



## **Web-Enhanced Instruction and Simulation: Technologies That Can Bridge the Theory to Practice Gap**

by

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### **Abstract**

The acuity of hospitalized patients has steadily increased causing newly graduated nurses to feel overwhelmed, stressed and incompetent. Two types of technologies that can improve confidence, psychomotor skills, and organization are web-enhanced instruction and high fidelity simulators. Their benefits and limitations are studied along with a proposed implementation plan. Current research is reviewed and a small scale research study was conducted at the British Columbia Institute of Technology comparing student test scores and survey responses between students taking a clinical techniques course before and after the implementation of a web-enhanced module and simulation exercise. Results were congruent with what research was showing: utilizing these technologies can help to decrease the theory to practice gap in nursing education.

## **Web-Enhanced Instruction and Simulation: Technologies That Can Bridge the Theory to Practice Gap**

Nursing is a profession that requires complex problem-solving, organization and psychomotor skills in order to provide the best care possible to a patient. The transfer of these skills from the laboratory and classroom setting to the clinical setting remains a struggle for many nursing students especially with the increasing acuity of hospitalized patients. This dichotomy is known in nursing as the theory to practice gap. Educational institutions have traditionally been settings where students learn theoretical and professional systems of knowledge; the hospital setting is viewed as the practice setting where learning is applied (Heslop, McIntyre & Ives, 2001). The transfer of nursing skills to the workplace can be an area of concern for newly graduated nurses who are expected to make a quick transition into their new professional role. New nursing graduates feel stressed and lack the confidence, organizational skills and psychomotor skills required to make an easy transition from the student to new graduate role. This article suggests that the implementation of simulation and web-enhanced learning technology into nursing education can help students gain confidence and competence in their nursing practice. The benefits and limitations of each technology is reviewed along with results from a small scale research project undertaken at the British Columbia Institute of Technology.

### **Defining the Issue**

The state of health care in Canada has changed over the last few decades. The health care system is facing a critical nursing shortage due to the retiring baby boomer generation along with the highest rate of population growth among G8 countries (CNA, 2006). Statistics demonstrate that nursing enrollments are not keeping pace with the shortfall of nurses predicted in the next

decade (Canadian Nursing Advisory Committee, 2002). There is also more emphasis on patients being nursed at home leading to only the more acutely ill patients being admitted to the hospital. Hospital stays are shorter and acuity levels are higher leading to an increased need for newly graduated nurses to be organized, confident, competent and adaptable. Experienced nurses and managers find that many students and new graduates lack the critical thinking skills needed to work in the increasingly complex clinical environment (Jeffries, 2005). Many new nursing graduates have reported a stressful transition from student to graduate nurse (Gernish, 2000; Heslop et.al., 2001) causing some new graduates to exit the nursing profession (Gernish, 2000). The major concerns identified were caring for a caseload of five or six patients (organization), caring for patients with complex health problems and performing psychomotor skills (Gernish, 2000; Heslop et.al., 2001; Salyers, 2007).

### **Technology as a Possible Solution**

Nursing institutions must ensure their curriculum is comprehensive and meets the need of both patients and students. With the current nursing shortage and the need to attract more individuals into the profession, education needs to be progressive and innovative in order to engage the computer savvy generation that is entering nursing schools. Technology may be the answer to this because the implementation of technology into nursing education “increases skills in clinical reasoning and expert decision-making” (Black & Watties-Daniels, 2006, p.103). Two types of technology that can be utilized to better prepare nursing students are high fidelity simulators and web-enhanced learning modules.

### ***The Learner***

The proposed solution of implementing simulation and web-enhanced learning modules will fit nicely with the new generation of learners that are entering the nursing profession.

Generation Y (also termed the Net generation or digital generation) are those born from 1980-2004. They began entering college and university in 2000 and are predicted to pack college classrooms in the near future (Walker, Martin, White, Elliott, Norwood, Mangum & Haynie, 2006). Research into the values, learning styles and marketing potential of this generation is unfolding. Generation Y can be described as the most culturally diverse generation of all time. They are becoming known for being self-reliant, questioning, and technologically advanced, beyond any other age group (Walker, et.al., 2006). They are addicted to visual media and want learning to occur in environments that are similar to real work settings such as in simulations and virtual reality (Billings & Kowalski, 2004). Their learning environment needs to be a place that is visual, engaging, interactive and allows for hands-on learning (Paschal, 2003).

Educational institutions need to stay in focus with who their learners are because in this generation lectures may not suffice as a teaching method. Today's learners often come to the educational table with a wealth of previous experience outside of nursing and are quite particular in their needs for professional development. They want to be the drivers in their educational journey and to progress to a higher level of competency (Cloutier, Shandro & Hrycak, 2004). Educational institutions may need to re-examine the way that they approach clinical education for the generation Y learner.

### **Web-enhanced teaching**

Web-enhanced teaching, also referred in the literature as computer-assisted instruction, is a broad term that encompasses a large range of activities, including multimedia programs, interactive programs, chat rooms, virtual reality, and internet-based learning (Travale, 2007). This technology can be used as an adjunct to traditional classroom teaching and has become widely popular because it is cutting-edge and student-centered (Black & Watties-Daniels, 2006).

### ***Strengths***

Adult learners prefer education that is problem-centered, relevant and practical: “adult learning principles suggest that adults prefer a range of strategies to stimulate learning, one of which is interactive computer programs...simulating real-life situations” (Travale, 2007, p.134). A review of current literature has shown that web-enhanced teaching reduces instruction time, enhances effectiveness and mastery of learