitators and hindrances related to simulation has been organized utilizing Cain and Mittman's (2002) critical dynamics of health care innovations which is based on Roger's Diffusion of Innovation Theory characteristics. These critical dynamics include (a) relative advantage, (b) trialability, (c) observability, (d) opinion leaders, (e) social network, (f) communication mechanisms, (g) faculty characteristics, (h) reinvention, (i) compatibility, and (j) infrastructure.

Simulation Defined

Simulation has many definitions and applications. One online dictionary defined simulation as the representation of the behavior or characteristics of one system through the use of another system, especially a computer program designed for the purpose of training (simulation, n.d.). A different definition from the online *Oxford English Dictionary* defined simulation as a "technique of imitating the behavior of some situation or process (whether economic, military, mechanical, etc.) by means of suitable analogous situation or apparatus, especially for the purpose of study or personnel training" (simulation B, n.d.). According to Gaba (2004), simulation is a "technique-not a technology-to replace or amplify real experiences with guided experiences that evoke or replicate substantial aspects of the real world in a fully interactive manner" (p. 2).

Simulation is designed to replicate a part of the working environment. Rehman, Mitman, and Reynolds (1995) described three purposes for airline flight simulation: (a) to provide practice on specific skills, (b) to reinforce acquisition and use of job-relevant knowledge, and/or (c) to evaluate a system or new concept. In a similar manner, Jeffries (2005) defined simulation for nursing to be a learning experience where the working environment is reproduced with the purpose of requiring the student to perform technical skills, and enhance decision making and critical thinking skills. Since these purposes may be quite different, strategic planning with different levels of fidelity may be required (Bredmose, Habig, Davies, Grier, & Lockey, 2010; Wisborg, Brattebo, Brinchmann-Hansen, & Hansen, 2009).

Fidelity refers to the degree to which the characteristics of the simulation match the true working environment (Rehman, et al., 1995). While low fidelity simulations use basic educational methods, such as a case study, high fidelity simulations require three crucial elements, i.e., equipment, environmental, and psychological fidelity (Alessi, 1988). Equipment fidelity refers to the how well the simulator duplicates and behaves like the real system. Environmental fidelity refers to the external visual and sensory cues provided by the simulator and its environment. The third element, psychological fidelity, refers to where the student suspends disbelief and enters into the simulated reality of the situation. Alessi (1988) proposed that learning varies with fidelity and that as students progress in their education, they benefit from increasing fidelity levels. He also proposed that the higher the fidelity, the easier it is for the learner to transfer knowledge gained to the real-world environment.

In nursing education, simulations and the equipment required to reproduce the experience vary from low to high fidelity. From case studies, task trainers, standardized patients, virtual reality, and integrated high-fidelity patient simulations, the purpose of simulation in health care is not to replace the need for clinical environment learning, but through preparation, to enhance the student's clinical experience and improve patient care (Maran & Glavin, 2003).

Simulation History

Simulation of real-life events has been used to educate humans for centuries. Since early Greece, little girls have played and made clothes for dolls (Gadia-Smitley, 1987), thereby imitating future roles through play. During the middle ages, medieval knights held jousting tournaments to hone battlefield skills. Simulation is presently being used to train within such industries as nuclear power, airline, health care, and the military. Improved teamwork with reduction of critical events has been observed in aviation simulation for crew resource management training (Helmreich & Foushee, 1993). Simulation is considered to have high reliability with a very low failure rate (Roberts &

Bea, 2001). A common thread found for using simulation in any occupation is that training or systems testing in the real world would be too costly or too dangerous to undertake (Bradley, 2006).

A growing interest in clinical simulation has been rapidly increasing in health care education for the purposes of improving patient safety and patient care through a variety of applications (Gaba, 2004). Different aspects of simulation have always been a part of nursing education and their history is provided in the discussion of the types of nursing simulations below. Simulation with the use of high-fidelity human patient simulators (HPS) has only recently been introduced to undergraduate nursing as an educational methodology (Bremner, Aduddell, Bennett, & VanGeest, 2006). The use of developed scenarios, along with HPS, provides unique opportunities to expose nursing students to clinical scenarios in a safe and supportive environment that would challenge and facilitate training (Henneman & Cunningham, 2005). Simulated guided experiences developed with careful attention to the consistent details of simulation, debriefing, and evaluation offers opportunities to teach nursing students important patient safety principles (Henneman & Cunningham, 2007).

Types of Simulation

Nurse educators may select from several different types of simulation methods to facilitate the students' understanding of nursing care concepts. Simulation methods may include the use of case studies, standardized patients, computer-based systems, software, virtual reality and haptic systems, part-task trainers, or the recently introduced human patient simulator. While simulation may vary in level of fidelity, the overall goal of assisting the student in developing and maintaining skills remains, including the application of clinical decision making and critical thinking.

Case Study Applications

Vandrey and Whitman (2001) acknowledged that case studies allow students to learn how to solve clinical problems in the safety of a classroom setting. Traditionally, case studies have been developed by educators based on their own experience to demonstrate classroom concepts. After the patient case is presented with relevant history and assessment findings, purpose-driven questions allow the student to respond and choose actions that they believe would be appropriate from a nursing perspective. Through discussion with the instructor, the case study provides the student "experience in thinking through clinical dilemmas, increases the student's repertoire of responses to a given clinical problem, and provides models of how expert practitioners would evaluate and respond to comparable situations" (Vandrey & Whitman, 2001, p. 24II). The case study method of instruction is limited. While case studies allow discussions about patient care, they do not offer students the opportunity to physically practice providing nursing care. In addition, they disallow the student from interacting with patients, family members, and providers in settings that mimic the clinical settings in which nurses will eventually practice (Henneman & Cunningham, 2005).

Standardized Patients

Standardized patients (SPs) present patient problems in a realistic manner through the use of role play. An individual is carefully trained to accurately depict an illness or scenario in a systematic, unvarying manner to a student (Becker, Rose, Berg, Park, &

Shatzer, 2006). The patient's history and physical examination findings are usually developed by an expert clinician. The SP presents the information in an identical manner with each student encounter, thereby providing a comparable experience for all students (Ebbert & Connors, 2004). Not only can the SP play a role, but he/she can also be involved in the teaching and evaluation of the students' response (Bradley & Postlethwaite, 2003). SPs are useful in teaching and evaluating the clinical skills of interpersonal communication, history taking, interviewing, physical and psychological assessment, and patient education (Gates, Fitzwater, & Telintelo, 2001; Gibbons, et al., 2002; Rosen, Leung, & Kan, n.d.; Stroud, Smith, Edlund & Erkel, 1999; Thomas, O'Connor, Albert, Boutain, & Brandt, 2001).

Ebbert and Connors (2004) described the use of SPs in simulated patient experiences (SPEs) with adult/geriatric nurse practitioner students. SPEs were implemented as part of the final clinical examinations throughout the four-semester program. During the first semester, students were video-recorded performing complete histories and physicals after their health assessment course. Acute primary care students were evaluated for developing a working diagnosis and plan of care after completing the history and physical on a SP with an acute illness. Students were subsequently evaluated at the completion of their capstone course by having them move between four different SPs with typical problems encountered by adult/geriatric nurse practitioners in a primary care facility. Faculty members for this nurse practitioner program believed the use of a SPE could be used to objectively demonstrate knowledge, skills (critical thinking and technical) and clinical competencies of the practitioner student. SPEs allowed reproducible learning and testing experiences for every student.

Implementing a SP program has significant costs, including the need for developing case studies, lengthy training of the SP, paying SP salaries, and video-taping the SPE. Ebbert and Connors (2004) estimated that it cost an average of $100 to provide the SPE for each student, with some of the cost being passed on to the student in the form of laboratory fees. In their one-year research study of student satisfaction with the SP experience, a 5-point Likert scale (5 = *strongly agree*, 1 = *strongly disagree*) instrument was administered to the students immediately after they completed the SP experience. Students reported that the patient encounters were realistic (M = 4.5), feedback received from the SP was useful (M = 4.5), and the challenge presented by conducting the history and physical was about right (M = 4.5). Information regarding the sample size, reliability or validity of the study was not included in the article.

Becker, et al., (2006) explained the results of an interventional pilot study comparing two different types of education practices. A student's interview with a SP with a diagnosis of depression was compared with a structured clinical conference interview where students were asked what they would do with a patient with depression. Although the structured clinical conference was the usual method of clinical depression instruction, there was never any patient interaction in the clinical conference interview. The study used a pretest-posttest, randomized, control group design with senior undergraduate nursing students enrolled in a psychiatric nursing course. Six consecutive classes were used for the study, providing a sample of 147 students who were randomly assigned to either the treatment group (n=58) or control group (n=89). Therapeutic communication skills and knowledge of depression were the dependent variables with the educational intervention being the independent variable. Students were asked to complete two instruments for the study. These instruments were the Communication Knowledge Test (CKT) and the Student Self-Evaluation of SP Encounter (SSPE). The SPs also completed two instruments developed by the authors, a post-encounter SP checklist and the Standardized Patient Interpersonal Ratings (SPIR) form. All of these tools were developed by the authors for the study and had no reliability or validity information reported.

Both groups of students completed the pretest CKT prior to receiving the intervention (treatment group) and within 1 week of attending didactic lectures on therapeutic communication and nursing care of clients with depression (both groups). After the students completed the course, the posttest CKT was administered. No statistically significant differences were observed between the two groups on their pretest or posttest CKT ($p=0.739$), SPIR ($p=0.943$) and SP checklist ($p=0.238$) scores. Both groups demonstrated improvement on the posttest CKT ($p=0.067$). Overall, the results indicated that there were no significant differences found between the two groups on measures of therapeutic communication skills and knowledge of depression; however, qualitative data from the students who participated in the SP method found it to be overwhelmingly positive, meaningful, and creative.

To bypass the additional cost of employing a 'standardized patient', Comer (2005) described a simulation role-playing method she implemented for students in a critical care course at an associate degree nursing program. A student from the class was selected to role-play a standardized patient with a specific medical condition, e.g., hypoxia. A prepared script assisted the student in assuming the patient role. Other participating students were given the opportunity to implement various nursing interventions from standing physicians orders with appropriate equipment, e.g., oxygen cannula. Since this simulation occurred during a lecture, classmates could be solicited as a resource for information. The simulation scenario progressed with patient deterioration as the class progressed with different members of the class taking turns participating in the nursing role. Debriefing of the simulation occurred after each scenario. Although not a research study, Comer found fewer students failed a corresponding course exam after the implementation of the role-play simulation. Ninety-six percent of the class reported enjoying the simulation and found the method to be a better way to learn about specific medical conditions.

Computer-Based Systems

Computer-based systems provide materials that can enrich the learning experience for students. Resources are being provided by publishers along with textbooks on the assumption that students born between 1980 and 2000 expect the use of technology-rich resources (Hawranik & Thorpe, 2008). Students today are provided with a plethora of computer-assisted educational materials along with their textbooks including, publisher websites, clinical resources, personal digital assistant (PDA) resources, NCLEX review questions, and learning games to name a few. Materials required for computer-based simulation instruction and training include multimedia, hypermedia, and/or virtual reality (Tsai, Fung, Tsai, Jeng, Doong, 2008).

Computer based system knowledge is imperative for today's nursing student. It has been estimated that 15-35% of nursing care time will be spent with institutional wide electronic health records (EHRs) utilizing computer hardware (Institute of Medicine, 2010). Hospitals are adopting certified EHRs in response to the American Recovery and Reinvestment Act of 2009 and in order to be eligible for federal incentive payments for reporting clinical quality of care patient data (Institute of Medicine, 2010). EHRs include patient demographics, vital signs, diagnoses, allergies, active medications and other patient tests. Sorian®, by Siemens®, is an example of how electronic nursing charting has moved beyond simple nurses' notes and assessments to an institutional wide EHR which obsoletes the need for paper records (Siemens Medical, 2010). In response to this, Elsevier© has purchased the simulated EHR system *NurseSquared*® for nursing students to teach them appropriate documentation using an EHR, including patient assessments, care plan construction and narrative charting (Elsevier, 2010).

Nurses are using more hand-held computer-based devices, mainly because they can be readily accessed at a patient's bedside for quick information (Miller, et. al., 2005). In a 9 month pilot project with 6 nurse practitioner students in Massachusetts, PDAs were tested and evaluated in a clinical decision making seminar (Koeniger-Donohue, 2008). The goals of the project were to learn how to utilize PDAs as a personal organizer and to determine the value of PDAs as an alternative to the traditional model of textbook use.

The college's technology resource librarian conducted hands-on seminars for PDA operations and introduced the teams to various health care websites.

At the conclusion of the 9 month project, the researcher conducted a 90 minute audio-taped focus group to allow the participants an opportunity to discuss and reflect on the PDA experience. The tapes were transcribed, analyzed and organized to identify where the PDAs added value to clinical rotations and learning. Major themes included time, learning, and personalization (Koeniger-Don0hue, 2008). The study participants valued how the use of the PDA at the bedside for researching information allowed them to spend more time with the patient. The theme of learning was illustrated with how patient problems could safely be solved through the small hand held device compared to mounds of traditional textbooks. The new technology also reiterated that learning was a lifelong process for the students in this study. PDA's allowed for personalization of patient care by assisting the student in determining a differential diagnosis through information provided for focused history and physical examinations.

More recently, students are utilizing wireless technology, e.g. smart phones applications, to assist with their learning. Students preparing for entering nursing education may elect to use Anatomy 1® flashcards on the I-phone® from Bold Type Media LLC® to enhance their understanding of first semester anatomy and physiology (Langlois, 2010). Nurses and physicians may also choose to download oncology applications to utilize for practice with the goal of improving patient care (Fried, 2010).

Software

Educational nursing software programs provide opportunities for students to interact with a situation, and receive feedback related to performed actions, e.g. Elsevier's© *Virtual Clinical Excursion*® (Cashion & Crum, 2006). This multimedia software program, with provided obstetrical case studies, simulates the real-world hospital care of obstetrical patients and can be independently used by the student. The program produces data on the student's interaction with the patient and provides feedback to the student after completion of the case study. It can be used as supplemental material for the student to integrate theory into a patient care situation.

There have been and continues to be multiple software programs available to help teach nursing students, including proper medication administration, electrocardiogram training and diabetes nursing care (Jeffries, 2000; Jeffries, Woolf & Linde, 2003; Tatti & Lehmann, 2001). In one of the earliest integrative reviews of computer-based simulation research articles, 75% showed positive effects of simulation on skill and/or knowledge acquisition (Ravert, 2002). Voluntary use of multimedia programs by the student, however, may be questionable.

To examine the use and effectiveness of medical-surgical electronic textbook companion materials, Missildine, Fountain and Summers (2009) administered an informal survey to students in two adult health nursing courses at the completion of those courses. Two hundred and fifty six anonymous surveys were completed. The 12-item informal survey developed by the authors used a 6-point Likert-type scale, which was divided into two parts to evaluate the textbook companion compact disc (CD) and the publisher-provided website. No reliability or validity information was available for the survey instrument.

Students were asked to estimate the number of times the companion pieces were used throughout one semester of the adult health course and to rate how helpful they found these resources on a scale of 0 (not helpful) to 5 (very helpful). The findings indicated that the NCLEX review questions from the textbook companion CD were used most often and were perceived to be helpful (n=151, 59%; M=3.7). The physical examination video clips were used most often from the publisher-provided website and were also perceived to be helpful (n=80, 31.3%; M=3.72). Voluntary use of companion electronic study materials was not well adopted by the students in this sample. Recommendations were made to improve utilization of the products, including introducing available learning resources at the beginning of each course.

Virtual Reality and Haptic Systems

Immersive virtual reality (VR) employs computers and multimedia products to produce a simulated virtual environment that students could perceive as comparable to the real world. Virtual reality completely isolates the student from the outside world and places him/her into a computer-generated environment (Simpson, 2003). The students may wear helmets that contain visual display units and speakers that project stimuli appropriate to the simulated settings. Virtual reality is used to simulate a realistic three-dimensional (3D) scene in which segments of a scenario can be manipulated, such as with the use of an intravenous injection simulator (Engum, Jeffries, & Fisher, 2003; Tsai, et al., 2008).

When haptics are incorporated as part of the virtual reality component, the interfaces between the computer system and the person using the system provide a realistic sense of touch (Dunkin, Adrales, Apelgren, & Mellinger, 2007). It is a sophisticated system that provides a graded resistance response to the user, giving the user a sensation of pushing or pulling. Haptic systems are being used with surgical, laparoscopic, and endoscopic trainers (Kanumuri, 2008; Kneebone, 2003; Murray, Edwards, Mainprize, & Antonyshyn, 2008). At present, there are few VR simulators for nursing education, but *Laerdal®* has introduced a virtual intravenous (IV) catheter with haptics that responds to inappropriate catheter starts by bleeding, swelling and bruising (Immersion Corporation®, n.d.). This virtual IV retails for $15,000 and comes with the haptics IV device, desktop computer, and choice of either a pre-hospital, in-hospital, military, or phlebotomy software program. (Laerdal®, 2006). If the consumer wants to purchase all 4 programs as listed above to use with the virtual IV, the price would increase to $20,000.

It is important for nursing students to become skilled at starting IV catheters because of the possibility of complications associated with infusion therapy and intravascular catheters (Rutledge & Orr, 2005). Catheter malposition, infection, and thrombophlebitis are the most common complications of intravenous therapy and can lead to patient death. A nursing student's proficient demonstration and understanding of this skill could be enhanced with the virtual intravenous catheter with haptics. This device provides the student a simulated response similar to a patient's response while he/she is inserting an IV catheter. The student would be able to demonstrate to the faculty member the step-by-step procedure of insertion of the catheter and removal of the needle. While observing the virtual environment images, the student could also feel the potential resistance of a patient's vein with their hand during catheter insertion. The student would be able to observe and feel IV catheter infiltration due to misplacement of the catheter, increasing the fidelity of the experience for the student.

Tsai, et al., (2008) proposed that the use of an IV injection simulator virtual reality program may be more economical and effective than the time-consuming observation of close faculty supervision. In their study to determine the stability and reliability of a VR IV Injection simulator, ten volunteers between the ages of 20 and 28 years underwent a test-retest procedure to compare time to complete the task of starting an IV injection and frequency of errors. Although the study participants did not have medical experience, they did have VR system experience.

The participants' performance was evaluated while maneuvering the VR IV catheter through 10 different procedural steps for the initial test. Ten days later, the participants performed the same procedure completing the identical steps as a retest. The researchers measured the time span between the first and last step of completing the procedure while identifying the number of errors made by each participant. Each participant was given 15 trials at starting an IV with the VR IV catheter. During the first test of the VR IV catheter, the initial average task time was 50.78 seconds, with a retest time of 44.49 seconds and an intraclass correlation coefficient (ICC) of 0.7309. Errors which occurred through breaking procedure (error frequency) while starting the IV at the beginning of the trials was 2.64, with final error frequency of 2.21 with an ICC of 0.86

after the sixth trial. At the beginning of the 15 trials, it took an increased amount of time (task time) to start the IV with increased procedure errors noted. By the sixth trial, the task time had become more stable and procedure errors in IV initiation were reduced. The ICC values which were calculated from the results of the first test and the retest were used to assess the IV-VR simulator reliability as a simulation. These values illustrated how the IV-VR simulator could offer a reliable simulation for the student as an effective tool for training.

One of the newest VR research developments for medicine is named the 'CAVEman®' (CAVEman®, n.d.). CAVEman® resides in a CAVE at the University of Calgary in Canada. The CAVE is a cube-shaped virtual reality room, or research holodeck, in which the 4D human model floats in space. CAVEman® is projected from three walls and the floor below. It is the world's first complete object-oriented computer model of a human body. This 4D human atlas is being used for various medical interventions, including planning complex surgeries, genetic research and observation of cancer progression. No nursing applications for CAVEman® have been developed to this date.

Part Task Trainers

Part task trainers are designed to "replicate only a part of the environment.... and are used to train basic psychomotor skills" (Maran & Glavin, 2003, p. 24). Part task trainers are usually anatomical models in which students can learn skills such as insertion of foley catheters or venipuncture, and are usually used by first year health care students (Rogers, et al, 2000). A key principle for a model and/or partial task trainer is that regardless of how much the equipment may be used in a skills lab, it is most important for the model to have an accurate reproduction of the underlying human structure and function (Bradley & Postlethwaite, 2003). Considered low-fidelity trainers, part task trainers are relatively inexpensive compared to the high-fidelity simulators that are now available, e.g., Susie Simon® by Guardard® may be purchased for less than $1000. These models are best suited for novice learners in a simple simulation training environment where focused task learning can occur (Dunkin, Adrales, Apelgren, & Mellinger, 2007).

The earliest low fidelity and part task trainer identified in literature was Mrs. Chase, who debuted in 1911 (Herrmann, 2008). Developed by a physician's wife, this life-sized mannequin had moveable elbows, hips, and knees. She was reinvented several times through the years with different mannequin skin and updated hairstyles. She was also given body orifices to allow a nursing student practice enema and catheterization care.

One of the first low fidelity and part task trainer human patient simulator developed for healthcare education was Resusci-Anne®. This simulator was invented by Laerdal®, a toymaker from Norway, in collaboration with the cardiopulmonary resuscitation (CPR) pioneers Safer and Elam over a period 40 years ago (Hunt, Nelson, & Shilkofski, 2006). Resusci-Anne® was the first full-size, economical training model for students to learn and practice the skills of CPR.

The original Resusci-Anne® has been reinvented since the initial one was introduced and has evolved with time to a higher fidelity level. Resusci-Anne® with

SkillReporter® manikins make it possible to record quantitative and qualitative data on both chest compressions and rescue breaths while the practitioner performs CPR (Heidenreich, et al, 2006). The Resusci-Anne® with SkillReporter® used with the manikin is able to indicate correct palpation of the carotid artery, chest compression depth, compression frequency, hand placement, and frequency and volume of ventilation (Vnuk, Owen, & Plummer, 2006). In addition to summary information, the manikins can produce real-time data strips illustrating the simulated resuscitation compressions and ventilations. This information can then be shared with the student to compare to the expected outcomes based on the American Heart Association's CPR standards. Resusci-Anne® with SkillReporter® is still available for purchase from Laerdal® starting at $2600 per mannequin (Laerdal®, 2010c).

Resusci-Anne® was recently used in a study of Irish nursing students' acquisition and retention of CPR knowledge and psychomotor skills following CPR training (Madden, 2006). A quasi-experimental time series design was used with a pre-test, CPR training program, post-test, and re-test to evaluate the student nurse's ability to respond quickly and effectively to a cardiac arrest. The sample (N=55) consisted of a convenience sample of second year nursing students in an undergraduate nursing diploma program. All students had previously received CPR training during the first year of their nursing program.

For the study, the students' CPR knowledge was assessed using a multiple-choice examination from the American Heart Association™. An established observation checklist designed by the American Heart Association™ was used to evaluate the students' psychomotor skills of CPR performance on the Resusci-Anne®. A pre and post test was completed on the day of CPR training and approximately 10 weeks later, the students were retested.

The mean score of CPR knowledge of the nursing students for the pre-test was 15.2. Following CPR training, the mean score of students' CPR knowledge was 18.1. Ten weeks later, the mean score of the students' knowledge was 16.8 The CPR skills pretest mean scores was 6, with a mean score of 15 for the posttest, and a mean score of 12 for the re-test. Statistical significance was noted in paired samples *t*-tests between pre-test/post-test cognitive knowledge (p=0.000), post-test/re-test cognitive knowledge (p= 0.004), and pre-test/re-test cognitive knowledge (p=0.002). Statistical significance was also noted with paired samples *t*-tests with CPR psychomotor skill tests between pre-test/post-test psychomotor skills (p=0.000), post-test/re-test psychomotor skills (p=0.000), and pre-test/re-test psychomotor skills (p=0.000). While students showed an acquisition in nurses' CPR knowledge and psychomotor performance following CPR training, they were unable to pass a CPR skills assessment test during the study. Despite this, Madden (2006) concluded that CRP training plays a critical role in assisting students' progression to a proficient cardiac emergency responder.

Initially developed in 1968, Harvey®, a part task cardiology simulator trainer, was developed at the University of Miami Center for Research in Medical Education (Ewy, et al., 1987; Issenberg, Pringle, Harden, Khogali, & Gordon, 2003; Maran & Glavin, 2003). Harvey® realistically simulates 30 cardiac conditions. Multiple physical assessment findings can be programmed for each of the following: blood pressure, bilateral jugular venous pulses, bilateral carotid pulses, and ausculatory events (Issenberg, Gordon, & Greber, 2003). Recently, Harvey® was reinvented with the benefits of digital technology to stimulate his heartbeat and pulse. He now weighs 650 pounds less than when he was first produced. Digital technology replaced the system of cams, levers, and driven pistons which previously simulated his heartbeat and pulse. The ability to speak, have abnormal breath sounds, and an interactive link to *UMedic®*, a multimedia computer curriculum in cardiology, were also added. Because of Harvey's® limitation to one body system, the model is considered to be a task trainer. A beginning price for Harvey® is about $60,000 with additional software teaching programs costing an additional $16,500 (Mordy & Leslie, 2007).

In order to determine the educational effectiveness of Harvey®, a study with 208 4th year medical students enrolled in 30 cardiology electives from five different participating medical schools was conducted (Ewy, et al,, 1987). One group of 116 students used the cardiology patient simulator (CPS), otherwise known as Harvey® during their elective while the other group of 92 students completed the elective without the simulator. Students who used Harvey® during their training worked independently in small groups with self-instructional slides as a substitute for a portion of the conventional bedside instruction involving patient contact. A 90-item multiple choice didactic pre-test (KR 20 = 0.65) and skills test on 2 cardiac conditions using Harvey® at the beginning of the course illustrated no statistically significant differences between the two groups. After completion of ¾ of the rotation, the students were post-tested with a parallel 90 item multiple choice test (KR-20=0.80), skills test on 2 cardiac conditions using Harvey®, and a bedside skills examination of two cardiology patients chosen for their availability, The scores from the multiple-choice tests and skills examinations were analyzed using a two-way analysis of variance (ANOVA). After the course, the students who used Harvey® were found to have achieved statistically significantly higher scores on a multiple-choice post test (CPS test mean = 60, non-CPS test mean 56.7; $p < 0.01$) as well as skills test on the CPS (CPS mean=68.2, non CPS mean= 58.6; $p<0.001$). It was determined that the skills learned with the CPS could be transferred to actual patient examinations and that patient-centered instruction could be enhanced by the use of the CPS simulator (Ewy, et al., 1987).

The London Helicopter emergency medicine services used low fidelity task trainers in high environmental and psychological fidelity settings to train emergency medical technicians without the prohibitive capital equipment cost of HPS (Bredmose, et al., 2010). These task trainers can be used for pre-hospital care training in different scenarios, such as extrication, splinting, hemorrhage control, and a variety of other procedures including intubation. Instead of the simulation scenario occurring in a controlled, replicated environment such as a simulation lab, the community environment is used for the training. The facilitators build psychological fidelity into scenarios so that the participant is immersed so deeply that they believe they are treating a real patient and experience a realistic level of stress. All scenarios use the same checklist for users that are used after true traumas occur. The author's rationale for using low fidelity simulators was due to the lack of published studies which have demonstrated a correlation between level of fidelity and effectiveness of the training at the time of the study (Bredmose, et al., 2010).

Integrated High Fidelity Simulators

Educators are now able to present students with more complex case scenarios with computer controlled high fidelity patient simulators. These scenarios allow students to hone their clinical skills as well as their critical thinking skills and knowledge. High fidelity simulation provides the student with an opportunity to bridge the gap between theory and practice (Comer, 2005; Fritz, Gray, & Flanagan, 2009; Morgan, Cleave-Hogg, DeSousa, & Lam-McCulloch, 2006). The 'hands on' approach with HPS allows the student to practice cognitive, psychosocial, and psychomotor skills in a realistic simulated setting without the potential to harm actual patients (Henneman & Cunningham, 2005).

The initial development of the first computer-based human patient simulator in 1967 (Sim One®) proved too expensive to produce extensively and was not well received (Grenvik & Schaefer, 2004). As computer technology progressed during the 1980's, Medical Education Technologies, Inc®. (METI) developed a human patient simulator that used sophisticated physiological and pharmacological software to mimic realistic responses to medical scenarios. This device was initially developed for anesthesiology education and provided the ability for respiratory gas exchange, anesthesia delivery, and patient monitoring with real physiological changes (METI, 2010). During the mid 1990's, Laerdal® developed SimMan®, which is a slightly less sophisticated high-fidelity simulator, but was more affordable (Bradley & Postlethwaite, 2003). Since then, pediatric and other patient simulators have also been developed and marketed to meet the demands of certain market areas. One example is Metiman®, which was developed specifically for nursing education and does not contain as many software capabilities or physiological capabilities as the simulator used for anesthesiology training. Several generations later and as technology progressed, both companies reinvented the software and physiological capabilities of their high fidelity models.

The Florida-based Gaumard® Scientific Company introduced Noelle®, an interactive female high fidelity simulator with one birthing baby and one interactive neonate (Noelle, n.d.). Noelle® was developed in 1999 to promote 'safe motherhood' (Sesneber International, 2010). This particular simulator can be programmed to duplicate various obstetric scenarios, such as shoulder dystocia, normal vaginal delivery, prolapsed cord, or fetal distress. Noelle® is being used in undergraduate nursing programs to help teach complicated deliveries, i.e. a woman who experiences disseminated intravascular coagulation after having a caesarian section (Robertson, 2006). Simulation scenarios using Noelle® allows the student to practice normal and complicated obstetrical nursing care. Student care can include performing prenatal chart reviews, admitting the patient and monitoring fetal heart rhythms, identifying abnormal fetal status findings, providing interventions, manipulating fetal position, and assisting with performing various types of deliveries (Gaurmard®, 2010). One weakness of Noelle® is the 'birthing baby' is not interactive and after delivery, nursing care must be switched to the interactive neonate. Noelle® is available for purchase from Gaumard® for approximately $38,000 per unit.

Nurse educators may select different types of simulation methods with different levels of fidelity to facilitate the students' understanding of nursing care concepts. Simulation methods may include the use of case studies, standardized patients, computer-based systems, software, virtual reality and haptic systems, part task trainers, or the recently introduced human patient simulator. Although simulation has been used in nursing education for close to a century, the use of high fidelity HPS is still evolving in nursing education, based partly on the facilitators and hindrances of use by nurse educators.

Facilitators and Hindrances

The literature exhibits some information on what nursing educators believe facilitates and/or hinders the use of HPS. In order to situate this literature into the context of the current study, the information will be reviewed in concert with the ten dynamic characteristics of Roger's *Diffusion of Innovation* theory as defined by Cain and Mittman (2002). These characteristics have been identified as relative advantage, trialability, observability, communication mechanisms, faculty characteristics, reinvention, social network, opinion leaders, compatibility, and infrastructure.

Relative Advantage

According to Cain and Mittman (2002), relative advantage is when the benefits outweigh the risks of using an innovation or when the innovation is better than what it replaces. Various examples of perceived advantages include improved economic profitability, prestige, convenience, or satisfaction. The greater the faculty member perceives the relative advantage to be, the greater the chance of the innovation diffusing among the adopters. The following factors specific to the characteristic of relative advantage will be discussed below: safety, clinical competency, team work opportunities, student satisfaction, and cost.

Safety. One of the most frequently cited relative advantages of using HPS in health care education is related to how well it maintains patient safety by allowing the students to practice their skills in a safe environment while also augmenting theory and clinical practice (Bearnson & Wiker, 2005; Beyea & Kobokovich, 2004, Hammond, 2004; Strouse, 2010). Patient safety continues to be a priority issue with patients, various health care facilities, accreditation organizations, and federal commissions (Decker, 2007a). Decker (2007a) argued that students should demonstrate specific competencies prior to engaging in patient care to ensure patient safety. In order to support her position, she used the four ethical principles of justice, autonomy, beneficence, and nonmaleficence to demonstrate the need for simulation in nursing education. The principle of justice was used to demonstrate how 'practicing' on patients is an unfair pedagogy and how simulation could be used to validate competencies and promote interdisciplinary teamwork prior to patient contact. Autonomy was used to illuminate the notion of how simulation can respect and address students needs, e.g. remedial instruction. The application of simulation in education can also be used to demonstrate the principle of beneficence, through assuring the competency of the health care provider and decreasing the overuse of local hospital services.

Simulation also allows the principle of nonmaleficence to be followed. According to Decker, a patient has the right to not incur any emotional, physical, and financial injury, yet medical errors continue to occur. The use of patient simulators can provide consistent scenarios for learning critical experiences. A HPS experience allows the student to critically examine event causes, circumstances, conditions, and other factors without causing harm to an actual patient.

Evidence related to improved consumer outcome has yet to be obtained from the airline industry or other high-hazard organizations where simulation has been utilized for a longer period of time, let alone in healthcare. Nursing scholars are in the initial stages of researching safe practice areas where students experience errors and other adverse events, such as failing to verify patient identification or allergies during medication administration (Henneman, et al, 2010).

In a recent retrospective study of student medication administration during a HPS nursing care interaction, 100% of the student participants either committed and/or failed to recover some type of rule-based medication error which would impact patient safety (Henneman, et al., 2010). Rule-based errors were described as inadequate habits and fell into four categories: coordination, verification, monitoring, and intervention. Videotaped simulation experiences utilizing two different critical scenarios were reviewed after informed consent was obtained from 50 senior nursing students in order to describe the types and frequency of errors that occurred during HPS exercises and described the types of errors recovered during an HPS exercise by the students.

The critical simulation scenarios, previously developed by the nursing faculty for senior nursing students, had intentional errors built into the patient care experience, e.g. an intravenous pump set at an incorrect hourly rate and a physician telephone order without the medication route. Two of the members of the research team reviewed the videotapes, recorded the data related to category of error and error recovery on their investigator-developed instrument and subsequently coded the types of errors within the four different categories. Inter-rater reliability between the two members of the research team was determined to be 95%.

Chi-square tests were used for the statistical analysis of the data with a preset alpha level of 0.05. After statistical analysis of the data, it was determined that all students committed at least one error, with an average of 4.08 errors for the trauma patient scenario and 4.8 errors for the patient with congestive heart failure scenario. Errors occurred in all categories of medication administration, but the most frequent and significant errors occurred during verification of the medication with the identification of the patient ($n=44$, 88%; $p< 0.001$) and identification of patient allergies ($n=34$, 68%,; $p=0.001$). Final analyses demonstrated that the students in both critical simulation scenarios were not able to recover errors that were present in the simulation cases. The patient could have experienced a myriad of complications had these nursing errors occurred in a clinical setting, from adverse reactions to death.

Clinical competency. Clinical skills, including critical thinking, can be repetitively practiced by the student on HPS until a defined level of competency can be acquired and demonstrated (Beyea, von Reyn, & Slattery, 2007; Bruce, Bridges, & Holcomb, 2003; Haskvitz & Koop, 2004). Nursing educators continue to struggle with a process to evaluate a student's nursing care performance during comprehensive scenarios. There are skills checklists available which can quantify a students' psychomotor technical performance (Morgan, Cleve-Hogg, DeSousa, & Tarshis, 2004); however, only recently have specific outcome measurement tools been designed and tested to determine if decision making and critical thinking are measurable with the use of simulation (Fero, et al, 2010; Gantt, 2010; Lasater, 2007).

Recently, Gantt and Webb-Corbett (2010) evaluated graduating senior student competencies in areas including blood administration, tracheostomy suctioning, and intravenous therapy. Using SimMan® techology, 204 nursing students were evaluated with a competency checklist after being randomly assigned to one of five 30- minute clinical scenarios. The scenarios required each student to complete 2 to 3 skillsets. The competency checklist contained established patient safety practices, such as hand washing, patient identification, and patient allergy verification before medication administration. Content validity for this checklist was not reported. Faculty members utilized the competency checklists to identify student actions as completed or failed to complete during the simulation. The completed checklists were used to guide the debriefing sessions with the students, with strengths and weaknesses shared with each student.

Findings with students in a single semester (N=84) revealed that students frequently omitted (61%) common patient safety practices, such as hand washing or proper patient identification procedures. Twenty-five percent of the students did not do either of the common safety practices during their simulation scenarios. Prior to the competency skills check off the following semester with a different group of senior students (N=110), an educational effort of reviewing basic patient safety practices by the faculty members was completed. Minimal progression in completing basic patient safety practices was measured with the second group of senior students with the competency checklists after the educational intervention. The results indicated that 48% of these students omitted common patient safety practices and 22% failed to perform several of them, illustrating some improvement in the number of omissions. Gant and Webb Corbett, (2010) support the idea that standards for performance should be clearly defined for certain competencies and students should repeatedly practice these skills in a simulation laboratory until a certain level of competency is observed in their performance.

Team work opportunities. HPS also offers opportunities for students in the healthcare discipline to practice as a team and to learn communication techniques between team members. Simulation allows team members to practice clinically challenging situations and links directly to their professional development and competence (Cannon-Diehl, 2009). Simulation provides scenarios to challenge teamwork skills, such as information gathering, communication, prioritization, and working effectively with others. With an overall goal of improving patient safety, team performance can readily be evaluated through performance debriefing (Gaba, 2006; Strouse, 2010). While working within the simulation environment, there is constant interaction between student team members as they share information and make decisions (Bearnson & Wiker, 2005). This is important for patient safety because the Joint Commission of Accreditation of Healthcare Organizations (as cited in Decker, 2007a) reported that communication breakdown between health care providers account for 76% of patient deaths (Decker, 2007a).

An example of a simulation implemented to improve team member communication and to assist with teaching scope of practice can be observed from a Minnesota Board of Nursing grant project (Simones et al, 2010). Nursing students within registered and licensed practical programs from three nursing schools were provided an opportunity to utilize concepts of delegation and supervision required of new undergraduate nurses. Nursing faculty from licensed, associate, and baccalaureate nursing programs partnered together to develop the simulation scenarios to help prepare the students for real world practice.

As part of the project, an evaluation rubric was developed to evaluate a team's performance related to scope of practice, delegation, supervision, teamwork, prioritization of care and communication. A second evaluation rubric was designed to evaluate his/her performance as the nurse. These rubrics were used during debriefing sessions to provide feedback about a student's individual and team performance. Validity and reliability of the evaluation rubrics were not established and modifications to the tools were recommended. Student and faculty anecdotal findings included satisfaction with working in a collaborative project to practice issues related to delegation and supervision in the real world environment where communication is important. Registered nursing students reported positive self evaluations pertaining to delegating, prioritizing, and communicating with team members. Licensed practical nursing students reported perceiving themselves as being efficient in completing assigned tasks and in working cooperatively with the registered nursing students. Similar simulation projects have been developed to improve and facilitate team work in health care, such as in operating rooms, intensive care units and emergency rooms (Fruscione & Hyland, 2010; Nickerson & Pollard, 2009; Weinstock, et al, 2005; Wolf, 2008).

Fruscione and Hyland (2010) described how nursing faculty and surgical technology professors at a community college utilized the simulation laboratory to teach an interactive simulated cholelithiasis operative experience to nursing students. The goal of the collaborative effort between faculty members was to create an operative scenario to provide students hand on training in preoperative, intra-operative, and postoperative processes of surgical patient care prior to participating in a true situation. With the use of simulation, the students were able to practice working together as a team, regarding different aspects of surgical care, including obtaining informed consent, transferring the patient care between teams, proper operative positioning, operative time-out, sponge count and other post anesthesia care procedures which could create a sentinel event. Through practicing these situations together, the two different healthcare providers learned how to communicate with each other while completing shared assigned tasks and benefited from observing the other providers responsibilities.

Student satisfaction. Students have frequently rated simulation experiences in a satisfactory manner and favor simulation as a method of learning (Bearnson & Wiker, 2005,; Childs & Sepples, 2006; Cioffi, 2001; Euliano, 2001; Feingold, Calaluce, & Kallen, 2004; Ravert, 2002; Wolf, 2008). Even though students were satisfied with the methods of HPS, there were no statistical differences noted in one study with student learning satisfaction when different simulation methods were used, i.e., HPS vs. standardized patient (SP) simulations (Walker 2008).

Walker (2008) compared perceived self-efficacy and learner satisfaction between 91 undergraduate nursing students in HPS and SP simulations in a descriptive post-test only study. The author developed and used the Likert type Self-Efficacy instrument, which was previously tested for internal consistency with a Cronbach's alpha of 0.927. She also used the Educational Session Satisfaction Likert scale developed by Dr. Mindi Anderson from the University of Texas at Arlington, which had also been previously tested for internal consistency with a Cronbach's alpha of 0.927. These tools were completed after the students completed care for postoperative simulation patients in a medical surgical course. A demographic tool was also completed. The tools were analyzed with descriptive statistics, *t*-test, and Fisher's exact test. In comparing the completed Educational Session Satisfaction surveys, there were no differences in learner satisfaction between the students completing the HPS laboratory experience (M=36.68, SD=5.75) compared to students completing the SP (M=36.45, SD = 5.67) t=-0.201, p = 0.841. In comparing the results from the self-efficacy surveys, students from the HPS group reported their self-efficacy, or belief in ability to respond and manage the situation higher (M=33.14, SD=4.74) compared to the SP group (M=31.16, SD=4.03) t=2.104, p=0.038.

Fountain and Alfred (2009) conducted a study in which student satisfaction with HPS and student learning styles were correlated. After completion of a cardiac dysrhythmia simulation, a convenience sample of 78 students, recruited from three campuses of a college of nursing, completed the National League for Nursing (NLN) Student Satisfaction and Self-Confidence in Learning Scale. Jeffries and Rissolo (2006) reported the Cronbach's alphas as 0.94 for the student satisfaction scale and 0.87 for the self confidence in learning scale. In this study, Cronbach's alpha for satisfaction was 0.91 and 0.84 for self confidence. The student's scores were then correlated with their learning style scores from their Educational Resource Institute Nurse Entrance Test (reliability information not provided) that was required prior to admission to the nursing program. Two learning styles were significantly correlated with student satisfaction: social learning ($r=.29$, $p=0.01$) and solitary learning ($r=.23$, $p = .04$). The researchers concluded that experiential learning opportunities with HPS increased the student's ability to synthesize critical content by engaging students in satisfactory learning activities while supporting their learning styles. HPS provides students of different learning styles the opportunity to internalize and apply the new information in a safe environment.

Cost. One of the main drawbacks of the relative advantage of HPS reported in the literature is related to the significant cost associated with the purchasing of and the subsequent upkeep of the simulation lab (Adamson, 2010; Harlow & Sportsman, 2007; Kurrek, & Devitt, 1997; Nehring, Ellis & Lashley, 2001; VanSell & Johnson-Russell, 2006). Simulation laboratories can cost up to, if not more than, $250,000; this cost is related to: (a) the initial purchase cost of the HPS and supportive equipment, (b) any renovation to an existing facility to make the simulation area more realistic, (c) the video and audio recording technology, and (d) supplies for student use, such as defibrillators (Parr & Sweeney, 2006). In addition, not all schools report maintaining an annual capital replacement budget for the HPS simulators or an operating budget to replace disposable supplies (Adamson, 2010).

Most economic reports regarding HPS focus on the initial capital investment a nursing school must make to build a laboratory, but fail to mention the annual operational investment required to sustain the use of the HPS laboratory. Adamson (2010) confirmed this when she reported that few schools in her state maintained an operational budget to maintain upkeep of their simulation program, with most schools reporting only the initial capital investment. It is important to note that software and certain hardware upgrades to previous HPS models can be purchased from the manufacturer at an additional cost to the university, which may exceed their resource capacities (Comer, 2005). Laerdal's customer service, as well as the other manufacturers, offers preventive maintenance and service contracts which could help defray costs in this area (Laerdal, 2010f). One new area of concern is that some of the manufacturers are now dating how long they will be carrying replacement parts and service for the older HPS models. Recognized as the sundown date by the biomedical field, motherboards and ram capacities of the computers in the older HPS systems have begun to age and will not be able to be replaced. Essentially, schools that have purchased and are using older models of HPS may run out of time for repair and replacement. They may find themselves in a position where they will have to expend from their capital budgets to repurchase new and reinvented HPS models to maintain their simulation programs. The cost of HPS does not end with the initial capital investment. These additional operational and reinvestment costs to the institution could hinder the school's use of simulation in the future.

Only one study was found that identified that calculated the cost benefit and effectiveness of a patient simulation center as a substitute to skills lab instruction for preparation of nursing students (Harlow & Sportsman, 2007). The center was a joint venture between two nursing schools and one hospital in the state of Texas and housed six Laerdal *SimMan*® mannikins. The goal of the study was to ascertain if cash savings from the use of patient simulators offset the cost of purchasing and setting up the center. Using a discounted flow methodology, it was determined that there were faculty cost savings, but that the investment costs at the time of the study outweighed the savings. Future proposed competency testing may become a requirement for licensure and this may offset some of the costs. While the results of this study sound unfavorable, they do not take into account the improved public interest and marketing potential that might occur as a result of the use of the patient simulator center. The authors identified that the use of the patient simulation center reduced the need to use real patients and reduced the risk to patient safety. It is unknown at this time how one can measure the positive social benefits that may accrue related to the use of simulation or how they can quantitatively be used to justify the cost. Some users of simulation have proposed that it may never be able to be measured (Gaba, 2006 & Lee, Grantham, & Boyd, 2008).

An earlier descriptive study was conducted to compare the cost benefit of a simulation suite used within a tertiary-care pediatric teaching hospital (Weinstock, et al, 2005). Specifically, the simulation center was used to increase exposure to various events for critical care physicians, nurses, and respiratory therapists with the purpose being to manage crises and improve team work. The pediatric simulator suite was constructed for $290,000. Leaders were selected and trained to run the HPS scenarios and to perform effective debriefing techniques. Over 1500 simulated patient encounters occurred during the year in the hospital for the different pediatric staff members. Annual orientation costs using the simulation center were equivalent to orientation costs without using the simulation center. This study appeared to demonstrate that hospital-based simulator suites may be more cost-effective after the initial capital investment compared to a school based suite.

Cost evaluation must include faculty and staff training and the time it takes to develop and administer courses (McLaughlin, Bond, Promes, & Spillane, 2006). A survey of emergency medicine programs to determine if HPS was used by their emergency residents revealed that only 29% utilized this training tool, even though the tool was available for use (McLaughlin, et al.). Reasons cited for the underutilization included faculty members being removed from the clinical environment to facilitate simulations, time to develop and administer courses, and other costs. HPS is a significant capital and operational cost to an organization and the organization must be dedicated to utilizing this educational strategy to recoup their investment.

The literature appears to demonstrate different relative advantage factors as facilitators for the implementation of HPS into nursing education. Simulation with HPS offers nurse educators ethical educational practices by allowing them to maintain patient safety while evaluating a student's clinical competency while performing patient care with different nursing concepts. Practicing in interdisciplinary team would also facilitate HPS implementation because practice with communication, as well as rehearsal would promote improved patient safety. Student's satisfaction with this instructional approach correlates with many of the student's learning styles. One factor of relative advantage which may hinder the implementation of HPS is related to the capital investment and operational cost of maintaining the HPS laboratory, which may exceed the school's resource capacity. The greater the benefits perceived by faculty members and students, the greater the chance HPS has of diffusing throughout nursing education.

Trialability

Uncertainties and anxiety with innovation risks and benefits are reduced and may be adopted more quickly when a consumer is allowed to try out an innovation without total commitment (Cain & Mittman, 2002). The lack of experience and observations of clinical simulation in other nursing programs prevent faculty from observing the benefits of the technology to students and the program. Trialability of the product allows the product to be modeled to future adopters.

Trialability is strongly associated with marketing of a new health care innovation. Early studies with diffusion illustrated that while advertisements created awareness of innovation, adopters required interpersonal contact. e.g., pharmaceutical companies marketing strategies where pharmacy representatives meet the physicians and provide samples of a new product compared to advertisements only being mailed to physicians (Greenhalgh, Robert, Bate, Macfarlane, & Kyriakidou, 2005). While there is no known research on 'trialability' of the HPS in nursing, there is information available about how

HPS has been marketed by different companies and how the companies have helped diffuse the technology into nursing education. Greenhalgh, et al. (2005) noted how most research in marketing is undertaken or commissioned by the manufacturers of particular products who are seeking to influence the behavior of others.

Manufacturers of HPS actively promote their hardware and software through demonstrations at various nursing conferences. As publicized through their simulator user forum, Laerdal® markets their HPS at multiple healthcare tradeshow or conference events, e.g., the American Association of College of Nursing semi-annual meetings, the National league for Nursing Education Summit, the Association of Military Surgeons of the United States, which now includes all federal health care agencies, and the National Association of Neonatal Nurses (Laerdal®, 2010d). METI®, Gamaurd®, and Harvey® are also generally used for demonstrations at the trade shows. Laerdal®, and METI® also offer training courses at their headquarters or onsite training at local facilities for those who have purchased the simulators.

Laerdal® has also recognized simulator centers that have exhibited consistent excellence in educational philosophy and have designated them as 'Centers of Educational Excellence.' The purpose of these regional centers is to "refer them as examples of the ways in which excellent educational programs are designed and implemented in the field of helping save lives" (Laerdal, 2010e). These centers are used to illustrate students' interactions with HPS. Research is lacking with respect to how triability facilitates and/or hinders the adoption of HPS in nursing education.

Observability

While early adopters were beginning to implement the use of an innovation, other potential users were observing their results. This is known as the dynamic characteristic of observability. Potential adopters are evaluating the relative advantage, the benefit, and safety of the technology through observation. The innovation is more likely to be adopted if positive relative advantages are seen. Dr. Jeffries (2006) and Dr. Nehring's (2001) early published research findings were one method for other users to observe the benefit and safety of the technology and are discussed below.

Opinion Leaders, Social Network, and Communication Mechanisms

These three critical dynamics of innovation diffusion are being discussed together because of the way they have interacted with each other over the past several years. Early adopters actively seek new ideas and advancements and can become opinion leaders and change agents for promoting the innovation (Cain & Mittman, 2002). Social networks are created and entered into for problem-solving and to accomplish common goals. These networks are used as communication mechanisms to move information from individuals who have knowledge and experience to those with limited or no knowledge and experience with the innovation (Greenhalgh, et al., 2005). Leaders within organizations can become opinion leaders and are critical to the diffusion of innovations because they create a cultural context that fosters innovation, and establish organizational strategies, structure and systems that facilitate innovation (Greenhalgh, et al.).

Instead of a social network, a professional network was developed between the NLN and Laerdal Medical in 2003 to engage in a three year, national, multi-site, multi-method project using simulation to encourage student learning (Jeffries, 2007). Eight NLN member schools were chosen for this project which was fully supported financially through a grant provided by Laerdal® (Laerdal®, 2010a). In addition to the development and testing of the teaching-learning simulation theoretical framework, student satisfaction and self confidence in learning with different types of simulation were measured. Data were obtained from 403 undergraduate students after the students completed a postoperative surgical simulation using the NLN Student Satisfaction instrument (α = 0.94) and Self-Confidence in Learning Scale (α = 0.87), which were developed and tested during this study.

Although there were no statistics released with the findings in the final report of this study, Jeffries and Rizzolo (2006) reported the findings as either 'significant' or 'not significant' in the summary report for the National League for Nursing and Laerdal® Medical project. No statistical values of significance were provided. Jeffries and Rizzilo reported that when comparing data between the three different types of simulation i.e., HPS, static mannequin, and case study, responses on the satisfaction scale revealed that the group using HPS had a significantly higher level of satisfaction with their learning experiences than did the students in the other two groups.

When comparing data between the three different types of simulation, responses on the Self-Confidence in Learning Scale revealed that students in the HPS and static mannequin groups had a significantly higher level of confidence about their care for a postoperative adult surgical patient compared to the case studies (Jeffries and Rizzolo). The study's primary conclusion was that students using HPS had a significantly higher level of satisfaction and self confidence and perceived a more active learning experience than the students in the other simulation groups; the researchers concluded that these findings were based on HPS utilizing more principles of best educational practice (Jeffries & Rizzollo, 2006). The endorsement of HPS by the NLN and its increased communication of the relative advantages through several different mechanisms can potentially speed the diffusion of HPS into nursing education.

As mentioned earlier in this chapter, METI's® simulator was the first simulator to be widely used in health care. Its use was limited to graduate medical education and nurse anesthesia due to the complexity and cost of the simulator. Nehring, an early opinion leader for HPS usage in undergraduate nursing education, began to focus her research on simulation in 2001 and developed the first theoretical framework for simulation called *Critical Incident Nursing Managemen*t in 2002 (Nehring, Lashley, & Ellis, 2002). Nehring's framework focuses on clinical characteristics and responses to a patient critical incident. Based on information from her publications, it appears that most of Nehring's early research was with the METI® simulator.

Jeffries, also an early opinion leader for HPS usage in undergraduate nursing education, began to focus her research on HPS at about the same time as Nehring. She developed her theoretical framework for simulation called *The Nursing Education Simulation Framework* (Jeffries, 2007) while directing and engaging in the NLN/Laerdal® study. Most of Jeffries' research was with the Laerdal® simulator.

Each of the theoretical frameworks have different characteristics and purposes for use within simulation research. At this time, Nehring is encouraging the use of HPS for competency testing on state board licensing examinations (Nehring, 2008).

While HPS research findings have been disseminated through various communication mechanisms in nursing, The HPS manufactures are now beginning to broadcast information of the innovation to health care consumers. On a national level, television is a primary communication mechanism for the public masses. HPS as a health care teaching instrument has been demonstrated to health care consumers on several television shows. *Metiman®* has been used on the television show, "The Doctors" (METI, 2009). The simulator was used for a hands-on demonstration of how to diagnose and treat victims of the H1N1 influenza virus during a pandemic. *SimMan 3G®* has been used on "Dr. Oz" to teach CPR basics for home emergencies (Winfrey, 2009). Through the use of HPS on medical-related television shows, the manufacturers are illustrating to the consumers their product's ability for use in health care education. Health care consumers' awareness through public communication of the availability of HPS for use in health care education, as well as the research and publications from the opinion leaders, will facilitate the implementation of the technology into nursing education.

Faculty Characteristics

Nurse educators share similar characteristics, goals, beliefs, and mutual understandings. Professional nursing education guidelines and state mandates help ensure the educator's competence, including the ability to apply instructional strategies, and program development and evaluation. Although faculty members share similar characteristics, differences, such as teaching at different degree levels or holding different degree levels of professional nursing, may influence their acceptance and use of HPS. Anecdotal evidence indicates that nursing faculty members have different comfort levels with HPS and that the technology may be underutilized (Adamson, 2010; Childress, 2006; Medley & Horne, 2005).

Limited studies have demonstrated faculty concerns or thoughts regarding the use of HPS in undergraduate nursing education. In one of these studies, factors contributing to the limited use of HPS were investigated in a two phase interventional study of faculty members who taught in an associate level program from the southeast portion of the United States when it was recognized that over one million dollars of HPS technology was rarely used (King, Moseley, Hindenlang, & Kuritz, 2008). During Phase 1 of the study, an electronic 47-item Likert-type scale was utilized to survey the faculty regarding their use and intention to use HPS as a teaching tool. The survey, *Faculty Attitudes and Intent to Use Related to the Human Patient Simulator*, was developed by the researchers. Eight items measured faculty's beliefs, nine items measured perceived behavioral control, and two items measured behavioral intent to use, with other items deriving demographic and qualitative data. No reliability or validity information was reported for the Phase 1 instrument, although two experts reviewed the instrument for content validity.

Thirty-four associate faculty members (N=34) from one school of nursing responded to the electronic survey. Analysis of the Phase I data, which utilized the framework of the Theory of Planned Behavior, indicated that 62% (n=21) of the faculty had no prior hands-on HPS training, yet 68% (n=23) reported that they had used the HPS during the previous academic year. Seventy three percent (n=25) had not attended any type of educational program on HPS. Even though most had no training or experience with HPS, they believed that HPS was an effective teaching strategy and provided realistic patient care experiences. Phase 1 findings indicated that the faculty members' intent to use HPS (M=4.2) was more positive than their attitude (M=3.9) and perceived behavior control (M=3.9). Qualitative data included statements about advantages, e.g. safe learning environment and promotion of critical thinking as well as disadvantages of HPS, e.g. lack of support from lab personnel and education.

To help facilitate faculty members' use of HPS, King, Moseley, Hindenlang, & Kuritz, (2008) developed an educational program as an intervention based on the assumption that the absence of formal training was a factor in the faculty participants' lack of competence and comfort. Prior to this intervention, 16 of the original 34 participants chose to attend the interventional educational program and continue with the study. These participants completed the 24 item, *Phase II: ADN Faculty HPS Pre-Educational Program* electronic survey. The educational program included methods of facilitating reflective debriefing, how to operationalize HPS into clinical course work, and structuring the HPS clinical experience. After the educational intervention, participants completed *Phase II: Faculty Post-Educational Program Survey on the Human Patient Simulator.* The two Phase II instruments were similar to the Phase I instruments, with the exception of the qualitative questions from Phase I which were purposefully omitted. Attitude scores from Phase 1 (M=3.9) improved significantly after the intervention in Phase 2 (M=4.6, SD 0.44), $t(15) = -0.5$, $p = 0.001$. Perceived behavioral control scores from Phase 1 (M=3.9) improved significantly after the intervention in phase 2 (M= 4.2, SD=0.34), $t(15)$=-0.-4, $p <0.001$). Comparison of the time-specific measures of the behavioral intention were not significantly different (p=0.07). Comparison of the general intention was statistically significant at the0.02 level. Cronbach's alpha within the factors ranged from 0.56 to 0.82, which was considered acceptable due to the sample size and the explorative nature of the study. Formal training for faculty along with assistance in obtaining experience has been identified as one area for faculty members to have improved feelings of comfort and competence with the HPS. Improved faculty members comfort could potentially improve a college's utilization of HPS (King, et al.).

A study demonstrating the concerns of faculty members in Washington State who taught only at the associate degree level was recently conducted. The associate level nurse educators' opinions were examined to determine the barriers, facilitators, and incentives for integrating HPS into nursing curricula (Adamson, 2010). This descriptive study utilized electronic surveys to collect data in order to facilitate increased geographic diversity of the sample and to reduce the expenses of recording, transcribing, and then analyzing the data.

Faculty members (N=24) were asked to identify conditions that facilitated and/or acted as barriers to integrating simulation into the nursing courses in which they taught. The participants were also offered an opportunity to recommend incentives and resources that would help faculty members facilitate the use of HPS into their courses. Common barriers to integrating simulation into nursing courses identified by the faculty members who taught at the associate level included: (a) lack of time, especially for preparation and planning for simulations; (b) lack of support, including administrative and technical; and (c) lack of appropriate equipment, including accessories such as cameras, scenarios, and/or medical equipment. Common facilitators to integrating simulation into the nursing courses included: (a) training in the use of simulation, (b) individual initiative and motivation to learn and use simulation, (c) adequate facilities and simulation equipment, and (d) support from colleagues and administrators. Faculty from the schools recommended: (a) additional paid time for learning the technology, designing scenarios, and running simulations; (b) additional training; and (c) additional resources, including money, equipment, and technology support staff, as incentives for improving the integration of HPS into the curricula. This study demonstrated concerns of associate level nurse educators who used HPS at their facilities. Baccalaureate nurse educators were not included in this study.

One method created by the NLN which can assist and support faculty members' integration of simulation into their curricula is through the Simulation Innovation Resource Center (SIRC) that can be found on the Internet (S.I.R.C., 2010). This particular site offers nine different online training courses for an educator to review and resources (i.e., funding, research, annotated simulation bibliography, etc.), as well as a user forum for those seeking answers to questions that may have already been answered by early adopters. The NLN developed this site in collaboration with Laerdal® who was instrumental in providing financial support and identifying global project partners to incorporate international perspectives into the course content and website (Hovancsek, et al., 2009). Other online support centers can be found at the Laerdal®, METI®, and Gaumard® Internet sites. Whether it is a formal educational program or an informal online program such as the use of a forum, faculty development and support in the use of simulation is imperative for the success of the program (Childress, 2006 & Medley & Horne, 2005).

Reinvention

Today's consumers of education have higher expectations of healthcare and nursing education is evolving into more complex roles with fewer resources (Cannon-Diehl, 2009). In response to the evolving environment in healthcare and technology, HPS has evolved and been reinvented. Technology improvements have facilitated the versatility and usefulness of the various HPS simulators. As observed in the previous discussion of Resusci Anne® and Harvey® simulators, the mannequins are now lighter, more maneuverable, have increased true joint movement, and can be controlled from a laptop from several rooms away (Mordy & Leslie, 2007; Vnuk, Owen, & Plummer, 2006). Through the recent release of Laerdal's Simman 3G®, students can choose to give intravenous medications during a scenario and the debriefing software will evaluate if the medication was given appropriately (Laerdal©, 2010b). Mannequins can respond verbally to the student's questions via a faculty member through a remote microphone. The evolved mannequins, along with their reinvented software programs, are assisting with determining the clinical competence and performance of nursing students. No research could be found that related to how the newer HPS technological advances have been more successful than the older HPS with respect to student outcomes. Reinvention of the HPS will facilitate the implementation of the technology into nursing education because it improves the educator's measurement of a student's clinical competency while decreasing the complexity of operating the HPS by the faculty member.

Compatibility

Cain & Mittman (2002) maintain that for the diffusion of the innovation to occur among potential adopters, the innovation needs to be compatible with the value system and needs of the adopters. While faculty members may have multiple values, their overall goal for a student is to see them be successful with their education and HPS have characteristics that make it compatible to use for student education. The following elements, as they relate to compatibility, will be discussed further: (a) debriefing and (b) improved clinical judgment.

Debriefing. One reason why many faculty members believe HPS is compatible for undergraduate nursing education is how the debriefing period following the simulation scenario allows the student to reflect on his/her provided nursing care. This is one of the most frequently cited strengths of simulation with HPS, with some researchers and participants believing this is the most important educational practice of the simulation experience (Childs & Sepples, 2006; Gordon & Buckley, 2009; Haskvitz & Koop, 2004; Parker & Myrick, 2010). The simulation performances are usually video recorded with debriefing software provided by the HPS manufacturer. Faculty members facilitate the debriefing conference after the simulation has occurred so that the student can reflect on the effectiveness of their nursing management of the clinical encounter (Jeffries & Rizzolo, 2006; Morgan, Cleave-Hogg, Desousa & Lam-McCulloch, 2006).

A debriefing conference provides time for faculty and students to reexamine the simulated clinical encounter. Students are encouraged to describe their strengths and areas for improvement after watching their actions during the scenario. Rationale for clinical decisions along with suggestions for different actions can be described. Mistakes can be identified for further remediation. Communication and interaction between participant team members can be evaluated. It is not a time for belittling, but rather a time for the student to recognize and come to terms with their developing clinical reasoning and judgment skills raised by the simulation (Kuiper, Heinrich, Matthias, Graham, & Bell-Kotwall, 2008). There are five defining attributes of debriefing after a simulation: (a) reflection, (b) emotion, (c) reception, (d) integration, and (e) assimilation (Dreifuerst, 2009).

Decker (2007b) considers reflection to be an essential element for simulation education and describes the process as an active self-monitoring process where the student discerns new knowledge to be applied to future situations during or after the experience. It is a period where the faculty member can facilitate the students' reexamination of the clinical experience and the thinking processes that took place for the decisions that were made. Nursing faculty assist the students to express their emotional responses during the time of debriefing since the student may cross the boundaries of simulation and internalize these simulated scenarios as reality. The emotions of the situation help embed the learning experience into the student's memory (Dreifuerst, 2009).

Although not a research study, Parker & Myrick (2010) explored the importance of the debriefing phase of the simulation learning experience in encouraging critical reflection through the transformative learning theory by Mezirow. According to Mezirow (as cited in Parker & Myrick), transformative learning theory advocates today's adult learners need to develop the ability to become an independent autonomous thinker. HPS based simulated scenarios present students with disorienting dilemmas, which challenges the student to transform "perspectives into new ways of interpreting phenomenon suddenly, or in some instances, gradually; affect values, beliefs, and previously held assumptions..... to alter their frames of reference" (Parker & Myrick, 2010, p. 328). Discussion of the student's experience after a simulation experience allows understanding and transformation of learning. Improved debriefing mechanisms, e.g., videotaping, with simulation will help facilitate the implementation of HPS into nursing education because this method has been used extensively in the clinical setting in the past and is compatible with nurse educators' educational practices.

Improved clinical judgment. Another reason why many faculty members believe HPS is compatible with undergraduate nursing education is that it can be used to evaluate a student's clinical judgment and provision of nursing care in order to potentially improve that student's clinical judgment. Multiple simulation studies have been performed to determine the effectiveness of improving critical thinking/clinical judgment with HPS in undergraduate nursing and medical education over the past few years (Alinier, Hunt, Gordon, & Harwood, 2006; Morgan, Cleave-Hogg, Desousa, & Lam-McCulloch, 2006; Steadman, et al, 1999). The initial studies used one group experiments that were evaluated with pre- and post-test questionnaires with the scenario-based simulation training acting as the intervention for knowledge gain (Alinier, et al, 2006; Morgan, Cleave-Hogg, Desousa, & Lam-McCulloch, 2006).

More recently, students' clinical judgment skills have been evaluated during the HPS simulations through grading rubrics designed for that purpose, e.g, the Lasater Clinical Judgment Rubric (LCJR). Instead of focusing solely on skill competencies, grading rubrics are beginning to be utilized and evaluated by nurse educators to assess a student's clinical judgment and/or critical thinking during simulation scenarios (Blum, Borglund & Parcells, 2010; Dillard, 2009; Gantt, 2010; Lasater, 2007).

The LCJR was developed as part of a larger mixed methods exploratory study design (Lasater, 2007). Four groups of 12 students (N=48) in a baccalaureate nursing program participated in the HPS study and utilized laboratory time in lieu of their clinical practicum during a single semester term. During each simulation laboratory experience of 12 students, four groups of 3 students (n=12) participated in a scenario, with 1 student serving as the primary nurse with ultimate patient responsibility. The rubric was developed and refined at the beginning of the semester and then used mid-semester to score students' clinical judgment skills (n=26). Descriptive statistics and ANOVA were used to examine five independent variables for any significant influence: (a) day of the week, (b) time of day, (c) scenario order, (d) small team composition, and (e) size of the small groups. Lasater reports there were no statistically significant findings for the five independent variables above and related this to the small sample size. The mean clinical judgment skill score for the students engaged in the primary nurse role was 22.98 points, with an observed range of 5 to 33.

Focus groups were subsequently conducted. Five themes emerged from the focus group discussion, including (1) strengths and limitations of high-fidelity simulation, (2) the paradoxical nature of simulation, (3) an intense desire for more feedback about their performances, (4) the importance of students connection with others and (5) recommendations for improved facilitation.

Reasons for utilizing LCJR as identified by Lasater included improved communication with students about clinical judgment concepts in a language that is understood by both faculty and students. Another facilitating reason to use the rubric was that the rubric provided standards that students could understand. Lasater acknowledged that further study is needed to observe if the LCJR grading rubric could have a valid place in the clinical setting to help develop and evaluate a students' clinical judgment component of clinical competency.

Gantt (2010) conducted a pilot study using the Clark Simulation Evaluation Rubric (CSER) with associate and baccalaureate degree nursing students and found that the tool could be used with or without a skills checklist. The CSER allows the nurse educator to capture more contextual and critical thinking components through pairing Benner's five levels of nursing experience (Benner, 1984) with Bloom's six cognitive domain categories (Bloom, Englehart, Furst, Hill, & Krathwohl, 1956). Through the use of the two education theories, the educator who is evaluating the student can choose a level of performance for specific observable behaviors. Critical thinking components being evaluated include areas of assessment, history gathering, critical thinking, communication, patient teaching, and recognition of necessary diagnostic studies. Interrater reliability for the CSER has yet to be established, yet various uses have demonstrated reliability estimates ranging from 0.29-0.31 for staff nurses to 0.64-0.74 for nursing students.

For Gantt's pilot study, associate degree seeking students (n=69) were evaluated during an obstetrical simulation laboratory and baccalaureate students (n=109) were evaluated during a medical-surgical simulation laboratory using the CSER (N=178). Since the associate faculty members and students were using the CSER in conjunction with the HPS laboratory as a pilot project, no definitive passing score or level was determined for this group of students. The senior baccalaureate students were scored with the CSER. If the baccalaureate students scored less than 80 (M=74), they repeated the simulations.

Conclusions drawn by Gantt (2010) from the pilot study for best practice while using a grading rubric included: (1) establishing grading reliability with the rubric, (2) determining what constitutes a passing score, and (3) determining adequate student performance. Another conclusion drawn was that the rubric was best used to evaluate individual students only and would not be reliable with group evaluations, e.g. team work scenarios (Gantt, 2010). Several limitations noted with the CSER in the study included: (1) the subjective, interpretive nature of Bloom's verbs which makes scoring difficult, (2) faculty members inability to place students in definite categories, and (3) the overlap of some categories. As Gantt (2010) noted student evaluation and grading of performance during and after a simulation may require several different tools and one tool may never be sufficient. Even though grading rubrics move education closer to being able to evaluate the critical thinking component of a students' clinical competency, the system is not yet perfect. Faculty members continuously seek methods to objectively measure critical thinking and clinical decision making skills. While instruments for measuring critical thinking skills during simulation are under development, until they have been repeatedly tested and communicated to nurse educators, the scarcity of measuring tools may hinder the implementation of HPS into nursing education.

Kuiper, et al. (2008) described a descriptive study which was conducted to determine if the Outcome Present State-Text Model (OPT) of clinical reasoning worksheets could be used as a method of structured debriefing following an HPS simulation. The OPT model of clinical reasoning is used to facilitate the clinical reasoning and reflective processes that students use. Students (N=44) in an adult health medical/surgical course completed 5-6 OPT worksheets after authentic clinical experiences and one simulation OPT model worksheet after a 4-hour patient simulation scenario. The OPT worksheets were used throughout the various scheduled clinical days to develop a patient care plan. Clinical faculty members provided feedback on patient care components of the OPT worksheets to improve the student's thinking responses on subsequent clinical assignments by directing the student's cognitive activities in specific content areas.

Clinical OPT worksheets were subsequently compared to the simulation OPT worksheets that the students completed after the medical-surgical simulation scenarios. Previously reported inter-rater reliability of the OPT worksheets was significant (Kendall's coefficient: W=0.703, X2 (24) = 0.573, p = 0.000). Student scores on the clinical OPT worksheets (M=47) illustrated no statistically significant differences from the simulation OPT worksheets (M=48), t=-1.321, p = 0.194. A paired samples t-test comparing the scores revealed no statistically significant differences between clinical experience and HPS (t=-0.680, p=.504). The OPT model worksheet used with the simulation allowed a method for students to review their clinical reasoning activities during the simulation and promoted reflection. Placing the information into a conceptual framework allowed the student to assimilate the knowledge, skills, and attitudes into practice where it could be used for future patient care (Kuiper et al, 2008). This instrument illustrated no differences in planning for nursing care between clinical and simulation experiences.

New graduates must demonstrate safe patient care and clinical competency with critical thinking and effective interventions (Fero, et al, 2010). In a recent quasi-experimental, cross-over design study with a convenience sample of 36 final semester nursing students, the relationship between metrics of critical thinking skills and performance in simulated clinical scenarios was measured. Several instruments were used for this study including: (a) the California Critical Thinking Disposition Inventory (CCTDI), (b) California Critical Thinking Skills Test (CCTST), and (c) a Videotaped

Vignettes (VTV) and/or High-Fidelity Human Simulation (HFHS) assessment tool (Fero, et al, 2010).

The CCTDI is a 75-item Likert-type attitudinal survey which measures critical thinking habits and has an established reliability alpha coefficient of 0.90 (Fero, et al, 2010). The CCTST has 34-items and measures an individual's ability to draw conclusions in the area of analysis, inference, evaluation, deductive, and inductive reasoning and has an established reliability of 0.78 using the Kuder Richardson-20 (Fero, et al, 2010). The VTV/HFHS assessment tool was developed by Fero, et al, to assess simulation-based performance. The VTV/HFHS tool is used to rate a nursing student's knowledge and performance in six areas including: (a) recognizing the clinical problem, (b) reporting of clinical data, (c) initiating nursing interventions, (d) anticipating medical orders, (e) providing rationale to support decisions, and (f) prioritization of care. Performance for these six areas are rated as either met or not met expectations by the researcher.

At the beginning of the study, students were asked to complete the CCTDI and the CCTST. The students were then separated into two different groups, with the first group observing a video of an actor displaying signs and symptoms of a pulmonary embolus. The group was then given 10 minutes to write a plan of care for the patient. The second group of participants was given 10 minutes to provide care to an HFHS who also displayed the signs and symptoms of a pulmonary embolus. The two groups then switched to the other's assignment and the VTV and HFHS assessment forms were completed by the researchers.

The Fleiss crossover binary response chi-square method was used to compare VTV and HFHS simulation performance scores. The relationship between critical thinking disposition and skills and simulation-based performance scores utilized Cramer's V statistic. During the study, most of the participants (75%) did not meet performance expectations with either VTV or HFHS. Although there were no overall statistically significant differences between VTV and HFHS performance ($p=0.277$), more students initiated nursing interventions in HFHS ($p<0.001$). While it was observed that there was a statistically significant relationship between critical thinking scores and use of HFHS, it is unknown as to whether the critical thinking lessons learned with HFHS could be transferred into actual practice. One implication from the study was that the VTV/HFHS assessment form could be used to assist in identifying a student's clinical competence with critical thinking for nursing care, including problem recognition, reporting of essential data, initiating appropriate nursing interventions, anticipating medical orders, providing rationale, and prioritizing.

One potential incompatibility noted for using HPS is the potential for negative transfer or learning (Lee, Grantham, & Boyd, 2008). Negative transfer of learning could occur if the student learns something incorrectly due to an imperfect simulation which can occur if the instructor fails to make clear the differences between training and a real situation. This can occur if either environmental or equipment fidelity is portrayed incorrectly or not identified to the student, such as the incorrect feel of a vein for venipuncture. Scenarios may be artificially accelerated which could also imprint incorrect clinical practice and clinical judgment. One method of preventing this is to have a knowledgeable narrator/director to ensure that the correct message is received by the learner (Grantham, 2010). Negative transfer of learning while a student is developing their clinical judgment skills would not be compatible with a faculty member's goals and could potentially hinder the implementation of HPS in nursing education.

The literature appears to demonstrate two compatible factors of HPS which would serve to facilitate its implementation into nursing education, namely, that HPS offers students opportunities to reflect on their practice with debriefing and offers faculty members methods to evaluate students' clinical judgment and critical thinking skills which can be used during debriefing sessions to facilitate student reflection. One hindrance factor of compatibility relates to the potential for negative transfer of learning, yet no nursing studies were found to support this assumption. As greater evidence of compatibility is demonstrated through research, the greater the chance HPS has of diffusing through nursing education.

Infrastructure

For HPS to be successfully adopted and implemented there must be an existing infrastructure within the college that can facilitate and help sustain its function in education. The presence of certain facilitating infrastructure features found as anecdotal notes in the literature include support resources, such as a laboratory coordinator or facilitator who would oversee the technical components of the simulation lab (King, et. al., 2008, Tuoriniemi & Schott-Baer, 2008) and the need for laboratory space and audiovisual equipment Jeffries (2008).

Adamson (2010), as previously noted with her research in which she described faculty characteristics, indentified infrastructure items that facilitated and/or hindered faculty use of HPS in one state. Common infrastructure barriers to integrating simulation into nursing courses identified by the faculty members who taught at the associate level included: (a) lack of support, including administrative and technical and (b) lack of appropriate equipment, including accessories such as cameras, scenarios, and/or medical equipment. Common infrastructure facilitators to integrating simulation into the nursing courses included adequate facilities and simulation equipment. This was a survey study, with no ranking or consensus identified. No Baccalaureate faculty members' opinions were included in this research study.

The literature appears to demonstrate different compatibility characteristics as facilitators for the implementation of HPS into nursing education. The use of HPS offers nurse educators' opportunities to debrief students after a simulation scenario, which encourages the student to reflect on the effectiveness of his/her, provided nursing care and management of the clinical encounter. Debriefing allows understanding and transformation of learning to occur in today's adult learners. Simulations also allow faculty members a method to evaluate a student's clinical judgment in order to potentially improve that student's clinical judgment. Instruments for evaluating a student's clinical judgment are presently being piloted and implemented. Compatibility characteristics which may hinder the implementation of HPS are related to the potential for negative transfer of learning and evaluation instruments being in their infancy. The more compatible HPS is perceived by faculty members with their values, the greater the chance HPS has of diffusing through nursing education.

Literature Summary

Cain and Mittman's (2002) Diffusion of Innovations in Health Care, based on Roger's Diffusion of Innovation theory, was utilized to analyze and frame the literature regarding the use of HPS technology. The theory provided concepts which were linked to facilitating and/or hindering characteristics of HPS use in undergraduate nursing education. Research related to HPS could not be found for some of the provided concepts of the theory, e.g. opinion leaders and others were limited, e.g. faculty characteristics.

Rourke, Schmidt, & Garga (2010) identified only 20 empirical reports which utilized theory to inform our understanding of high fidelity simulation use in nursing education after reviewing the Cumulative Index of Nursing and Applied Health literature and Proquest Dissertations from 1989 to 2009. The level of evidence for simulation needs well-designed and clinically important studies to facilitate its acceptance as an educational practice (Melnyk, 2008).

Simulation has been used in nursing for close to a century, with the level of fidelity increasing with each reinvention of the different simulator mannequins. Initially, Mrs. Chase was the first simulator patient developed a century ago with bendable hips, elbows and orifices for basic skills. Resusci Anne® and Harvey® followed Mrs. Chase and were both developed 50 years later to allow more invasive procedures. Most recently, HPS has arrived in nursing education, with mannequins that can talk and react in a manner similar to a true patient. In the foreseeable future, holodeck nursing education may actually become reality.

Simulation with HPS appears to be facilitated with the dynamic characteristics of the innovation including: relative advantage, faculty characteristics, communication mechanisms, social network, opinion leaders, and compatibility. Patient safety, team work possibilities, and student satisfaction are all relative advantages for using HPS. Faculty members share many similar characteristics, yet may still be very different in how HPS is perceived. Nursing scholars are actively involved in performing research and publishing their findings, as well as publishing the different mechanisms for utilizing HPS. Yet, as of 2010, only 20 articles based on theory were identified in the literature pertaining to HPS in nursing education. Nursing education's opinion leaders are needed to perform research, publish, and provide support and encouragement to faculty members who are considering adopting the innovation. Debriefing and clinical judgment provided by the HPS are compatible with faculty values.

A gap exists in the literature, with no opinions from educators who teach at the baccalaureate level explored or from those faculty members who do not have HPS as to what they believe facilitates and/or hinders implementation of HPS into nursing education. There is limited research on the use of HPS based on theoretical concepts. This study has helped to fill some of those gaps.

Chapter Summary

This chapter reviewed literature as it relates to simulation. Not only were definitions of simulation reviewed, but the different types and uses of simulation in nursing education were examined. What has facilitated and hindered high-fidelity simulation were reviewed. The literature review was deconstructed into the following components: (a) stimulation defined, (b) the history of simulation, (c) the types of simulation, including its use in case studies, standardized patients, computer-based systems, software programs, virtual reality and haptic systems, part task trainers, and integrated high fidelity systems. The section on literature pertaining to facilitators and hindrances related to simulation was organized utilizing Cain and Mittman's (2002) critical dynamics of health care innovations based on Roger's Diffusion of Innovation Theory characteristics including: (a) relative advantage, (b) trialability, (c) observability, (d) opinion leaders, (e) social network, (f) communication mechanisms, (g) faculty characteristics, (h) reinvention, (i) compatibility, and (j) infrastructure.

CHAPTER III

METHODOLOGY

Procedure for Collection and Treatment of Data

The primary purpose of this study was to determine if there was consensus opinion among nursing educators of what has facilitated and/or hindered implementation of HPS in undergraduate education within the state of Texas. The normative (real-time) form of the Delphi technique was used as the research methodology. Through a structured group communication process of questionnaires and controlled feedback, the most reliable consensus of expert opinion can be obtained regarding a complex problem using this methodology (Linstone & Tuloff, 2002; McKenna, 1994). Summarized reorganization of individual faculty member's views of the HPS's dynamic characteristics provided the panel members a method to collectively agree on HPS characteristics that have facilitated and/or hindered its implementation, as well as determining reasons for any disagreement.

Research Design

A mixed methods design, which is a combination of data collection and analysis procedures in parallel or sequential phases (Halcomb & Davidson, 2006), was used as the research design for this study. This research design is different from purely qualitative or quantitative designs in that a combination of both designs are used to provide a sense of 'confirmation' of the data through "the enhancement of validity and confidence in the findings and a completeness of the understanding of the concept(s) under investigation"

(Halcomb & Davidson, p. 40). The qualitative component of the methodology provides depth of understanding and insight into the phenomenon, while the quantitative component provides casual links within the data through statistical generalizations (Stewart, 2001). The Delphi technique is considered to be a mixed-methods research design (Valdez, 2009). Through an integration of both qualitative and quantitative methods, the technique was used to gather information and ideas and then, through a specific sequence, was used to determine if there was a consensus of opinion (Pearson, 1997).

Delphi Technique

The normative (real-time) Delphi technique is a particularly useful methodology when there is little knowledge or uncertainty surrounding the area being investigated (Hardy, et.al, 2004). The technique allows the investigator to tap the knowledge, expertise or opinions of a category of people who have that knowledge and expertise (Mead & Moseley, 2001a; Mead & Moseley, 2001b). It is a progressive, systematic methodology used to solicit and refine expert opinion with the goal of obtaining a combined or consensual position (Beech, 2001; Bowles, 1999).

The Delphi technique was originally developed by the Rand Corporation in California during the 1950s as a structured process, in an attempt to "eliminate interpersonal interactions as the controlling variables in decision making as usually happens when groups of experts interact in meetings" (Goodman, 1987, p. 729). The methodology was initially used with 7 expert members regarding the effects of strategic atomic Russian bombing of industrial targets in the United States. Dalkey and Helmer

(1963) argued that the use of the Delphi technique facilitated group discussion and decision making and long-range planning could be undertaken with confidence. The original intent of using the classical Delphi during this time was as a forecasting technique and involved “the repeated individual questioning of the experts to avoid direct confrontation of the experts with one another” (Dalkey & Helmer, 1963, p. 458).

While forecasting is one form of the Delphi technique, there are other forms for use in research (Jairath & Weinstein, 1994; Yousuf, 2007). The policy form of the Delphi technique allows strongly opposing viewpoints and ideas on a policy issue to be generated from the participants in order to identify differing opinions and expose the range of positions (Bjil, 1992; Crisp, Pelletier, Duffield, Adams & Nagy, 1997; Mease, Arnold, Crofford, Williams, Russell, et al, 2008; Rayens & Hahn, 2000). Another particular useful form of the Delphi technique for educational use is the normative (consensus/conventional) form, which "gathers the opinions and views of a defined group of experts on clearly specified issues, with the aim of achieving consensus” (Osborne, Ratcliffe, Collins, Millar, & Duschl, n.d., p. 19). This form is frequently used for curriculum planning and development (Petrina & Volk, 1992; Smith & Simpson, 1995). The real time Delphi, which was used for this study, is a simplified conventional Delphi used to gather information and build consensus through the use of teleconferencing, electronic mail, and other interactive networks (Jairath & Weinstein, 1994).

Linstone and Turoff (as cited in Yousuf, 2007) argued that the Delphi technique has applications in several areas (e.g., the planning of university curriculum development) and allows the educator to communicate needs and other factors related to a particular area of education. Strengths associated with the Delphi technique allow for organization and clarification of views in an anonymous way (Linstone & Turoff, 2002; Rieger, 1986). Nursing and medicine have welcomed the Delphi technique as a research methodology and are utilizing it for (a) developing competency standards for renal advanced practice nursing and health promotion in community health nursing (Bonner & Stewart, 2001; Irvine, 2005), (b) developing legislative policies regarding tobacco use (Rayens & Hahn, 2000), (c) determining research priorities for palliative care nursing, parenting and child health, nursing administration, and midwifery (Chang & Daly, 1998; Hauck, Kelly, & Fenwick, 2007; Lynn, Layman, & Richard, 1999; McCance, Fitzsimons, Keeney, Hasson, & McKenna, 2007), (d) assisting with education development (French et al, 1996; Last & Fulbrook, 2003), and (e) determining best evidence based practice for culturally competent care and palliative sedation (Kim-Godwin, Alexander, Felton, Mackey, & Kasakoff, 2006; Morita, Bito, Kurihara, & Uchitomi, 2005). The Delphi technique is frequently used when there has been minimal work in a topic area or in a policy-making arena when there are issues that may be uncertain or need to be prioritized (Goodman, 1987). Due to HPS simulation use in nursing education being in its infancy with uncertain issues, Hovancsek (2007) has implored nurse scholars to help establish simulation as a sound form of education through research.

A series of questionnaires or rounds using a special sequence are employed to gather and to provide information to the expert panel until consensus is reached with the Delphi technique (Keeney, Hasson, & McKenna, 2001; Mead & Mosely, 2001b). The technique may be modified in different ways to fit a particular research question and can include up to six steps: (a) selecting the expert panel, (b) formulating the question, (c) statement generation, (d) reduction and categorization, (e) rating, and (f) analysis and iteration (Mead & Moseley, 2001a, p. 13). This six-step approach was used for data analyses for this study.

Participating research members are chosen according to relevant but fixed criteria and become part of an expert panel (Mead & Moseley, 1996). Through the Delphi technique, a group of geographically dispersed experts on specific issues can discuss and generate a consensus opinion in a cost- and time-efficient manner (Keeney, Hasson & McKenna, 2001). Questionnaire responses from the expert panel can be obtained through a variety of mechanisms including traditional mail, telephone, and/or electronic mail (Marsden, Dolan, & Holt, 2003; Meho, 2006; Rayens & Hahn, 2000). More recently, some investigators have used online survey sites as a method for collecting data with the Delphi approach (Zeigler & Decker-Walters, 2010), which this study employed.

There are three basic data collection stages for the Delphi technique, which are commonly known as Rounds (Malcolm, Knighting, Forbat, & Kearney, 2009; Yousuf, 1997). Structured feedback of panel participants input into the study occurs during the Rounds. The purpose of the first round is to elicit opinions, judgments, predictions, or activities from the expert panel using open ended questions to direct the responses. Panel responses are collated between each round and are returned anonymously with an original or revised instrument for further input from the panel (Mullen, 2003). During the second round, a list generated from the first round statements is sent back to each expert and the expert is asked to rate or evaluate the item by a criterion of importance. In the third or final round, the list is resent to the experts along with the group's ratings; during this round, participants are asked to revise their opinions or discuss their reasons for not arriving at consensus with the remainder of the group.

Characteristics of the Delphi technique which support the design used for this study included (a) the need for collective subjective judgments, (b) anonymity and confidentiality of expressed judgments, (c) retention of heterogeneous participants from diverse backgrounds to avoid group domination, (d) controlled feedback during the interaction rounds, (e) allowance for a statistical group response, and (f) the time and cost efficiency of the methodology (Beretta, 1996; Bonner & Stewart, 2001; Linstone & Turoff 2002; Lynn, Layman, & Englebardt, 1998; Yousuf, 2007). Barnes (as cited in Yousuf, 2007) identified several limitations to the technique including: a potentially compromised consensus, the judgments are of those who chose to participate, required skill for written communication, and time and participant commitment. Hodgson (2004) suggested that participant frustration and possible dropout from the study could be reduced if short time intervals were used between rounds to collect the data.

Setting

This real time, normative Delphi study was conducted with faculty from Texas professional undergraduate nursing education programs as approved by the BNE via the online survey site *PsychData*. An online survey software tool, *PsychData* is engineered to secure and protect online data (PsychData, n.d.). This resource can be used to proficiently collect data in a more rapid and cost-effective manner using an online instrument formatted to the researcher's specifications. All survey data are encrypted with

Secure Sockets Layer (SSL) technology from the survey to the password protected database. The secure survey environment minimizes the risk of loss of confidentiality of the participants. It also allows for data collection on the Web at the convenience of the participants. Data from the instrument can be downloaded directly into *Statistical Package for Social Science* (SPSS) or Excel files for statistical analysis.

The survey may be completed by the participant at a self-selected location that has computer access and Internet connectivity, whether it be at home or work. If a participant leaves the survey prior to completion, their responses can be saved and they can complete the survey at a later time. Links within the survey facilitate the participant's navigation as he/she completes the questionnaire.

While the survey site was used for collection of data, electronic mail (e-mail) with the survey site link embedded into it was used to recruit participants for the various rounds. According to Meho (2006), there are multiple compelling reasons to use e-mail as a tool for the gathering of data: (a) it is considerably less costly to administer, (b) it allows for the inclusion of participants from geographically dispersed areas, (c) data is transcribed by the participant, (d) it enables the researcher to study individuals or groups with special characteristics or those who are often difficult or impossible to reach for face-to-face interview, (e) it allows for more than one participant at a time to be surveyed, and (f) it allows participants time to answer questions in a familiar environment. Identified disadvantages for using e-mail to gather data include: (a) people can delete invitations to the study before it is read, (b) the need for reminder e-mails, and (c) the possibility for non-delivery (Meho, 2006). Electronic mail correspondence for this study assisted with reducing costs, facilitated inclusion of participants from seven regions of the state, and enabled the researcher's ability in obtaining difficult to reach panel members.

Gonzalez (2002) argued against thc use of the Internet for research due to unequal access by individuals with the possibility of introducing bias into the findings. However, since the population selected was professional nurse educators who likely had Internet and e-mail access through their educational facilities, the Internet served as an appropriate medium for this study. In addition, this study incorporated a heterogeneous, yet homogenous, group of faculty members from diploma, associate, and baccalaureate programs with varying degrees and amounts of simulation experience from different regions of the State. In line with the philosophy of participants maintaining anonymity using the Delphi technique, the use of an Internet survey site also helped safeguard against possible embarrassment among peers when they described potentially sensitive events and experiences (Kim, Brenner, Liang, & Assay, 2003). With the combined use of the Delphi technique coupled with an online setting, the information provided by individual expert members was not personally identifiable. An initial round of group e-mails eliminated the possibility of collusion between experts and prevented the elimination of minority views at an early stage.

Population and Sample

The target population for this study consisted of undergraduate professional nursing education instructors within the State of Texas. The Board of Nurse Examiners (BNE) for the State of Texas's Internet site listed the approved professional nursing education programs in the State and each school's respective Internet site (Texas Board of Nursing Education, 2009). Each of these sites were reviewed to identify undergraduate nursing instructors, who were usually listed under the nursing faculty link located on the website. For this study, all faculty members identified on the schools' websites as undergraduate faculty members were asked to participate in the study. Instructors from all professional registered nurse undergraduate programs (i.e., associate, diploma and baccalaureate) from 7 different regions of the state were invited to participate. Institutional Review Board (IRB) approval was obtained prior to study initiation (Appendix A). An invitational e-mail was sent asking the faculty members to participate in the study (Appendix B). If no faculty members were identified, the school's contact person listed on the website was sent the invitational e-mail. Since the different schools' websites did not list personal information about the faculty members, inclusion criteria for the study were included in the invitational e-mail.

Selection of the expert panel is critical for a Delphi study. Participants must be knowledgeable and have experience in the area of interest, but do not necessarily need a high level of expertise (Baker, Lovell, & Harris, 2006; Yusuf, 2007). Expert panel members provide an accessible source of information that can be quickly harnessed to gain opinion and knowledge when more traditional research has not been undertaken (Baker et al.). The choice of panel members is crucial and the members should be representative of their profession as well as have the power to implement the findings (Duffield, 1993).

Panel members who are directly affected by the outcome of the study are more motivated to engage in discussion and stay involved throughout the Delphi study (Hardy et al, 2004). The commitment of participants is related to their interest and involvement with the question or issue being addressed (Keeney, Hasson, & McKenna, 2001). Because this study was focused on assembling a representative knowledgeable profile of key stakeholders in one state, the inclusion criteria for participation in the study included being an undergraduate Texas professional nurse educator with at least 1 year of educational experience. Exclusion criteria included failure to identify educational level or identified themselves as teaching at the graduate level.

The size of an expert panel in a Delphi study depends on the homogeneity of members of the panel, with heterogeneous panels larger than homogeneous panels. While some studies have included many participants on their expert panel (Gazi et al., 2007; Lynn, Layman, & Richard, 1999), others had fewer than 5 (Mullen, 2003). Accuracy of findings "deteriorates rapidly with smaller sizes and improves more slowly with large numbers" (Mullen, 2003, p. 41). Typically, panel composition size is determined by the nature and scope of the issue to be addressed, with improved reliability and reduced error observed with an increased number of participants (Cochran, 1983). However, larger panels tend to have higher drop-out rates between rounds and it is believed that panels of 20 tend to retain members (Mullen, 2003).

Protection of Human Subjects

Permission was obtained from the IRB of TWU prior to implementation of the study (Appendix A). In the invitational (solicitation) e-mail (Appendix B), participants were provided a link to the *PsychData* Survey Website where the IRB approved consent form was embedded (Appendix C). The participants were informed of the purpose of the study, research procedures, potential risks and benefits of participation and how to contact the researcher via the consent form. Voluntary consent for the study was obtained when the participant agreed to participate in the study by selecting the 'I accept' toggle at the end of the consent form imbedded on the survey site. If a participant selected the 'I decline' toggle, they were unable to complete the survey and were directed to the "thank you" page.

Potential risks to the participant included loss of confidentiality and loss of time. *PsychData's* ability to encrypt data during transmission from the survey to the password protected database assisted with minimizing the risk of loss of confidentiality. Confidentiality was maximized by developing a group name for the initial correspondence group e-mail, with only the researcher having access to each individual participant's e-mail address and name. Individual e-mail invitations were sent to those who chose to participate during the subsequent rounds (Round 2 and Round 3). No paper copies of participant's demographic information or personal information were kept. The researcher's computer and network access was password protected, and the researcher also had an assigned password allowing her to access the *PsychData* account. Any survey results that are presented or published will include only collective responses. The participants were informed of the required need for 3 rounds of data gathering in the invitational e-mail, thereby allowing the participant to have a better idea of what would be involved in the research process before any commitments were made. Participants were allowed to discontinue their participation at any time.

Potential benefits of participation of the study included the opportunity to gain a better understanding of their own opinions and those of their peers of how the implementation of simulation was facilitated and/or hindered in other nursing schools throughout the State of Texas. A copy of the study results will be provided to the participants and will be located on the University of Texas at-Tyler graduate nursing Internet site at a later date.

Instrument

The Delphi technique does not utilize an existing instrument. Rather, it begins with questions formulated by the researcher and these questions further evolve as the study progresses. Since the major purpose of the study was to explore the opinions and to develop consensus among Texas undergraduate nurse educators regarding their opinions on what has facilitated and/or hindered implementation of HPS innovation in the clinical teaching of undergraduate nursing students, the questions were worded to emphasize these concerns. The initial questions used to generate opinion statements from undergraduate nursing educators regarding HPS implementation within clinical nursing coursework were as follows:

1. In your opinion, what factors have facilitated, or could facilitate, the implementation of HPS into the clinical nursing course(s) you teach?

2. In your opinion, what factors have hindered, or could possibly hinder, the implementation of HPS into the clinical nursing course(s) you teach?

A demographic questionnaire was included with the above questions for Round 1 (Appendix D). This data was used to describe the faculty members who responded to Round 1. The first four questions served to determine if the participants met the inclusion criteria in order to be contacted as panel members for subsequent rounds. The fifth question served to determine if HPS was used at their facility. If HPS was used at their facility, the participant was asked to answer 8 additional questions regarding HPS use (e.g., brand used, which nursing courses employed HPS, and if HPS laboratory time was considered to be a replacement for clinical time). This information served to provide a picture of how HPS was utilized within the State.

Validity and Reliability

It is believed that expert panel members provide high content, face, and concurrent validity, yet expert panel members can adversely affect the reliability of the study (Beech, 2001; Sharkey & Sharples, 2001). Content validity refers to the adequacy with which the behaviors, characteristics, or information is sampled by the test (Portney & Watkins, 2000). Reid (as cited in McKenna, 1994) believes the Delphi technique can be used to systematically collect and combine informed judgments from a group of experts regarding specific questions and issues. Content validity can be assumed if the expert panel participating in the study is representative of the group or the area of knowledge (Goodman, 1987; Mullen, 2003). This evolves out of the planning for the study, construction of the survey, and selection of the expert panel. High face validity and high concurrent validity is achieved when consensus is achieved following successive rounds of data collection (Williams & Webb, 1994).

Reliability is the extent to which a procedure produces similar results under constant conditions on all occasions (Hasson, Keeney, & McKenna, 2000; Keeney, Hasson & McKenna, 2001). Reliability using the Delphi technique remains questionable because it is unknown whether two different panels would reproduce the same results and if the size of the panel and member bias could affect the reliability (Beretta, 1996; Fry & Burr, 2001; Mullen, 2003; Williams & Webb, 1994). Definitive statements are difficult to make about establishing reliability and validity of findings using the Delphi technique (Crisp, Pelletier, Duffield, Adams, & Nagy, 1997). Some authors have argued for the criteria of transferability, credibility, applicability or confirmability of the results as being more appropriate (Keeney, Hasson, & McKenna).

Data Collection and Treatment of Data

The initial solicitation e-mail included certain information to rapidly inform the nurse educator of the intent of the study. Specifically, the invitation to participate in the study included the title of the study, purpose of the study, inclusion criteria, and link to the *Psych-Data* survey site. The e-mail subject line was titled 'Invitation to participate in Dissertation study, "Nurse Educators' Consensus Opinion of High Fidelity Patient Simulation." In the body of the e-mail, the principal investigator (P.I.) provided a brief biographical introduction, including her status as a doctoral student at Texas Woman's University (TWU), as well as information about the study itself. The invitational e-mail contained a link to the *PsychData* survey site where Round 1 of the study was located with the IRB approved consent form and the Round 1 questions. E-mail correspondence was used during the study to notify the expert panel of the readiness of subsequent rounds and to direct them with a link to the survey sites. Reminder e-mails were sent to the panel to maximize participation in the study.

Round 1-Statement Generation, Reduction, and Categorization

Three rounds of data collection were used to obtain consensus with the expert panel members. For the initial round (Round 1), the panelists were asked to complete a brief demographic survey, which included questions about years of teaching, level of teaching, area of teaching expertise, and support provided for HPS use. After completing the demographic survey, panel members were asked to freely generate opinion statements to the two questions for this study. Carefully designed, straight forward, open-ended questions allowed panel members freedom in their responses (Mead & Mosely, 2001a). Panel members were provided 1500 character type spaces for answering each open-ended question. Statements from the questions helped develop the Likert-type scale for Round 2.

Once Round 1 was completed, the generated statements were reduced and categorized in preparation for Round 2 by the P.I. in a similar method proposed by Burnard (1991). The statements were transferred from *PsychData* into a Microsoft word document and were analyzed through a method of thematic content analysis (Burnard, 1991). Categories were identified with immersive reading of the participant's statements. The transcribed statements were read several times, with notes made on general themes. Open coding of the statements after rereading the statements provided categorical themes. The categories were then collapsed into five broad categories. A doctorally prepared nursing faculty colleague, who is experienced in qualitative research, reviewed and provided feedback for the P.I.'s identified five categories.

A total of 336 statements of factors that facilitated and/or hindered implementation of HPS into clinical nursing education were received, with 55 remaining after all duplications were removed. Participant statements were allocated to the five identified categories through color coding with different colored highlighting pens. If a statement generated by the participant contained two or more categories, the statement was separated into different statements for Round 2. If statements could not be collapsed, the statements were left intact for the next round for the panel to critique. Infrequently occurring items were not omitted to allow the participants to judge the items for quality; the wording used by the participants were used as much as possible in Round 2 (Hasson, Keeney, & McKenna, 2000). The demographic survey data collected during Round 1 were transferred from *PsychData* into SPSS, v. 17.0 for statistical analysis. The demographic data were analyzed with frequency statistics (Mean) for this round.

Round 2- Statement Rating

The second Round of the Delphi process provided the reduced statements generated in Round 1 in a Likert-type format back to the participants who responded to Round 1 (Appendix E). The statements were arranged by thematic categories to provide a dimensional framework. The panel members were asked to express their opinion on a scale of 1 (not important at all) to 7 (extremely important). This scale generated ordinal level data.

SPSS, v. 17.0, was used to analyze the data from Round 2. Descriptive measures of central tendency (i.e., means and medians) and levels of dispersion (i.e., standard deviations) were calculated for each statement to help determine if the statement met consensus of the group. The mean is a measure of central tendency and represented the group opinion of that particular statement (Greatorex & Dexter, 2000). The standard deviation is a measure of spread, thereby representing the amount of disagreement within the panel about that particular statement. When responses converged around a mean, agreement or consensus was achieved by the panel (Vazquez-Ramos, Leahy, Hernandez, 2007). When there was an increase in the dispersion (standard deviation) of responses for a question, there was a decreased level of response agreement among the panel (Vazquez-Ramos, Leahy, Hernandez, 2007). For example, if the mean of the panel was close to 5 for an item with a standard deviation of 2, the overall group recognized that the issue was important, but there was disagreement within the panel. Essentially, the greater the SD, the more uncertain the panel was about that particular statement.

The primary goal of the study was to reach consensus. The opinion statements with a small standard deviation (<1.0) represented strong agreement and consensus of opinion for that statement among the panel members. If the standard deviation was large (>1.0), then strong disagreement existed among the panel members. The preset levels of agreement (consensus items) for this study were items that fell within 1 standard deviation (68% of the faculty members) of the mean (Vazquez-Ramos, Leahy, Hernandez, 2007).

Round 3-Analysis and Iteration

Round 3 of the study proceeded by providing the results of Round 2 (the group's means and standard deviations for each item) back to the panel members. After reviewing each statement of the Likert-type scale presented in Round 2 and the group means and standard deviations for each item, the panelist was asked to rerate his/her opinion response on a scale of 1 (not important at all) to 7 (extremely important). This round allowed the panel member to reconsider his/her initial rating for the questions and to allow a change of his/her opinion regarding the statement. The data obtained from Round 3 were subsequently downloaded into the *SPSS* program for reevaluation. Measures of central tendency (i.e., means and medians) and levels of dispersion (i.e., standard deviations) were calculated for each statement to determine if the statement achieved consensus from the group. The mean represented the group opinion of each particular statement. Data were reanalyzed to determine how many of the statements fell within 1 SD of the mean.

Ranking of the items occurred as described by Smith and Simpson (1995), with the use of the group means. Means and standard deviations were calculated for each item with a score of 7 representing the highest degree of importance and 1 being the lowest. Items closer to seven were viewed as the most important. The statements were then placed in mean descending order based on Round 3 in order to ascertain the panel's opinion about the statements that were most important.

While the Delphi technique attempts to refine the opinions of a heterogeneous group, it is possible to submerge differences of opinion (Jones, 2002). It is important for divergent opinions to be evaluated because the presence of disagreement is more significant when large groups share similar positions and may bias their responses when asked to evaluate areas where they are presently working (Jones, 2002). While all panel members were nurse educators, there was a certain amount of diversity within the group, making the group more heterogeneous (i.e. level of professional nursing taught-associate or baccalaureate and if HPS were being utilized at the facility). For this reason, the panel members were clustered into more homogeneous groups while analyzing Round 3. In addition to the primary or expert sample, the panel members were assigned to the two homogenous groups. This allowed study of consensus opinions between the nurse educators who taught at different levels of professional education and nurse educators who had HPS available for use/not for use at their institutions and whether they differed statistically. Group differences of the Round 3 opinion rankings for the smaller homogenous groups were analyzed using the *Mann-Whitney-U Test* ($p \leq 0.05$). This nonparametric test was selected for determining whether the ratings of the groups were significantly different (Portney & Watkins, 2000).

Pilot Study

Faculty members at a University in East Texas participated in a pilot study that preceded this larger study. Faculty members were asked to respond to 14 open-ended questions regarding their opinions on using simulation in nursing education. The research questions were placed on *Survey Monkey* after receiving IRB approval from the participating university. The questionnaire asked general questions about HPS (e.g. how was HPS being used in the laboratory course, what faculty member valued about using

HPS, what did they not find beneficial). The questionnaire was available online from March 19 to April 6, 2007 for the nursing faculty members after an e-mail was sent inviting them to participate. Participation in the survey implied informed consent.

The primary purpose of the pilot study was to determine the accuracy and efficiency of data collection techniques using *SurveyMonkey.* This software program allows the researcher multiple creative methods of developing a real time survey (Survey Monkey, n.d.). The researcher determined that *SurveyMonkey* was not feasible for the larger study because the data could not be downloaded directly into SPSS for data analysis. An alternate program, *PsychData,* was used for the larger study so that the data could be directly downloaded aiding to a more time-efficient data analysis process.

A second reason for the pilot study was to validate the questions that would be most relevant for the larger study. Two nursing scholars with research experience who reviewed the pilot questions provided valuable insight into rewording the open-ended questions intended to elicit better responses for the larger study. While the pilot study questions were not used for the larger study, the pilot study allowed the PI to observe the process of a real-time Internet survey and assisted in reorganizing and rewording both the purpose of the study and the questions necessary to elicit the needed data.

Chapter Summary

This chapter focused on the methodological approach for this study. This chapter introduced the study's research design, setting, population and sample, protection of human subjects, instruments, data collection, and treatment of the data. The purpose of this study was to determine if there was consensus opinion regarding what facilitated and/or hindered the use of HPS within undergraduate professional nursing among Texas undergraduate nurse educators. Use of an electronic survey, coupled with the Delphi technique, helped obtain the required information to determine the consensus opinion of expert nurse educators in the State of Texas.

CHAPTER IV

ANALYSIS OF DATA

Introduction

The major purpose of this study was to explore the opinions of Texas nursing educators regarding the implementation of HPS innovation in clinical teaching of undergraduate nursing students and to develop consensus about implementation of this innovation. This study employed an electronic Delphi survey consisting of 3 rounds for data collection. The different rounds of data were analyzed using various statistical tests, including frequencies, measures of central tendency, and the *Wilcoxin-Man-Whitney-U* nonparametric statistical test. The following results will be discussed: (a) expert panel member characteristics, (b) Round 1 statements generated, (c) Round 2 consensuses, and (d) Round 3 rerating of consensus, including statistical significance of differences and rating of importance.

Expert Panel Member Characteristics

The initial panel of experts consisted of 86 Texas nurse educators. Demographic data were collected during Round 1 of this Delphi study and were explored using frequency analysis. The same participants from Round 1 were invited to participate in the two subsequent rounds with panel fluctuation observed as some chose to participate or not to participate between rounds. The Texas nurse educators who participated in the initial Round identified themselves as educators in associate (n=29; 28.4%), diploma (n=1; 1%), and baccalaureate (n=68; 66.7%) educational programs for nursing.

The highest level of education of the panelists was primarily that of a master's degree (n=62; 60.8%) and the remainder had doctoral degrees (n=31; 30.4%). Years of teaching nursing education ranged from 1-26+ years with most of the respondents having taught 5-7 years. All seven regions of the state were represented, with the largest areas being the Gulf Coast (n=40; 39.2%), Prairies and Lakes (n=21; 20.6%), Panhandle Plains (n= 13; 12.7%), and Piney Woods (n=11; 10.8%). Only eight of the participants reported themselves to be from the South Texas Plains area and one from Big Bend. All areas of Texas responded to the first Round.

The majority of the panelists reported using HPS in their curricula (n=62; 60%) and of those 62 participants, 55 (92%) use the Laerdal® Brand of HPS. Some of the panelists used the Medical Education Technology® (METI) human patient simulator (n=15; 25%). Several of the panelists reported utilizing the Gaumard® Noella® simulator for their obstetrical undergraduate courses (n=6; 10%).

Years of HPS usage varied from 0 to 6 years. Most of the panelists (n=49; 81%) had used HPS 3 years or less, while the remainder (n=11; 19%) had used HPS for more than 3 years. The use of HPS was reported for all components of nursing education, including medical-surgical (n=42; 70%), intensive/critical care (n=30; 70%), obstetrical (n=27; 45%), fundamentals (n=24; 40%), health assessment (n=23; 38%), leadership (n=6; 10%), psychiatric nursing (n=6; 10%), and community health nursing (n=2; 3.3%).

The panelists reported they were educated in the use of HPS through various methods including: attending seminars (n=37; 61.7%); reading simulation research (n=37; 61.7%); or watching other faculty members while they used HPS (n=34; 56.7%).

Several of the panelists reported having received no formal training, learning through 'trial and error' (n=3; 5%).

Educators' support for the utilization of HPS also varied. Many of the panelists conveyed having to completely facilitate the simulation lab, including creating the simulation case studies, operating the case scenarios, and programming the computers for the simulation laboratory experience (n=16; 26%). Other panelists created the case studies, but had someone available to help operate the simulation scenarios (n=9; 15%). Some of the panelists reported having a fully staffed simulation laboratory with a person who programmed and operated the case scenarios (n=11; 18.3%). Several of the participants reported that their schools had purchased simulation case studies, yet the educator was the individual responsible for operating the case scenarios for the simulation laboratory experience.

The majority of the panelists reported HPS laboratory time as an accepted part of the required clinical time in their nursing programs (n=53; 88%). While a number of the panelists reported that less than 10 hours of simulation were used for clinical time (n=19; 35%), some of the panelists reported using simulation for greater than 30 hours of clinical time (n=7; 13%). Several of the participants reported using HPS for 45-75 hours of clinical time. One educator reported using HPS for the entire portion of clinical time.

Data Collection and Analysis Procedures

Undergraduate nurse educators from the State of Texas were asked to identify items that either facilitated and/or hindered implementing HPS within their colleges. The time process for panel selection extended from March 16 to April 16, 2009. Over 90 approved professional schools of nursing were identified through the Texas Board of Nursing Education website, including 64 Associate Degree of Nursing programs (ADN), 2 Diploma Nursing programs and 29 Baccalaureate Degree of Nursing (BSN) programs (Texas Board of Nursing, 2009). Each of these school's websites was used to identify nursing faculty members. While most of the websites had faculty members identified with contact e-mails, some sites had no faculty members listed or only listed the Dean as the point of contact. Group e-mails were created for each school for undergraduate faculty members listed under the nursing school's Internet site. Some school Internet sites did not differentiate between faculty members who were teaching only in the undergraduate or graduate programs, so some graduate nursing faculty members may have been included in the invitational e-mail correspondence. The three rounds of electronic data collection extended from April 16, 2009 to January 26, 2010. A summary of these data collection activities can be found in Table 1.

Table 1: Data Collection Summary

Date	Activity	Appendices
April 3 2009	Survey placed on *PsychData* Site prepared and tested.	C,D,E
April 10, 2009	Email invitations sent to faculty to participate in Round 1	B
April 11, 2009 – May 19, 2009	Round 1 data collected	
June 6, 2009 – October 27, 2009	Round 2 instrument developed. Instrument placed on *PsychData*	F
October 29, 2009	Invitations sent to registered Round 1 panelists to participate in Round 2	G

(*table continues*)

Table 1 (continued)

Date	Activity	Appendices
November 12, 2009	Reminder e-mail for Round 2	H
November 17, 2009	Data for Round 2 collected	
November 18, 2009- December 6, 2009	Round 3 Instrument developed and placed on PsychData	
December 7, 2009	Invitations sent to registered Round 1 panelists to participate in Round 3	I
January 19, 2010	Reminder e-mail for Round 3	J
January 26, 2010	PsychData Survey site closed. Data Analysis initiated.	

Round 1 questions used to generate opinion statements from undergraduate nursing educators regarding HPS implementation within clinical nursing coursework were as follows:

1. In your opinion, what factors have facilitated, or could facilitate, the implementation of HPS into the clinical nursing course you teach?

2. In your opinion, what factors have hindered, or could possibly hinder, the implementation of HPS into the clinical nursing course you teach?

Data were collected from 86 participating nursing faculty members by May 19, 2009. Data from Round 1 were divided into two broad categories, facilitators and hindrances regarding implementation of HPS in nursing education curriculum. The description of the expert panel member characteristics were analyzed using descriptive statistics. Round 1 data consisted of qualitative statements provided by the panel in response to the two research questions and the statements were analyzed using content analysis.

Data collected from Rounds 2 and 3 consisted of ordinal level data and were analyzed using measures of central tendency (i.e., means and medians) and levels of dispersion (i.e., standard deviations).

Content Analysis

Once the Round 1 survey was completed and returned by the experts, generated statements were reduced and categorized in preparation for Round 2 by the P.I. in a method similar to that proposed by Burnard (1991). The statements were transferred from *PsychData* into a Microsoft word document and were analyzed through a method of thematic content analysis. Categories were identified with immersive reading of the participant's statements. A doctorally prepared nursing faculty colleague, who was experienced in qualitative research, reviewed and provided feedback for the P.I.'s five thematic categories. Participant statements were allocated to the five identified categories through color coding with different colored highlighting pens. If a statement generated by the participant contained two or more categories, the statement was separated into different statements for Round 2. If statements could not be collapsed, the statements were left intact in the next round for the panel to critique. Infrequently occurring items were not omitted to allow the participants to judge the items for quality. The wording used by the participants was used as much as possible (Hasson, Keeney, & McKenna, 2000).

Results

Round 1

The 86 panel members who participated in Round 1 submitted a total of 198 responses for the question regarding perceived *facilitators* of implementing HPS in nursing education. From these responses, five emergent themes with a total of 32 statements remained after duplications and similarities were removed. These five emergent themes included: resources, faculty, student, laboratory, and administrative; these categories and associated statements can be found in Table 2. The 86 panel members who participated in Round 1 also submitted a total 138 responses pertaining to *hindrances* to implementing HPS into nursing education. From these responses, five emergent themes with a total of 19 statements remained after duplications and similarities were removed. These five emergent themes included: resources, faculty, student, laboratory, and administrative; these categories and their associated statements can be found in Table 3.

Table 2:
Emergent Themes Related to Facilitators of Implementing HPS in Nursing Education

		Statement
Resources		
	1.	Readily available realistic equipment for use, i.e., IV pumps that work, monitors, or ventilators.
	2.	Well-designed, evidence-based simulation case scenarios developed for specific course objectives, e.g. leadership, critical care, obstetrical, medical-surgical or psychiatric scenarios.
	3.	Funding to update simulation equipment, lab, and other equipment.
	4	Appropriate education on the simulation equipment, e.g. workshops sponsored by the vendor.

(table continues)

Table 2 (continued)

5. Appropriate education on teaching with simulation into the coursework. Guidelines on incorporating simulation objectives of criteria into course syllabi.
6. Adding a stipend to salary to implement stimulation into the coursework.
7. Guidelines on incorporating simulation objectives of criteria into course syllabi.
8. Faculty members with attitudes who will embrace innovative methods for delivering nursing content and be willing to change teaching methodology.
9. Engaging and sharing responsibility of the Sim-Lab with other faculty members in the school so that the cheerleader is not the sole caretaker of the lab.
10. Need for increased sharing of information between educators on appropriate methodologies, research, scenarios, e.g. publications.
11. Being able to utilize products created for simulation as scholarship activities.

Student

1. Allows students to practice communication and enhance their nursing skills in a safe/controlled environment.
2. Enables students to critically analyze and understand complex concepts.
3. Allows students to practice in inter-professional teams, allowing them to practice communication and delegation while caring for patients together.
4. Reduces fear the student may experience.
5. Allows students to feel more secure about their practice prior to entering a clinical setting.
6. Limited clinical sites/spots are becoming overwhelmed by students.
7. Student enthusiasm for the more realistic simulation experiences.
8. Allows the student to care for patients where there may be a limited population of patients, e.g. pediatric patients or where there is an inconsistency in patient population.
9. Allows the student to receive immediate feedback on performance through debriefing after the simulation scenario.

Laboratory

1. Having someone available to run and troubleshoot the computer and other technological components of the HPS so that the instructor can teach/focus on the students.

(table continues)

Table 2 (continued)

	Statement
	2. A full time dedicated Sim-Lab coordinator/learning lab coordinator who would help with setting up the lab, ordering simulation supplies, etc.
Administrative	
	1. Leadership encourages simulation use.
	2. Leadership embraces change in education methodology, encouraging the creating and trial of new innovations/ideas in teaching.
	3. Leadership in program provides vital support, e.g. release time from other duties, sending to workshops, etc.
	4. If unable to provide at own school, leaders who are willing to seek out opportunities to enter agreements with other facilities to share limited resources.

Table 3

Emergent Themes Related to Hindrances to Implementing HPS into Nursing Education

	Statement
Resources	
	1. Inadequate funding to purchase the simulators.
	2. Inadequate funding to maintain the simulators.
	3. Inadequate funding to provide appropriate support equipments (e.g. videotaping, crash cars, oxygen therapy).
	4. Inadequate numbers of developed case scenarios for medical/surgical nursing available for use.
	5. Inadequate numbers of developed case scenarios for diverse nursing specialties (e.g., psychiatric nursing and leadership) available for use.
Faculty	
	1. Faculty members' workloads would be increased due to the time required to incorporate into their course, including creating, preparing, and operating scenarios for students.
	2. A faculty member's attitude toward change; moving away from traditional teaching strategies, integrating new educational innovations, and learning new technology could limit their acceptance and integration of HPS into their course.
	3. Faculty shortages across the state may limit a schools 'ability to integrate HPS.
	4. Faculty members concern for grading simulation activities could limit their acceptance and integration of HPS.
	5. A lack of scientific nursing evidence that demonstrates improved NCLEX results occur with the use of HPS.

(table continues)

Table 3 (continued)

	6.	Lack of current clinical knowledge by the faculty member, e.g. ability to implement current standards of practice.
Student		
	1.	There is a lack of scientific nursing evidence that demonstrates the effectiveness and improvement in students' critical thinking and clinical judgment through using HPS.
	2.	Students not perceiving the simulation as 'real life.'
	3.	The students' learning experiences would be diminished by taking them away from real patients.
	4.	Reconciling the value of 1-2 hour HPS scenario with the amount of real clinical hours a student attends.
Laboratory		
	1.	Scheduling conflicts with other clinical courses requiring the skills lab when scheduling time for course activities that use HPS.
	2.	A lab with insufficient space makes it difficult to run simulations.
Administrative		
	1.	Lack of administrative support and knowledge of desired outcomes for a HPS program.
	2.	Lack of appropriate regulatory guidelines by the BNE on the percent of clinical time HPS can replace real world clinical time.

Round 2

A total of 36 panelists from Round 1 responded to Round 2. The second round of the Delphi was strictly asking for responses to hindering/facilitating statements. No additional demographic information was obtained during this round. On October 29, 2009, registered participants from Round 1 were sent an e-mail introduction to Round 2 (Appendix G), including a link to the instrument at the *PsychData* survey site. A total of 27 initially responded to the e-mail. On November 12, 2009, a friendly e-mail reminder was sent to the group (Appendix H) and an additional 9 participants responded, making a total of 36 participants for Round 2.

Round 2 data were collected from these 36 participating nursing faculty members by November 17, 2009. The Round 2 instrument provided the developed Round 1 statements (n=51) back to the participants in a Likert scale format. The participants were given an opportunity to rate their agreement with the statements from 1 to 7 (1=*strongly disagree* and 7 *strongly agree*) (Appendix F). SPSS, v. 17.0, was used to analyze the data from Round 2. Measures of central tendency (means and medians) and levels of dispersion (standard deviations) were calculated for each statement to determine if the statement met consensus of the group.

Round 2 facilitators of implementing HPS in nursing education. Faculty members were able to provide their opinions toward the 32 facilitating items: resources, faculty, student, laboratory and administrative. The item statements and their associated means and standard deviations can be found in Appendix K. One item (use of developed simulation products for scholarship activity) was accidently omitted from the instrument for Round 2. Consensus was reached on a statement when items fell within 1 standard deviation (68% of the faculty members) of the mean. Five of the 32 statements were found to achieve consensus of the 36 participating panelists and can be found in Table 4.

Table 4: Round 2 Statements that Achieved Consensus

	Statement	M	SD
	Facilitating Statements		
1.	Allows students to practice communication skills in a safe/controlled environment.	6.31	0.93
2.	Allows students to enhance their nursing skills in a safe/controlled environment.	6.54	0.70
3.	Enables students to critically analyze and understand complex concepts.	6.34	0.84

(table continues)

Table 4 (continued)

4.	Allows the students to care for patients when there may be a limited population of patients (e.g., pediatric patients) or where there is an inconsistency of patient population	6.34	0.87
5.	Allows the student to receive immediate feedback on performance through debriefing after the simulation scenario.	6.6	0.65

Round 2 hindrances of implementing HPS in nursing education. Faculty members were also able to provide their opinions toward the 23 hindering items: resources, faculty, student, laboratory, and administrative categories during Round 2. Measures of central tendency (means and medians) and levels of dispersion (standard deviations) were calculated for each statement to determine if the statement indicated consensus of the group. Consensus was reached on a statement when items fell within 1 standard deviation (68% of the faculty members) of the mean. The item statements and their associated means and standard deviations can be found in Appendix K. None of the hindrance statements met consensus by the Round 2 participants.

Round 3

A total of 48 panelists from Round 1 responded to Round 3. For Round 3, the panelists were asked to rerate each statement after observing and considering the group's overall mean and standard deviation values from Round 2. The participants were also asked to identify the level of professional nursing education where they taught and whether or not HPS was used in their curriculum.

SPSS v. 17.0 was used to reanalyze the data from Round 3 with descriptive measures of central tendency (means and medians) and levels of dispersion (standard deviations). Seven of the participants (17%) were filtered from the data set because of identified/lack of identified teaching level (n=5) or missing data (n=2). Baccalaureate degree educators constituted the majority of the remaining responders (n=22; 55%), with Associate degree educators constituting the difference (n=19; 45%). No diploma degree educators responded to Round 3. Most of the responders (n= 35; 85.41 %) were using HPS at their institution, with fewer participants not using HPS (n=6; 14.6%). More baccalaureate degree educators responded that they were using simulation (n=20; 90%) compared to the associate educators (n=15; 80%). Measures of central tendency (means and medians) and of dispersion (standard deviations) were computed from the Round 3 data, the results of which can be observed in Appendix L.

Round 3 revealed that the panel's means and standard deviations had changed from the previous rounds. Instead of moving closer to consensus with a decrease in the standard deviations, it was observed that the panel appeared to move further apart with an increase in the standard deviations. The Round 3 data were then evaluated by selecting cases of teaching level with descriptive measures of central tendency (means and medians) and levels of dispersion compared. It was noted at this point that panel members who identified themselves as teaching in a baccalaureate degree program met consensus on 9 different facilitating and/or hindrance statements (Table 5). Panel members who identified themselves as teaching in an associate degree program did not meet consensus on any item.

	Table 5: Baccalaureate Consensus Opinion Statements		
	Statement	M	SD
	Facilitating Statements		
1.	A full-time dedicated Sim-Lab coordinator learning lab coordinator who would help with setting up the lab, ordering simulation supplies, etc.	6.59	0.59
2.	Dedicated Sim-Lab staff who help with setting up and changing case scenarios between clinical groups.	6.45	0.74
3.	Adequate space facility to house simulation that offers a supportive physical environment (e.g, not having to compete with other courses for the room.)	6.45	0.86
4.	Leadership embraces change in education methodology, encouraging the creation and trial of new innovations/ideas in teaching.	6.40	0.8
5.	Allows the student to receive immediate feedback on performance through debriefing after the simulation scenario.	6.32	0.57
6.	Leaders who are willing to seek out opportunities to enter agreements with other facilities to share limited resources, if unable to provide HPS at own school.	6.32	0.95
7.	Leadership encourages simulation use.	6.23	0.87
8.	Allows students to enhance their nursing skills in a safe/controlled environment.	6.18	0.73
9.	Enables students to critically analyze and understand complex concepts.	6.09	0.68

Subsequently, the Round 3 data were evaluated by selecting cases of 'those who had and those who did not have HPS for use' with a comparison of measures of central tendency (means and medians) and levels of dispersion (standard deviations). Panel members who identified themselves as having HPS for use did not meet consensus on any item. It was noted that panel members who identified themselves as not having HPS for use at their facility met consensus on 10 different facilitating and/or hindrance statements (Table 6).

Table 6
Panel Members Who do not Have HPS Available for Use Consensus Statements

	Statements	M	SD
	Facilitating		
1.	Allows students to practice communication skills in a safe/controlled environment.	6.29	0.76
2.	Allows students to enhance their nursing skills in a safe controlled environment.	6.14	0.90
3.	Enables students to critically analyze and understand complex concepts.	6.43	0.79
4.	Allows students to practice in interprofessional teams while caring for patients, allowing them to practice communication and delegation.	6.29	0.76
5.	Reduces fear the student may experience.	5.43	0.98
6.	A full-time dedicated Sim-Lab coordinator/learning lab coordinator who would help with setting up the lab, ordering simulation supplies, etc.	6.86	0.38
7.	Dedicated Sim-Lab staff who help with setting up and changing case scenarios between clinical groups.	6.58	0.79
	Hindrances		
8	Faculty shortages across the state may limit a school's ability to integrate HPS.	5.71	0.75
9.	Reconciling the value of a 1-2 hour HPS scenario with the number of the students' real clinical hours.	4.43	0.98
10.	A lab with insufficient space makes it difficult to run simulations	6.14	0.69

Additional Analysis

Once it was determined that the panel members who taught baccalaureate students and panel members who did not have HPS for use at their facility could arrive at a consensus opinion on several of the statements,some follow-up analysis was done of the responses to Round 3. The nonparametric statistical test, the Mann-Whitney U test, was applied to the data set to determine if there were differences between the sub-populations among the 48 panelists who responded to Round 3. The Mann-Whitney-U test can only be used with ordinal data and does not require that the two independent populations be normally distributed or equal in size. The median is used to determine if there was significance between the groups. This test was appropriate for these data because of the abnormally distributed sample of "ADN/BSN panel member groups" and of "those that had and did not have HPS available to for use groups". The data from the ADN/BSN panel members were analyzed using the Mann-Whitney-U test with statistically significant ($p \leq 0.05$) differences observed in 5 opinion statements (Table 7).

Table 7
BSN-ADN Statistically Significant Statement Differences

	Statement	BSN Median	ADN Median	Significance
	Facilitators			
1.	Leaders who are willing to seek out opportunities to enter agreements with other facilities to share limited resources, if unable to provide HPS at own school.	7.00	6.00	0.001
2.	Leadership in program provides vital support (e.g., release time from other duties and sending to workshops.	7.00	6.00	0.004
3.	Readily available realistic equipment for use (e.g. IV pumps that work, monitors, and ventilators).	6.00	5.00	0.037
4.	Leadership embraces change in education methodology, encouraging the creation and trial of new innovations/ideas in teaching.	7.00	6.00	0.047
	Hindrances			
1.	A lab with insufficient space makes it difficult to run simulations.	6.00	5.00	0.006

The Mann-Whitney U test was further applied to the data to determine if there were statistically significant differences ($p \leq 0.05$) between the level of education taught (i.e,. associate verses baccalaureate) and the availability of HPS (available for use verses not available for use). Statistical significance ($p \leq 0.05$) was observed between these 2 variables (Table 8).

Table 8
Availability of HPS: Statistically Significant Statement Differences

BSN faculty statements	Had HPS Median	No HPS Median	Significance
1. Faculty members are provided release time from faculty workload and other duties to develop and implement simulation.	5.5	2.0	0.041
2. Maintaining consistency of faculty members who have been trained on the equipment and scenarios to run the labs.	6.0	3.0	0.029
3. Appropriate education on using the simulation equipment (e.g., workshops sponsored by the vendor).	6.00	4.00	0.022
4. Appropriate education on teaching with simulation scenarios (e.g. simulation workshops on and off campus).	6.00	3.00	0.024
5. Engaging and sharing responsibility of the Sim-Lab with other faculty members in the school so that the "cheerleader" is not the sole caretaker of the lab.	6.00	3.00	0.022
6. Increased sharing of information among educators on appropriate methodologies, research, scenarios, and publications.	6.00	4.00	0.032

(table continues)

Table 8 continued

	ADN faculty statements Hindering Statements	Had HPS	No HPS	Significance
1.	Faculty members' attitude toward change (e.g., moving away from traditional teaching strategies, integrating new educational innovations, and learning new technology).	4.00	5.00	0.048
2.	Lack of scientific nursing evidence that demonstrates the effectiveness and improvement in students' critical thinking and clinical judgment through using HPS.	4.00	5.00	0.035
3.	A lab with insufficient space makes it difficult to run simulations.	5.00	6.50	0.004
4.	Being able to utilize products created for simulation as scholarship activities.	5.50	7.00	0.035

Statistical Ranking of Mean Scores

Item mean scores from *Facilitators of implementing HPS in nursing education* from Round 3 are presented in rank order of importance based on mean values in Table 9. A total of 29 items of the 33 items had a mean score of 5 or higher, indicating the majority of panel members viewed them as important or very important. None of the statements, though, reached consensus during Round 3 with the entire group. There were only 4 items where the mean dropped below 5 on the Likert scale, representing either a neutral position with the opinion statement or disagreement. Standard deviations, all greater than 1.00, showed the variation of the item rankings.

Item mean scores, with standard deviation, of *Hinderers of implementing HPS in nursing education* from Round 3 are presented in rank order of importance (Table 10). A total of 6 items had a mean score of 5 or higher, indicating that these items were important or very important for most panel members. There were 15 items where the mean dropped below 5 on the Likert scale, representing either a neutral position with the opinion statement or disagreement with the statements among the panel. None of these statements reached consensus through the rounds.

Table 9
Rank Order of HPS Implementation Facilitators in Texas Nursing Education

	Facilitator Statement	M	SD
1.	A full-time dedicated Sim-Lab coordinator/learning lab coordinator who would help with setting up the lab, ordering simulation supplies, etc.	6.34	1.13
2.	Dedicated Sim-Lab staff who help with setting up and changing case scenarios between clinical groups.	6.24	1.15
3.	Adequate space facility to house simulation that offers a supportive physical environment (e.g. not having to compete with other courses for the room).	6.17	1.24
4.	Having someone available to run and troubleshoot the computer and other technological components of the HPS so that the instructor can teach/focus on the students.	6.10	1.37
5.	Leadership embraces change in education methodology, encouraging the creation and trial of new innovations/ideas in teaching.	6.02	1.25
6.	Allows the student to receive immediate feedback on performance through debriefing after the simulation scenario.	6.00	1.14
7.	Allows students to enhance their nursing skills in a safe/controlled environment.	5.95	1.14
8.	Leadership encourages simulation use.	5.93	1.23
9.	Allows students to practice communication skills in a safe/controlled environment.	5.80	1.25
10.	Enables students to critically analyze and understand complex concepts.	5.78	1.15

(table continues)

Table 9 continued

11.	Engaging and sharing responsibility of the Sim-Lab with other faculty members in the school so that the 'cheerleader' is not the sole caretaker of the lab.	5.73	1.53
12.	Leaders who are willing to seek out opportunities to enter agreements with other facilities to share limited resources, if unable to provide HPS at own school.	5.71	1.49
13.	Allows the student to care for patients when there may be a limited population of patients (e.g., pediatric patients) or when there is an inconsistency of patient population.	5.71	1.49
14.	Increased sharing of information among educators on appropriate methodologies, research scenarios, and publications.	5.63	1.27
15.	Faculty members who are willing to change teaching methodology and who will embrace innovative methods for delivering nursing content.	5.63	1.52
16.	Being able to utilize products created for simulation as scholarship activities.	5.61	1.27
17.	Leadership in program provides vital support (e.g., release time from other duties and sending to workshops).	5.56	1.83
18.	Allows students to practice in inter-professional teams while caring for patients, allowing them to practice communication and delegation 5.49	5.49	1.47
19.	Funding to update simulation equipment, lab, and other needed equipment.	5.49	1.5
20.	Appropriate education on teaching with simulation scenarios.	5.37	1.58
21.	Maintaining consistency of faculty members who have been trained on the equipment and scenarios to run the labs.	5.29	1.52
22.	Availability of instruments to evaluate and grade simulation activities.	5.27	1.32
23.	Allows students to feel more secure about their practice prior to entering a clinical setting.	5.27	1.36
24.	Appropriate education on using the simulation equipment (e.g. workshops sponsored by the vendor).	5.24	1.63
25.	Student enthusiasm for the more realistic simulation experiences.	5.15	1.49

(table continues)

Table 9 continued

26.	Well-designed, evidence-based, simulation case scenarios developed for specific course objectives, e.g. leadership, critical care, etc.	5.15	1.49
27.	Existence of a core group of faculty members ('simulation cheerleader') who are enthusiastic and dedicated to developing and improving the simulation program.	5.15	1.64
28.	Guidelines on incorporating simulation objectives into course syllabi.	5.02	1.39
29.	Readily available realistic equipment for use (e.g., IV pumps that work).	5.02	1.73

Table 10

Rank Order of HPS Implementation Hindrances in Texas Nursing Education

	Hinderer Statement	M	SD
1.	Faculty members workloads would be increased due to the time required to incorporate HPS into their course, including creating, preparing, and running scenarios for students.	5.43	1.43
2.	A lab with insufficient space makes it difficult to run simulations.	5.33	1.68
3.	Inadequate funding to provide appropriate support equipment (e.g., videotaping, crash carts, oxygen therapy).	5.25	1.69
4.	Faculty shortages across the state may limit a school's ability to integrate HPS.	5.18	1.36
5.	Inadequate number of developed case scenarios for diverse nursing specialties (e.g., psychiatric nursing and leadership) available for use.	5.18	1.41
6.	Faculty members' attitude toward change (e.g., moving away from traditional teaching strategies, integrating new educational innovations, and learning new technology.	5.02	1.80

Chapter Summary

This chapter reported the findings from the three rounds of this Delphi study. Expert panel members' characteristics obtained during Round 1 were described. Details on how the consensus quantitative instrument was developed from the qualitative facilitating and/or hindering statements received during Round 1 were also provided. The level of importance of the statements was rated by the panel during Rounds 2 and 3. Although the faculty panel as an entire group was unable to reach consensus during the third round, the panel members who taught BSN students were able to meet consensus on 9 items. Three of these items were also consensus items found as a result of Round 2. The panel members who did not have HPS available at their facilities to use for education also met consensus on 10 items. Statistically significant differences in opinion were observed between faculty members teaching in ADN and BSN programs on 5 facilitating and/or hindering statements. There were also statistically significant differences in opinion between programs that had and did not have HPS on 10 facilitating and/or hindering statements. Twenty-nine items viewed as facilitating HPS implementation were rated as having a mean greater than 5. Six items viewed as hindering HPS had means greater than 5. All of these items had standard deviations greater than 1.00.

CHAPTER V

SUMMARY OF THE STUDY

Introduction

The major purpose of this study was to explore the opinions of Texas nurse educators about what facilitated and/or hindered the implementation of the HPS innovation in clinical teaching of pre-licensure nursing students in the State of Texas. The study utilized a normative real-time Delphi technique with panel members composed of undergraduate nursing faculty from within the state. The research question explored was, "What are the consensus opinions of undergraduate nurse educators in Texas about what has facilitated and/or hindered HPS implementation within pre-licensure nursing coursework?"

Although the entire faculty panel was unable to reach consensus during Round 3, consensus was observed among the panel members who taught baccalaureate nursing students and from among the panel members who did not have HPS for use at their facility. Three consensus statements from the panel members who taught baccalaureate nursing students also met consensus during Round 2 from the entire panel group. Three consensus statements from the panel members who did not have HPS for use at their facility also met consensus during Round 2 from the entire panel group.

Nurse educators are presently challenged to prepare new nurses to "practice safely, accurately, and compassionately, in a variety of settings, where knowledge and innovations increase at an astonishing rate" (Benner, Sutphen, Leonard, & Day, 2010, p.

1). HPS was a relatively new innovation in 2004 (Nehring & Lashley, 2004), but has become rapidly integrated throughout graduate and undergraduate nursing education programs over the past 5 years, with many schools having at least one HPS simulator model (Nehring & Lashley, 2009). Many faculty members perceive the use of HPS to be a method for promoting critical thinking and reflective thinking skills, interdisciplinary communication, safety, and clinical competency (Beyea, von Reyn, & Slattery, 2007, Bruce, Bridges, & Holcomb, 2003, Decker, 2007a, Haskvitz & Koop, 2004, Institute Of Medicine, 2010; Strouse, 2010). Even so, with the exception of one recently published article (Adamson, 2010), the literature has only alluded to items that have helped facilitate or hindered the implementation of HPS in nursing education (Childress, 2006; Medley & Horne, 2005). This chapter presents a summary and discussion of the findings related to what this sample of nurse educators perceived as facilitators and/or hindrances to the implementation of HPS in undergraduate professional pre-licensure nursing education in Texas. The implications of these findings as well as recommendations for further research will also be delineated.

Discussion of Findings

Consensus of Opinions Related to Critical Dynamics

Roger's theory of *Diffusion of Innovations* as interpreted by Cain and Mittman (2002) assisted with the response analysis of these findings. While the panel members could not obtain consensus as an entire group, most members agreed or strongly agreed with the opinion statements generated from Round 1. Statements generated during Round 1 and evaluated during Round 2 and 3 could be linked to Cain and Mittman's critical dynamics of (a) relative advantage, (b) communication mechanisms, (c) faculty characteristics, (d) opinion leaders, (e) compatibility, and (f) infrastructure. No statements generated during Round 1were noted to be linked to the critical dynamics of (a) trialability, (b) observability, (c) reinvention, or (d) social network.

While no hindrance statements reached consensus among panel members who teach baccalaureate students, these members were able to obtain consensus on nine of the facilitating statements developed from Round 1 during Round 3. These statements are closely associated to four of Cain and Mittman's critical dynamics of health care innovations including: (a) relative advantage, (b) opinion leaders, (c) compatibility, and (d) infrastructure. The facilitating consensus statements and their associated critical dynamics of health care innovations can be found in Table 11.

Table 11: HPS Critical Dynamics for BSN Educators

	Statement	Critical Dynamic
	Facilitating Statements	
1.	A full-time dedicated Sim-Lab coordinator learning lab coordinator who would help with setting up the lab, ordering simulation supplies, etc.	Infrastructure
2.	Dedicated Sim-Lab staff who help with setting up and changing case scenarios between clinical groups.	Infrastructure
3.	Adequate space/facility to house simulation that offers a supportive physical environment (e.g, not having to compete with other courses for the room.)	Infrastructure
4.	Leadership embraces change in education methodology, encouraging the creation and trial of new innovations/ideas in teaching.	Opinion Leader
5.	Allows the student to receive immediate feedback on performance through debriefing after the simulation scenario.	Compatibility

(table continues)

Table 11 continued

6.	Leaders who are willing to seek out opportunities to enter agreements with other facilities to share limited resources, if unable to provide HPS at own school.	Opinion Leader
7.	Leadership encourages simulation use.	Opinion Leader
8.	Allows students to enhance their nursing skills in a safe/controlled environment.	Relative Advantage
9.	Enables students to critically analyze and understand complex concepts.	Compatibility

Panel members who did not have HPS available for use at their facilities were able to obtain consensus on 10 of the statements developed from Round 1 during Round 3. These statements are closely associated with four of Cain and Mittman's critical dynamics of health care innovations including: (a) relative advantage, (b) opinion leaders, (c) compatibility, and (d) infrastructure. The consensus statements and their associated critical dynamics of health care innovations can be found in Table 12.

Table 12
HPS Critical Dynamics for Panel Members Who do not Have HPS Available for Use

	Statements	Critical Dynamic
	Facilitating	
1.	Allows students to practice communication skills in a safe/controlled environment.	Relative Advantage
2.	Allows students to enhance their nursing skills in a safe controlled environment.	Relative Advantage
3.	Enables students to critically analyze and understand complex concepts.	Compatibility
4.	Allows students to practice in interprofessional teams while caring for patients, allowing them to practice communication and delegation.	Relative Advantage
5.	Reduces fear the student may experience.	Relative Advantage
6.	A full-time dedicated Sim-Lab coordinator/learning lab coordinator who would help with setting up the lab, ordering simulation supplies, etc.	Infrastructure

(table continues)

Table 12 continues

7.	Dedicated Sim-Lab staff who help with setting up and changing case scenarios between clinical groups.	Infrastructure
	Hindrances	
8	Faculty shortages across the state may limit a school's ability to integrate HPS.	Infrastructure
9.	Reconciling the value of a 1-2 hour HPS scenario with the number of the students' real clinical hours.	Compatibility
10.	A lab with insufficient space makes it difficult to run simulations	Infrastructure

Infrastructure. The critical dynamic characteristic of infrastructure helps to facilitate and sustain HPS within a college and its use for nursing education. Underutilization of HPS can occur if the infrastructure is weak or absent. As noted in Table 10 in Chapter 4, several facilitating infrastructure statements met consensus as identified by the panel members who taught at the baccalaureate level and those who do not have HPS for use at their facilities. These statements included (a) the need for a full-time Sim-Lab coordinator, (b) the need for a dedicated Sim-Lab staff, and (c) adequate space for a simulation laboratory.

Infrastructure facilitating factors are important placements at an institution to support a HPS program and according to one panel member,

> Lack of time to work with the HPS has been a critical factor for me. I am enthusiastic about HPS and then my other duties prevent me from spending time with the system. When I try to use the system, I must reorient myself again. We do not currently have anyone assisting in the laboratory, so setup, etc. are all the instructor's responsibility. A full-time person to concentrate on simulation would be the ideal situation.

A different panel member stated, "I could not use Sim-Man without the full time support staff assigned to the lab. This includes teacher assistants that assist with set up and takedown between clinical groups." One panel member summed these three dynamics together with these shared written words,

> Having a larger simulation lab, having dedicated lab personnel to set up simulators before the simulations and to tear down after simulations completed, having personnel who can trouble shoot and fix simulator problems, having personnel to run the computers, having compressed air and all the supplies and equipment, all of these would facilitate improvement in use of HPS in our course so that I can teach/focus on the students.

Having these three infrastructure dynamics in place would allow the faculty member to focus on the student, compared to "having my time spread very thin" as one panel member noted.

Opinion leader. The panel members who taught at the baccalaureate level readily identified the importance of the opinion leader in facilitating the implementation of HPS into undergraduate nursing education. An opinion leader is one who focuses on the available benefits the innovation offers that differ from products in the past (Rogers, 1995); these opinion leaders are given credit for having a great deal of influence over other consumers. While the researcher utilized the term "leader" as all encompassing, the panel members referred to leadership in several ways, including "leader", administration, or dean.

According to Lancaster (2008), the nursing school dean is responsible for leading and providing vision for the school while setting priorities and leveraging resources. While faculty members may identify various educational opportunities, it is the dean who determines the school's priorities and manages the allocated resources, thereby influencing faculty direction. The dean is the primary advocate for the school and through a holistic view, "balances the vision of the nursing school and individual needs of faculty with the external demands of the institution, including education of students" (Lancaster, p. 510). This person skillfully develops a nursing program that is consistent with the overall mission of nursing and the home institution. Panel members affirmed this belief by recognizing that the leader's priorities would either facilitate and/or hinder HPS implementation. Many of the panel members recognized how leaders were supportive of HPS implementation. One panel member stated, "We have been given vital support from the leadership in our program." A different panel member supported this idea with the statement, "Support of the director facilitated use of HPS as this person found grant money for purchase of 2 Sim man and 1 Noelle."

The implementation of HPS represents a significant budget allocation to any school (Harlow & Sportsman, 2007; Kurrek, & Devitt, 1997; Nehring, Ellis & Lashley, 2001; VanSell & Johnson-Russell, 2006). The dean is required to understand how his/her budgetary funds are allocated and options available for influencing the decision making regarding funds if they are not directly responsible for his/her budget (Lancaster, 2008). Issues which must consistently be considered include the school's needs and priorities and whether the cost justifies the benefit. In situations where a school's budget does not all allocation for HPS, the panel members in this study who teach at the baccalaureate level would like to see their leaders seek out opportunities to work with other schools that may have simulation already in place. As one panel member stated, "One of the obstacles we faced was lack of understanding for the need on the part of our new dean and the lack of cooperation between the community college who has the equipment already and us." While nationally recognized opinion leaders introduced HPS across the nation, it was the leadership in the individual schools who acted as local opinion leaders and helped facilitate its diffusion within his/her facility.

Compatibility. The panel members who taught baccalaureate nursing students also agreed with HPS' compatibility (dynamic characteristic) with nursing education. For the innovation to be adopted and diffused throughout nursing education, it must be compatible with the educator's value system and needs. The panel members in this study strongly agreed that the use of HPS allowed the student to receive immediate feedback on their performance through debriefing after a simulation experience. As one panel member noted, "The debriefing of students after their lab experience (using video tapes) provides them immediate feedback of what they are doing right, and how they can improve their clinical performance in a low risk environment." This finding was supported in the nursing literature, with several nurse authors believing this to be the most important educational implication of the simulation experience because it allows the student to reflect on his/her nursing performance in a clinical situation (Childs & Sepples, 2006; Decker, 2007b; Haskvitz & Koop, 2004; Morgan, et al., 2006).

The panel members who taught baccalaureate students and panel members who did not have HPS for use also agreed with the compatible characteristic of HPS enabling the students to critically analyze and understand complex concepts. As one panel member noted, "I teach in the leadership course. HPS facilitates students to critically think out loud the principles of management, such as priority setting, delegation, talking with physicians, and dealing with difficult staff in a safe environment."

Relative Advantage. The relative advantage of using the technology involves safety as well as the compatibility of the technology, and critical thinking. These were frequently interwoven as important dynamic characteristics of HPS by members of the expert panel. As one panel member stated, "HPS will enable students to understand complex concepts in a safe/controlled environment. This will provide opportunities to put things together and enhance their clinical rotation in the hospital setting."

Group Differences

An additional finding at the end of Round 3 was the observed increased dispersion of group opinions as identified by the larger standard deviations. Statistically significant differences were observed between the panel members who taught at different educational levels and between panel members that had/did not have HPS. Statistical analysis for significant differences between the group's means in the generated opinions allowed for an objective impartial analysis of each group's opinion. One disadvantage of the Delphi technique is that the methodology forces participants to conform to another participant's response. Distinct differences between panel groups who taught at the two levels of professional nursing could be observed. Statistically significant differences with group means can be observed in Table 13.

Table 13
BSN-ADN Statistically Significant Statement Differences ($p<0.05$)

	Statement	Level of Significance	BSN Mean	ADN Mean
1.	A lab with insufficient space makes it difficult to run simulations	0.006	5.9	4.6
2.	Readily available realistic equipment for use (e.g. IV pumps that work, monitors, and ventilators).	0.037	5.5	4.47
3.	Leadership embraces change in education methodology, encouraging the creation and trial of new innovations/ideas in teaching.	0.047	6.4	5.57
4.	Leadership in program provides vital support (e.g. release time from other duties and sending to workshops.	0.004	6.3	4.68
5.	Leaders who are willing to seek out opportunities to enter agreements with other facilities to share limited resources, if unable to provide HPS at own school.	0.001	6.31	5.0

Analysis of the 9 consensus statement data from panel members who taught baccalaureate students demonstrated that those panel members agreed more strongly with the opinion statements than the panel members who taught at the associate level (Table 13). Similar to the Council on Collegiate Education in Nursing of the Southern Regional Education Board (2002) who found statistically significant differences between associate and baccalaureate educators on ranking of educator competencies, this study also demonstrated heterophily between groups. Diffusion requires a certain degree of heterophily to allow for information to be exchanged between individuals (Rogers, 1995);

however, it is unknown what factors may have created these differences between the panel members who taught at the two educational levels. Since determining the reason for differences between associate and baccalaureate panel members' opinion regarding HPS was beyond the purpose of this present study, no further data collection occurred.

Ranking of Items

All facilitating and hindering opinion items were rated by the entire panel during Round 3. Ratings ranged from 1 to 7, with 7 being strongly agreed upon and 1 being strongly disagreed upon. The top 5 issues identified from Round 3 data for the entire panel on both Likert scales can be found in Table 14. The importance of an infrastructure to support the nurse educator appears to be the most strongly held facilitation and hindrance opinion. Deans in nursing schools and other administrators within the university/college must plan for providing an infrastructure support system with appropriate resources to facilitate a successful simulation center. They should make budget changes to support the resources including: lab space and audiovisual equipment (Jeffries, 2008) and lab coordinators and technical support (King, et al., 2008; Tuoriniemi & Schott-Baer, 2008). Attention to the infrastructure provides opportunities for student growth and improved student outcomes by giving the educator time to evaluate the student's clinical decision making process.

Table 14
Issues Ranked in Order of Importance Based on Mean Values

Statement		M
Facilitated		
1.	A full-time dedicated Sim Lab coordinator/learning lab coordinator who would help with setting up the lab, ordering simulation supplies, etc.	6.34
2.	Dedicated Sim-Lab staff who help with setting up and changing case scenarios between clinical groups.	6.24
3.	Adequate space/facility to house simulation that offers a supportive physical environment (e.g., not having to compete with other courses for the room).	6.17
4.	Having someone available to run and troubleshoot the computer and other technological components of the HPS so that the instructor can teach/focus on the students.	6.10
5.	Leadership embraces change in education methodology, encouraging the creation and trial of new innovations/ideas in teaching.	6.02
Hindered		
1.	Faculty members workloads would be increased due to the time required to incorporate HPS into their course, including creating, preparing, and running scenarios for students.	5.43
2.	A lab with insufficient space makes it difficult to run simulations.	5.33
3.	Inadequate funding to provide appropriate support equipment (e.g. videotaping, crash carts, oxygen therapy).	5.25
4.	Faculty shortages across the state may limit a school's ability to integrate HPS.	5.18
5.	Inadequate number of developed case scenarios for diverse nursing specialties (e.g., psychiatric nursing and leadership) available for use.	5.18

Limitations

Limitations were observed in this study. Although there were only two diploma schools noted on the BNE site, only one faculty member who taught at the diploma school responded to Round 1, but not Round 3. Concerns with the reliability of the study became unavoidable with the heterogeneous panel which changed between rounds of the study. This was an uncontrollable variable that was inherent in this Delphi study. Unequal groups were also observed between the different homogeneous groups, including panel members who taught at the BSN or ADN levels and panel members who either used HPS at their facilities or did not use HPS at their facilities. The results of the study were produced by interaction between BSN and ADN panel members and can be said to constitute a reality construct for this panel group (Jones, 2002). Results can be generalized only to faculty members in the state of Texas because panel members were limited to Texas nurse educators.

It is interesting to note that three of the facilitating statements that met consensus during Round 2 also met consensus with the baccalaureate panel members during Round 3. These three statements ranked by their means between both panel groups were:(1) Allows the students to receive immediate feedback on performance through debriefing (Round 2 M=6.6, Round 3 BSN M= 6.32), (2) Allows students to enhance their nursing skills in a safe/controlled environment (Round 2 M=6.54, Round 3 BSN M= 6.18), and (3) Enables students to critically analyze and understand complex concepts (Round 2 M=6.34, Round 3 BSN M= 6.09). In addition, panel members who did not have HPS available for use also met consensus with a different statement from Round 2 which was (1) HPS allows students to practice communication skills in a safe/controlled environment (Round 2 M=6.31, Round 3 Non-use M= 6.29). The non-user group did not meet consensus with the importance of a debriefing statement, but agreed with the other two statements from the panel members who taught BSN students. These findings could signify the second round was mostly comprised of baccalaureate panel members or could have been a completely different panel altogether. Either way, those shared statements appear to be reliable and were also observed in the Washington State study (Adamson, 2010). Attrition was a threat to internal validity since members dropped out of the study between rounds.

Conclusions and Implications

Even though there were no clear findings among the total group, conclusions can be drawn about what facilitates and/or hinders the implementation of HPS in professional pre-licensure nursing education in Texas. The study identified information from panel members on what could potentially facilitate the implementation of HPS use in Texas in the future. Based on these findings, the following four conclusions with implications were made.

First, an infrastructure must be in place for an educator to use HPS, or underutilization or non-use of the technology could potentially occur. The implication from this finding is that while many schools of nursing have allocated a major portion of their budgets for the initial capital purchase of the mannequin equipment, there must also be a commitment from the dean and/or university/college administration to maintain an operating budget for its continued use. This would include planning for best HPS placement with space allocated, while maintaining an operational budget for sustaining mannequin repair and upgrades, supply equipment, technology and/or laboratory coordinators, as well as assistants to help with the laboratory experiences. These recommendations are also noted in the literature (Adamson, 2010; Jeffries, 2008; King, et. al., 2008; Tuoriniemi & Schott-Baer, 2008). An established infrastructure may also facilitate removal of some of the noted hindrances.

Second, leadership support at the facility is important for guiding and directing implementation of educational innovations. Leadership should consider the concerns of the adopters, i.e., panel member concerns for increased work load. The panel members in this study were concerned about the increased time required to develop and implement simulation scenarios. An implication from this finding is the opinion leader at the nursing program should evaluate the faculty members' receptiveness to using HPS as an educational method. Anecdotal literature findings with limited scientific data were found on faculty members' perception of using HPS (Adamson, 2010; Jeffries, 2008; King, et. al., 2008; Tuoriniemi & Schott-Baer, 2008), however, it is the leadership at the individual school that helps in implementing change (Lancaster, 2008; Starkweather and Kardong-Edgren 2008).

Third, faculty development and support for the use of simulation is imperative for the success of the program (Childress, 2006; King, Moseley, Hindenlang, & Kuritz, 2008; Medley & Horne, 2005). An implication for this conclusion is that leadership can facilitate the use of simulation by sending 1-2 faculty members for intense, formal, hands-on training with HPS and then allowing these faculty members to teach other faculty members so that they are not the "sole caretaker" of the HPS. This is supported by Starkweather and Kardong-Edgren (2008), who utilized the Diffusion of Innovation theory to explain one method for teaching faculty members in the use of HPS. The opinion leader (cheerleader), if given an opportunity, can diffuse the implementation to the latent adopters through teaching, demonstrating, and encouragement. Leadership can facilitate further faculty development through encouraging use of the Simulation Innovation Resource Center (SIRC) a web-based resource, which offers 11 different online training courses for an educator to review, resources for simulation technology and a user forum for those seeking answers to questions that may have already been answered by early adopters.

Fourth, differences of opinion exist between BSN and ADN faculty members and between users and nonusers. While there are many homogenous characteristics and beliefs among the two groups, each group produced different concerns. Funding issues are different between state- supported universities and community-supported colleges, which may have affected some of the differences. There have previously been noted differences in opinions on teaching competencies between BSN and ADN faculty members in the past (Southern Regional Education Board, 2002). No other research could be found in the nursing literature where differences could be observed between faculty members who taught at different undergraduate educational levels. These differences need further study, especially with the entry to practice concern voiced over the past several decades.

While there are many similarities, the results regarding what facilitates and/or hinders implementation of HPS in this study are somewhat different from the results found in Adamson's study (2010). Adamson only studied ADN faculty members; BSN faculty members were excluded. This study included both BSN and ADN faculty members. Adamson identified similar factors which facilitated and/or hindered HPS implementation, but did not measure for consensus of opinions among the faculty members. Specifically, consensus opinions on several facilitating items were determined from the BSN panel members in this study. Statistically significant differences in opinions were observed between BSN and ADN panel members and HPS users and nonusers on several of the items in this study. While one particular facilitating suggestion from her study was the need to supplement faculty income for using this technology, the Texas panel members were neutral (M=4.68) and did not meet consensus with this suggestion.

The assumptions of the study were met. Opinions of undergraduate nursing educators regarding the implementation of HPS in clinical teaching existed and could be elicited, however, only the panel members who taught at the baccalaureate level and with those who did not have HPS for use in his/her facility could achieve consensus. Expert panel members were able to express their honest opinions about the implementation of HPS as part of clinical nursing education. The use of the Diffusion of Innovation theory assisted in capturing the factors which facilitated and/or hindered HPS implementation in the State of Texas.

Recommendations for Further Study

This study supports the need for further investigation of the opinions of simulation as an educational strategy from the perspective of nursing faculty as well as consumers. Recommendations for further study include the following questions:

1. Is there a measurable difference in student satisfaction with HPS simulation when online lecture capture methods (e.g. with *Tegrity®* software recorded lecture) replaces classroom lecture (in process).

2. Why are there statistically significant differences between baccalaureate and associate degree educators on some of the consensus statements identified in this study?

3. Would instruments developed to evaluate critical thinking, i.e. Lancaster rubric, reveal differences in critical thinking between ADN and BSN students, or between students who use/do not use simulation?

4. Are the skills learned during simulation transferable to the patient care environment?

5. What is the percentage of clinical time devoted to HPS that best correlates with the ability of students to transfer critical thinking skills into a real life clinical situation?

6. What is the observed clinical effect on patient care of a new graduate nurse, as perceived by staff nurse peers, who has graduated from an undergraduate nursing program that has chosen to utilize 100% simulation as their clinical evaluation mechanism?

7. What are the opinions of bedside professional nursing staff members with the pedagogy shift toward competency-based nursing education licensure with the use of HPS?

Chapter Summary

The focus of this Delphi dissertation study, guided by Roger's *Diffusion of Innovations* theory as defined by Cain and Mittman (2002), was to gain a richer understanding of the opinions of nursing educators about what facilitates and/or hinders the implementation of the HPS innovation in the clinical teaching of pre-licensure nursing students in the state of Texas. Data obtained from the purposive sample panel during the three rounds of the study were analyzed using both qualitative and quantitative methods.

This chapter included the discussion of the study findings, with consensus statements from faculty members related to the critical dynamics of diffusion in health care, identified limitations of the study, and presented the conclusions regarding the findings of the study with implications and recommendations for further study. Nursing scholars who perform research related to HPS continue to seek answers on determining whether this technology is an effective way to educate undergraduate nursing students. Leadership in nursing schools requires this evidence as assurance that it is an effective way to educate students (Institute Of Medicine, 2010). Understanding of HPS use in nursing education will be enlightened through both qualitative and quantitative theory based research.

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APPENDIX A

TWU IRB Approval Letter

TWU IRB Approval

TWU
TEXAS WOMAN'S UNIVERSITY
DENTON DALLAS HOUSTON

Institutional Review Board
Office of Research and Sponsored Programs
P.O. Box 425619, Denton, TX 76204-5619
940-898-3378 Fax 940-898-3416
e-mail: IRB@twu.edu

March 25, 2009

Ms. Rebecca Fountain

Dear Ms. Fountain:

Re: Nurse Educators' Consensus Opinion of High Fidelity Patient Simulation

The above referenced study has been reviewed by the TWU Institutional Review Board (IRB) and appears to meet our requirements for the protection of individuals' rights.

If applicable, agency approval letters must be submitted to the IRB upon receipt PRIOR to any data collection at that agency. A copy of the approved consent form with the IRB approval stamp and a copy of the annual/final report are enclosed. Please use the consent form with the most recent approval date stamp when obtaining consent from your participants. The signed consent forms and final report must be filed with the Institutional Review Board at the completion of the study.

This approval is valid one year from March 25, 2009. According to regulations from the Department of Health and Human Services, another review by the IRB is required if your project changes in any way, and the IRB must be notified immediately regarding any adverse events. If you have any questions, feel free to call the TWU Institutional Review Board.

Sincerely,

Dr. David Nichols, Chair
Institutional Review Board - Denton

enc.

cc. Dr. Patricia Holden-Huchton, College of Nursing
Gail Davis, College of Nursing
Graduate School

APPENDIX B

Participant Invitation E-mail

Participant Invitation E-mail

To: Undergraduate Texas Nursing Faculty Member

Subject: Invitation to participate in Dissertation study
"Nurse Educators' Consensus Opinion of High Fidelity Patient Simulation"

Body of e-mail:

You are invited to participate in a dissertational research study being conducted by Rebecca Fountain, RN, MSN, a doctoral student at Texas Woman's University. The major purpose of this Delphi study will be to explore opinions of Texas nursing educators about the implementation of high fidelity human patient simulators (HPS) in clinical teaching of undergraduate nursing students and to develop a consensus opinion about implementation of this innovation. In light of how limited public educational dollars are being reduced and allocated across the State, it is imperative to investigate and report back to these funding agencies Texas nursing educators' consensus opinion of high fidelity human patient simulator use. This study is intended to provide needed information to assist in the process of program development by those responsible for the delivery, evaluation, and funding of nursing education programs. Eligibility to participate includes (1) being a full-time faculty member in an associate degree, diploma, or baccalaureate school of nursing in Texas and (2) continuous teaching of a clinical nursing course for at least one academic year. Having used HPS as part of clinical teaching is not a requirement.

Study participation will consist of completing a series of three questionnaires and a General Information Form that will be embedded in *Psych Data*. Your responses will be anonymous to both the researcher and other respondents. This secure, reliable and encrypted Website will be used to store all data and host each round of survey questioning. Participation in the study will involve responding to three rounds of questioning aimed at determining consensus opinion. The researcher has estimated that the maximum total time commitment for study participation is approximately 60 minutes, divided into parts (approximately 20 minutes each) over a 3-4 month period.

The potential risk for this study is loss of confidentiality and loss of time. There is a potential loss of confidentiality in email, Internet, and downloading transactions. Measures will be taken to reduce risk through the use of *PsychData*. Your involvement in this research study is completely voluntary, and you may discontinue your participation in the study at any time without penalty. Should you choose to participate in the study, the consent form and initial questionnaire can be found at the following web address: https://www.psychdata.com/s.asp?SID=129261

Thanks so much for your consideration. If you have any questions, please feel free to contact me by phone or e-mail. Your e-mail address will not be retained, and the e-mail will be deleted from the computer as soon as your question is answered.

Rebecca A. Fountain, RN, MSN
rfountain@mail.uttyl.edu
(903) 566-7096 (voice mail work)

APPENDIX C

Approved TWU Consent Form

Approved TWU Consent Form

TEXAS WOMAN'S UNIVERSITY
CONSENT TO PARTICIPATE IN RESEARCH

Title: Nurse Educators' Consensus Opinion of High Fidelity Patient Simulation

Investigator: Rebecca Fountain, RN, MSN..903/566-7096..Rebecca_Fountain@uttyler.edu
Advisor: Gail Davis, RN, EdD.......940/898-2409....................................gdavis@twu.edu

Explanation and Purpose of the Research

You are being asked to participate in a research study for Mrs. Fountain's dissertation at Texas Woman's University. The purpose of this Delphi research study will be to explore opinions of Texas nursing educators about the implementation of high fidelity human patient simulators (HPS) in clinical teaching of undergraduate nursing students and to develop a consensus opinion about implementation of this innovation. This study is intended to provide needed information to assist in the process of program development by those responsible for the delivery, evaluation, and funding of nursing education programs.

Research Procedures

For this study, the investigator will ask the participant to complete a series of questionnaires that will be embedded in *PsychData*, a secure, reliable and encrypted Website which will be used to store participant demographic and identifying information and host each round of the survey questions and responses. The study will include three rounds of questions, spread out over 3 to 4 months. During this time, your participation will be requested two more times following this initial round. The subsequent rounds will follow the receipt and analysis of data from the previous round. Round one will ask participants to complete a general information sheet and to freely generate responses to two open-ended questions regarding what factors have facilitated or hindered the implementation of HPS into nursing clinical coursework. During Round 2 of the study, participants will be provided reduced statements generated from the first round and asked to rank their importance on an ordinal scale. During Round 3 of the study, participants will be provided the Round 2 results, including statistical information that indicates collective group opinion. Given this information, participants will be asked to again rank the opinions. The estimated time for participation in all three rounds of the study is a maximum of 60 minutes (1 hour), with each round of taking approximately 20 minutes to complete.

Potential Risks

A possible risk related to your participation in the study is loss of confidentiality. There is a potential loss of confidentiality in email, Internet, and downloading transactions. Confidentiality will be protected to the extent that is allowed by law. Measures will be taken to reduce risk through the use of *PsychData*, a secure, reliable and encrypted Website. The researcher will have no hard copies of participant demographic information or any other identifying material. The participant's identity will remain anonymous to the researcher and other participants. Participants will register with *PsychData,* giving their e-mail address and a password. This information will be stored in a file that is separate from the survey data. It will be accessed only for resending the data for Rounds 2 and 3; no attempt will be made to match it with survey responses. The registration data file will be deleted from *PsychData* upon analysis of the data and completion of the study, when the e-mail is used for a final time to send to the participants a link to an abstract of the study findings. The survey data will be downloaded from *PsychData* to the researcher's computer for the purpose of data analysis, with no identification of the respondent. The researcher's computer and network access is password protected, and the researcher also has an assigned password allowing her to access the *PsychData* account. Any survey results that are presented or published will include only collective responses.

Another possible risk related to your participation in the study is loss of time. The maximum total time commitment estimated for study participation is approximately 60 minutes, divided into 3 parts (approximately 20 minutes each) over a 3-4 month period. The participant may determine the time that is best for responding; the password will allow entry to the system at another time, if it is not possible to complete the response at one time. You may withdraw from the study at any time.

The researchers will try to prevent any problem that could happen because of this research. You should let the researchers know at once if there is a problem and they will help you. However, TWU does not provide medical services or financial assistance for injuries that might happen because you are taking part in this research.

Participation and Benefits

Your involvement in this research study is completely voluntary, and you may discontinue your participation in the study at any time. The research and literature regarding HPS is limited and largely anecdotal regarding the opinions of nursing faculty about its implementation. This study would attempt to rectify that deficiency. This study has the potential to assist university and nursing administrators, as well as legislators, in making decisions about investment in the use of HPS in the nursing curriculum. The only direct benefit of this study to you is that at the completion of the study a summary of the results will be made available to you. These may be accessed, approximately May, 2010 Clarifies part 3 at http://www.uttyler.edu/nursing/research/.

Questions Regarding the Study

If you have any questions about the research study you may ask the researchers; their phone numbers and e-mail addresses are at the top of this form. You may send your question(s) anonymously; there is no need to give your name. Your e-mail address will not be retained, and the e-mail will be deleted from the computer as soon as your question is answered. If you have any questions about the research study you should ask the researchers; their phone numbers are at the top of this form.

If you have questions about your rights as a participant in this research or the way this study has been conducted, you may contact the Texas Woman's University Office of Research and Sponsored Programs at 940-898-3378 or via e-mail at IRB@twu.edu.

Informed Consent

Please note that by clicking on the option that you agree to participate in this study, you are indicating your informed consent to participate in the study. If you have read and understand the above statements, please click on either "Yes, agree to participate" or "No, do not agree to participate." Agreement to participate will take you to the demographic form followed by the two initial study questions. Before proceeding, please print a copy of the consent form to retain for your records. If you do not agree to participate, simply close this Internet address with the consent form.

APPENDIX D

Demographic Questionnaire

Demographic Questionnaire

<u>Instructions:</u> Please choose or fill-in the answer which best describes you and your situation.

1. What is your highest educational preparation?
A). BSN, BS, or other baccalaureate degree
B). MSN, MS, or other master's degree
C). PhD, EdD, or other doctorate
D.) Other: Specify:______________________________

2. Do you teach associate, diploma or baccalaureate professional nursing?
A). Associate
B). Diploma
C). Baccalaureate

3. How many years have you been a nurse educator?
A). 1-4 years
B). 4-7 years
B). 7-10 years
C). 10-15 years
D). 15-20 years
E). 20+ years

4. In which region of Texas do you teach nursing?
A). <u>Panhandle Plains</u> (Amarillo, Lubbock and surrounding area)
B). <u>Big Bend Country</u> (El Paso and surrounding areas)
C). <u>Hill Country</u> (Austin, Fredericksburg, Wimberley, Kerrville and surrounding areas)
D) <u>Prairies and Lakes</u> (Dallas, Fort Worth, Waco, and surrounding areas)
E) <u>Piney Woods</u> (Marshall, Nacogdoches, Tyler and surrounding areas)
F). Gulf Coast (Galveston, Beaumont, Corpus Christi, Houston, Brownsville and surrounding areas)
G). South Texas Plains (San Antonio, and surrounding areas)

5. Which brand of high-fidelity human patient simulator (HPS) do you use?
A). Laerdal Sim Man
B). METI
C). I do not have high-fidelity human simulators available
D). Other (Define)____________________________________

6. How many years have you been using HPS as part of your clinical course(s)?
A). 0 years
B). 1 years
C). 2 years
D). 3 years
E). 4 years
F). 5 years
G). 6+ years

7. In which courses do you use HPS? (Choose all that apply).
A). Health Assessment
B). Fundamentals of nursing content
C). Medical surgical nursing content
D). Intensive/Critical care nursing content
E). Obstetrical or family nursing content
F). Community Health nursing content
G). Leadership or management nursing content
H). Psychiatric nursing
I). Other: Specify:________________________________
J). Do not use high-fidelity simulator in any course.

8. As a faculty member, how much training have you obtained to be able to use HPS? (Choose all that apply)
A). I attended training seminars and was able to practice at these seminars with the HPS
B). I have read simulation research and education articles
C). I became exposed to it by watching other faculty members
D). None, I learned through trial and error.
E). Other: Specify:____

9. Describe the support you have for using HPS simulation
A). I create the simulation case studies, run the case scenarios, and program the computer
B). I create the case studies, but there is someone available to help run the simulation scenarios
C). Someone else created the case studies, yet I have to run the simulation scenarios
D). I have a simulation laboratory fully staffed with a person who programs and runs the developed case scenarios.
E). The school purchased simulation case studies, but I run the case scenarios
F). Other: ____

10). Is HPS laboratory time accepted as part of required clinical time in your program?
A). Yes
B). No

11). If HPS is accepted as part of required clinical time in your program, how many hours are delegated to the HFHS lab? ____________________

12). Please describe how you are using HFHS within your course.

APPENDIX E

Delphi Initial Survey Questions

Initial survey questions

Round 1

1. In your opinion, what factors have facilitated, or could facilitate, the implementation of HPS into the clinical nursing course you teach?

2. In your opinion, what factors have hindered, or could possibly hinder, the implementation of HPS into the clinical nursing course you teach?

Round 2

1. Please rank the importance of each issue listed below based on your educational experience.

Round 3

1. Please review the issues identified by the group. If you believe that a consensus has been reached, please indicate that you agree. If you do not believe a consensus has been reached please indicate that you disagree and provide your opinion as to why you disagree and what issues you think should be added.

Appendix F

Delphi Round 2 and Round 3 Likert Scale

Facilitators and Hindrances of HPS in Nursing Education

Instructions:

This questionnaire includes a series of statements of your personal opinions about what facilitates or hinders the use of simulation in nursing education. These statements represent the opinions of educators who responded to the first round of this Delphi study which asked you and others to identify factors that (1) have hindered, or could possibly hinder, or (2) have facilitated, or could facilitate, the implementation of high fidelity patient simulators (HPSs). The statements are arranged under representative headings. Please note that HINDRANCE statements are listed first, followed by FACILITATOR statements.

In this second round, you are asked to rate the level of your agreement with each statement. There are no right or wrong answers. The rating that you select, based on the rating scale below, should reflect your own personal opinion about each statement. None of your responses will be personally identified with you.

Please Mark:

1=STRONGLY DISAGREE with the statement
2=DISAGREE WITH THE STATEMENT
3= SOMEWHAT DISAGREE with the statement
4=NEITHER AGREE OR DISAGREE with the statement
5=SOMEWHAT AGREE with the statement
6=AGREE with the statement
7=STRONGLY AGREE with the statement

Resource Hindrances to implementing HPS into nursing education

1. Inadequate funding to purchase the simulators.
2. Inadequate funding to maintain the simulators.
3. Inadequate funding to provide appropriate support equipments (e.g. videotaping, crash cars, oxygen therapy).
4. Inadequate numbers of developed case scenarios for medical/surgical nursing available for use.
5. Inadequate numbers of developed case scenarios for diverse nursing specialties (e.g., psychiatric nursing and leadership) available for use.

Faculty Hindrances to implementing HPS into nursing education

1. Faculty members' workloads would be increased due to the time required to incorporate into their course, including creating, preparing, and operating scenarios for students.
2. A faculty member's attitude toward change; moving away from traditional teaching strategies, integrating new educational innovations, and learning new technology could limit their acceptance and integration of HPS into their course.
3. Faculty shortages across the state may limit a schools 'ability to integrate HPS.

4. Faculty members concern for grading simulation activities could limit their acceptance and integration of HPS.
5. A lack of scientific nursing evidence that demonstrates improved NCLEX results occur with the use of HPS.
6. Lack of current clinical knowledge by the faculty member, e.g. ability to implement current standards of practice.

Student **Hindrances to implementing HPS into nursing education**

1. There is a lack of scientific nursing evidence that demonstrates the effectiveness and improvement in students' critical thinking and clinical judgment through using HPS.
2. Students not perceiving the simulation as 'real life.'
3. The students' learning experiences would be diminished by taking them away from real patients.
4. Reconciling the value of 1-2 hour HPS scenario with the amount of real clinical hours a student attends.

Laboratory **Hindrances to implementing HPS into nursing education**

1. Scheduling conflicts with other clinical courses requiring the skills lab when scheduling time for course activities that use HPS.
2. A lab with insufficient space makes it difficult to run simulations.

Administrative **Hindrances to implementing HPS into nursing education**

1. Lack of administrative support and knowledge of desired outcomes for a HPS program.
2. Lack of appropriate regulatory guidelines by the BON on the percent of clinical time HPS can replace real world clinical time.

Resources **Facilitators of implementing HPS in nursing education**

1. Readily available realistic equipment for use, i.e., IV pumps that work, monitors, or ventilators.
2. Well-designed, evidence-based simulation case scenarios developed for specific course objectives, e.g. leadership, critical care, obstetrical, medical-surgical or psychiatric scenarios.
3. Funding to update simulation equipment, lab, and other equipment.
4. Availability of instruments to evaluate and grade simulation activities.

Faculty **Facilitators of implementing HPS in nursing education**

1. Faculty members are provided release time from faculty workload and other duties to develop and implement simulation.
2. A core group of faculty members who are enthusiastic and dedicated to developing and improving the simulation program in a nursing school, e.g. simulation cheerleaders.
3. Maintaining consistency of faculty members who have been trained on the equipment and scenarios to run the labs.
4. Appropriate education on the simulation equipment, e.g. workshops sponsored by the vendor.

5. Appropriate education on teaching with simulation into the coursework. Guidelines on incorporating simulation objectives of criteria into course syllabi.
6. Adding a stipend to salary to implement stimulation into the coursework.
7. Guidelines on incorporating simulation objectives of criteria into course syllabi.
8. Faculty members with attitudes who will embrace innovative methods for delivering nursing content and be willing to change teaching methodology.
9. Engaging and sharing responsibility of the Sim-Lab with other faculty members in the school so that the cheerleader is not the sole caretaker of the lab.
10. Need for increased sharing of information between educators on appropriate methodologies, research, scenarios, e.g. publications.
11. Being able to utilize products created for simulation as scholarship activities.

Student Facilitators of implementing HPS in nursing education

1. Allows students to practice communication and enhance their nursing skills in a safe/controlled environment.
2. Enables students to critically analyze and understand complex concepts.
3. Allows students to practice in inter-professional teams, allowing them to practice communication and delegation while caring for patients together.
4. Reduces fear the student may experience.
5. Allows students to feel more secure about their practice prior to entering a clinical setting.
6. Limited clinical sites/spots are becoming overwhelmed by students.
7. Student enthusiasm for the more realistic simulation experiences.
8. Allows the student to care for patients where there may be a limited population of patients, e.g. pediatric patients or where there is an inconsistency in patient population.
9. Allows the student to receive immediate feedback on performance through debriefing after the simulation scenario.

Laboratory Facilitators of implementing HPS in nursing education

1. Having someone available to run and troubleshoot the computer and other technological components of the HPS so that the instructor can teach/focus on the students.
2. A full time dedicated Sim-Lab coordinator/learning lab coordinator who would help with setting up the lab, ordering simulation supplies, etc.

Administrative	**Facilitators of implementing HPS in nursing education**
1.	Leadership encourages simulation use. Leadership embraces change in education methodology, of new innovations/ideas in teaching. Leadership in program provides vital support, e.g. release time from other duties, sending to workshops, etc. If unable to provide at own school, leaders who are willing to seek out opportunities to enter agreements with other facilities to share limited resources.

APPENDIX G

Round 2 E-mail

Appendix G

Participant in Delphi Study:

Thanks so much for your participation in Round 1 of the Delphi study aimed at gaining consensus of nursing educators' opinions about the implementation of human patient simulators in undergraduate nursing education programs in Texas. I am now requesting your participation in Round 2.

As in Round 1, and as stated in the original Consent to Participate, measures will be taken to protect your confidentiality through the use of *PsychData*, a secure, reliable, and encrypted Website. The researcher will have no hard copies of participant demographic information or any other identifying material. Your identity will remain anonymous to the researcher and other participants. None of your responses will be personally identified with you.

Completion of Round 2 should take approximately 20 minutes, and you will have the option of completing at one time or of saving your responses and completing later. Completion is requested by **November 11, 2009.**

Thank you for your continued participation in this research. If you have any questions regarding the study, please feel free to contact me at 903-566-7096.

To access the study, please open the following Internet site:

https://www.psychdata.com/s.asp?SID=127979

You will need to enroll as a new participant.

Thank you!
Rebecca Fountain
Doctoral Candidate
Texas Woman's University – Denton

APPENDIX H

Round 2 Reminder E-mail

Appendix H

Participant in Delphi Study:

Thanks so much for your participation in Round 1 of the Delphi study aimed at gaining consensus of nursing educators' opinions about the implementation of human patient simulators in undergraduate nursing education programs in Texas. I am now requesting your participation in Round 2.

As in Round 1, and as stated in the original Consent to Participate, measures will be taken to protect your confidentiality through the use of *PsychData*, a secure, reliable, and encrypted Website. The researcher will have no hard copies of participant demographic information or any other identifying material. Your identity will remain anonymous to the researcher and other participants. None of your responses will be personally identified with you.

Completion of Round 2 should take approximately 20 minutes, and you will have the option of completing at one time or of saving your responses and completing later. Completion is requested by **November 11, 2009.**

Thank you for your continued participation in this research. If you have any questions regarding the study, please feel free to contact me at 903-566-7096.

To access the study, please open the following Internet site:

https://www.psychdata.com/s.asp?SID=127979

You will need to enroll as a new participant.

Thank you!
Rebecca Fountain
Doctoral Candidate
Texas Woman's University – Denton

APPENDIX I

Round 3 E-mail

Appendix I

Participant in Delphi Study:

Thank you so much for your participation in Round 2 of the Delphi study aimed at gaining consensus of nursing educators' opinions about the implementation of human patient simulators in undergraduate nursing education programs in Texas. I am now requesting your participation in Round 3 to ***complete*** the study.

As in Round 1 and 2, and as stated in the original Consent to Participate, measures will be taken to protect your confidentiality through the use of *PsychData*, a secure, reliable, and encrypted Website. The researcher will have no hard copies of participant demographic information or any other identifying material. Your identity will remain anonymous to the researcher and other participants. None of your responses will be personally identified with you.

Completion of Round 3 should take approximately 20 minutes, and you will have the option of completing at one time or of saving your responses and completing later. Completion is requested by **December 17, 2009.**

Round 3 of this study is being provided by to you in a similar manner as round 2 on the psych data site. The opinion statements will include the group's mean, standard deviation, and range of responses. The mean represents the group's opinion of that particular statement. The standard deviation represents the amount of disagreement about that statement among the group. I am requesting that you re-rate your opinion on the importance of the items. This allows you the opportunity to change your mind regarding your own opinion.

Thank you for your continued participation in this research. If you have any questions regarding the study, please feel free to contact me at 903-566-7096.

To access the study, please open the following Internet site:

https://www.psychdata.com/s.asp?SID=132885

You will need to re-enroll as a new participant (just once more!).

Thank you so much for your participation!
Rebecca Fountain
Doctoral Candidate
Texas Woman's University – Denton

APPENDIX J

Round 3 Reminder E-mail

Appendix J

Participant in Delphi Study:

Thank you so much for your participation in Round 1 and/or 2 of the Delphi study aimed at gaining consensus of nursing educators' opinions about the implementation of human patient simulators in undergraduate nursing education programs in Texas. I am now requesting your participation in Round 3 to ***complete*** the study. If you have already responded to the request, please disregard this e-mail.

As in Round 1 and 2, and as stated in the original Consent to Participate, measures will be taken to protect your confidentiality through the use of *PsychData*, a secure, reliable, and encrypted Website. The researcher will have no hard copies of participant demographic information or any other identifying material. Your identity will remain anonymous to the researcher and other participants. None of your responses will be personally identified with you.

Completion of Round 3 should take approximately 20 minutes, and you will have the option of completing at one time or of saving your responses and completing later. Completion is requested by**, January 26, 2010.**

Round 3 of this study is being provided by to you in a similar manner as round 2 on the psych data site. The opinion statements will include the group's mean, standard deviation, and range of responses. The mean represents the group's opinion of that particular statement. The standard deviation represents the amount of disagreement about that statement among the group. I am requesting that you re-rate your opinion on the importance of the items. This allows you the opportunity to change your mind regarding your own opinion.

Thank you for your continued participation in this research. If you have any questions regarding the study, please feel free to contact me at 903-566-7096.

To access the study, please open the following Internet site:

https://www.psychdata.com/s.asp?SID=132885

You will need to re-enroll as a new participant (just once more!).
Thank you so much for your participation!
Rebecca Fountain
Doctoral Candidate
Texas Woman's University – Denton

APPENDIX K

Round 2 Table of Facilitating Statements

Appendix K

Round 2 Facilitators of implementing HPS in nursing education

	Facilitator Statement	M	SD
Resources			
1.	Readily available realistic equipment for use: i.e. IV pumps that work, monitors or ventilators.	5.25	1.64
2.	Well designed, evidence-based simulation case scenarios developed for specific course objectives, e.g. leadership, critical care, obstetrical, medical-surgical or psychiatric scenarios.	5.25	1.40
3.	Funding to update simulation equipment, lab, and other equipment.	5.61	1.70
4.	Availability of instruments to evaluate and grade simulation activities.	5.06	1.57
Faculty			
1.	Faculty members are provided release time from faculty workload and other duties to develop and implement simulation.	4.57	2.27
2.	A core group of faculty members who are enthusiastic and dedicated to developing and improving the simulation program in a nursing school, e.g. simulation cheerleaders.	5.63	1.57
3.	Maintaining consistency of faculty members who have been trained on the equipment and scenarios to run the labs.	5.63	1.46
4.	Appropriate education on the simulation equipment, e.g. workshops sponsored by the vendor.	5.43	1.63
5.	Appropriate education on teaching with simulation scenarios, e.g. simulation workshops on and off campus.	6.6	1.56
6.	Adding a stipend to salary to implement simulation into the coursework.	5.14	1.91
7.	Guidelines on incorporating simulation objectives of criteria into course syllabi.	5.54	1.40
8.	Faculty members with attitudes who will embrace innovative methods for delivering nursing content and be willing to change teaching methodology.	6.12	1.28
9.	Engaging and sharing responsibility of the Sim-Lab with other faculty members in the school so that the 'cheerleader' in not the sole caretaker of the lab.	6.29	1.07

(table continues)

Table continued

10.	Need for increased sharing of information between educators on appropriate methodologies, research, scenarios, e.g. publications.	6.02	1.29
11.	Being able to utilize products created for simulation as scholarship activities.	----	----
Student			
1.	Allows students to practice communication skills in a safe/controlled environment.	6.31	0.93
2.	Allows students to enhance their nursing skills in a safe/controlled environment.	6.54	0.70
3.	Enables students to critically analyze and understand complex concepts.	6.34	0.838
4.	Allows students to practice in inter-professional teams, allowing them to practice communication and delegation while caring for patients together.	5.83	1.42
5.	Reduces fear the student may experience.	5.34	1.59
6.	Allows students to feel more secure about their practice prior to entering a clinical setting.	5.77	1.95
7.	Eases the demands for clinical learning sites that are becoming overwhelmed by students.	5.86	1.16
8.	Student enthusiasm for the more realistic simulation experiences.	5.94	1.16
9.	Allows the student to care for patient where there may be limited population of patients, e.g. pediatric patients or where there is an inconsistency of patient population.	6.34	0.87
10.	Allows teh student to receive immediate feedback on performance through debriefing after the simulation scenario.	6.6	0.65
LAB			
1.	Having someone available to run and troubleshoot the computer and other technological components of the HPS so that the instructor can teach/focus on the students.	6.54	1.15
2.	A full time dedicated Sim-Lab coordinator/learning lab coordinator who would help with setting up the lab, ordering simulation supplies, etc.	6.57	1.15
3.	Dedicated Sim-Lab staff that help with setting up and changing case scenarios between clinical groups.	6.51	1.15

(table continues)

Table continued

	4. Adequate space/facility to house simulation that offers a supportive physical environment and not having to compete with other courses for the room.	6.43	1.40
Administrative			
	1. Leadership encourages simulation use.	6.28	1.11
	2. Leadership embraces change in education methodology, encouraging the creation and trial of new innovations/ideas in teaching.	6.29	1.00
	3. Leadership in program provides vital support, e.g. release time from other duties, sending to workshops, etc.	5.69	1.94
	4. If unable to provide at own school, leaders who are willing to seek out opportunities to enter agreements with other facilities to share limited resources.	5.94	1.41

APPENDIX L

Round 2 Table of Hindrance Statements

Round 2

Hindrances of implementing HPS in nursing education

	Hindrance Statement	M	SD
Resources			
1.	Inadequate funding to purchase the simulators.	5.39	1.57
2.	Inadequate funding to maintain the simulators.	5.44	1.38
3.	Adequate funding to provide appropriate support equipment, e.g. videotaping, crash carts, oxygen therapy.	5.67	1.43
4.	Inadequate numbers of developed case scenarios for medical/surgical nursing available for use.	4.25	1.68
5.	Inadequate numbers of developed case scenarios for diverse nursing specialties (e.g., psychiatric nursing and leadership) available for use.	5.08	1.4
Faculty			
1.	Faculty members' workloads would be increased due to the time required to incorporate into their course, including creating, preparing, and running scenarios for students.	6.0	1.29
2.	A faculty member's attitude toward change; moving away from traditional teaching strategies, integrating new educational innovations, and learning new technology could limit their acceptance and integration of HPS into their course.	5.22	1.5
3.	Faculty shortages across the state may limit a schools ability to integrate HPS.	5.44	1.28
4.	Faculty members concern for grading simulation activities could limit their acceptance and integration of HPS.	4.81	1.37
5.	A lack of scientific nursing evidence that demonstrates improved NCLEX results occur with the use of HPS.	4.64	1.4
Student			
1.	There is a lack of scientific nursing evidence that demonstrates the effectiveness and improvement in students' critical thinking and clinical judgment through using HPS.	3.83	1.40
2.	Students not perceiving the simulation as 'real life'.	4.06	1.64
3.	The students' learning experience would be diminished by taking them away from real patients.	3.25	1.83

(table continues)

Table continued

	Reconciling the value of a 1-2 hour HPS scenario with the amount of real clinical hours a student attends.	4.03	1.58
LAB			
	Conflicts occur with other clinical courses while scheduling time in the HPS lab for course activities requiring the skills lab.	5.28	1.6
	A lab with insufficient space makes it difficult to run simulations.	5.72	1.28
Administrative			
	Lack of administrative support for HPS implementation	4.14	1.87
	Lack of administrative knowledge of desired outcomes for a HPS program	4.5	1.68
	Lack of appropriate regulatory guidelines by the board of nursing on the percent of clinical time HPS can replace real world clinical time.	4.53	1.34

APPENDIX M

Round 3 Table of Facilitating Statements

Round 3 Facilitators of implementing HPS in nursing education

Table
Round 3 Facilitators of implementing HPS in nursing education

	Facilitator Statement	M	SD
Resources			
1.	Readily available realistic equipment for use: i.e. IV pumps that work, monitors or ventilators.	5.02	1.73
2.	Well designed, evidence-based simulation case scenarios developed for specific course objectives, e.g. leadership, critical care, obstetrical, medical-surgical or psychiatric scenarios.	5.15	1.49
3.	Funding to update simulation equipment, lab, and other equipment.	5.49	1.50
4.	Availability of instruments to evaluate and grade simulation activities.	5.27	1.32
Faculty			
1.	Faculty members are provided release time from faculty workload and other duties to develop and implement simulation.	4.71	2.12
2.	A core group of faculty members who are enthusiastic and dedicated to developing and improving the simulation program in a nursing school, e.g. simulation cheerleaders.	5.15	1.64
3.	Maintaining consistency of faculty members who have been trained on the equipment and scenarios to run the labs.	5.29	1.52
4.	Appropriate education on the simulation equipment, e.g. workshops sponsored by the vendor.	5.24	1.64
5.	Appropriate education on teaching with simulation scenarios, e.g. simulation workshops on and off campus.	5.37	1.58
6.	Adding a stipend to salary to implement simulation into the coursework.	4.688	2.12
7.	Guidelines on incorporating simulation objectives of criteria into course syllabi.	5.02	1.39
8.	Faculty members with attitudes who will embrace innovative methods for delivering nursing content and be willing to change teaching methodology.	5.63	1.53

(table continues)

Table continued

9.	Engaging and sharing responsibility of the Sim-Lab with other faculty members in the school so that the 'cheerleader' in not the sole caretaker of the lab.	5.73	1.53
10.	Need for increased sharing of information between educators on appropriate methodologies, research, scenarios, e.g. publications.	5.63	1.28
11.	Being able to utilize products created for simulation as scholarship activities.	5.61	1.26
Student			
1.	Allows students to practice communication skills in a safe/controlled environment.	5.80	1.25
2.	Allows students to enhance their nursing skills in a safe/controlled environment.	5.98	1.14
3.	Enables students to critically analyze and understand complex concepts.	5.78	1.15
4.	Allows students to practice in inter-professional teams, allowing them to practice communication and delegation while caring for patients together.	5.48	1.47
5.	Reduces fear the student may experience.	4.88	1.44
6.	Allows students to feel more secure about their practice prior to entering a clinical setting.	5.26	1.36
7.	Eases the demands for clinical learning sites that are becoming overwhelmed by students.	4.95	1.66
8.	Student enthusiasm for the more realistic simulation experiences.	5.15	1.49
9.	Allows the student to care for patient where there may be limited population of patients, e.g. pediatric patients or where there is an inconsistency of patient population.	5.71	1.45
10.	Allows teh student to receive immediate feedback on performance through debriefing after the simulation scenario.	6.00	1.14
LAB			
1.	Having someone available to run and troubleshoot the computer and other technological components of the HPS so that the instructor can teach/focus on the students.	6.10	1.37
2.	A full time dedicated Sim-Lab coordinator/learning lab coordinator who would help with setting up the lab, ordering simulation supplies, etc.	6.34	1.13

(table continues)

Table continued

	3. Dedicated Sim-Lab staff that help with setting up and changing case scenarios between clinical groups.	6.24	1.16
	4. Adequate space/facility to house simulation that offers a supportive physical environment and not having to compete with other courses for the room.	6.17	1.24
Administrative			
	1. Leadership encourages simulation use.	5.93	1.23
	2. Leadership embraces change in education methodology, encouraging the creation and trial of new innovations/ideas in teaching.	6.02	1.25
	3. Leadership in program provides vital support, e.g. release time from other duties, sending to workshops, etc.	5.56	1.83
	4. If unable to provide at own school, leaders who are willing to seek out opportunities to enter agreements with other facilities to share limited resources.	5.70	1.4

APPENDIX N

Round 3 Table of Hindrance Statements

Round 2 Hindrances of implementing HPS in nursing education

	Hindrance Statement	M	SD
Resources			
1.	Inadequate funding to purchase the simulators.	4.63	1.93
2.	Inadequate funding to maintain the simulators.	4.78	1.75
3.	Adequate funding to provide appropriate support equipment, e.g. videotaping, crash carts, oxygen therapy.	5.25	1.63
4.	Inadequate numbers of developed case scenarios for medical/surgical nursing available for use.	4.37	1.82
5.	Inadequate numbers of developed case scenarios for diverse nursing specialties (e.g., psychiatric nursing and leadership) available for use.	5.18	1.41
Faculty			
1.	Faculty members' workloads would be increased due to the time required to incorporate into their course, including creating, preparing, and running scenarios for students.	5.43	1.43
2.	A faculty member's attitude toward change; moving away from traditional teaching strategies, integrating new educational innovations, and learning new technology could limit their acceptance and integration of HPS into their course.	5.03	1.80
3.	Faculty shortages across the state may limit a schools ability to integrate HPS.	5.17	1.36
4.	Faculty members concern for grading simulation activities could limit their acceptance and integration of HPS.	4.55	1.51
5.	A lack of scientific nursing evidence that demonstrates improved NCLEX results occur with the use of HPS.	4.33	1.18
Student			
1.	There is a lack of scientific nursing evidence that demonstrates the effectiveness and improvement in students' critical thinking and clinical judgment through using HPS.	3.73	1.47
2.	Students not perceiving the simulation as 'real life'.	3.93	1.58
3.	The students' learning experience would be diminished by taking them away from real patients.	3.15	1.46

(table continues)

Table continued

4.	Reconciling the value of a 1-2 hour HPS scenario with the amount of real clinical hours a student attends.	3.92	1.46
Lab			
1.	Conflicts occur with other clinical courses while scheduling time in the HPS lab for course activities requiring the skills lab.	4.98	1.58
2.	A lab with insufficient space makes it difficult to run simulations.	5.33	1.68
Administrative			
1.	Lack of administrative support for HPS implementation	4.02	1.72
2.	Lack of administrative knowledge of desired outcomes for a HPS program	4.35	1.70
3.	Lack of appropriate regulatory guidelines by the board of nursing on the percent of clinical time HPS can replace real world clinical time.	4.25	1.60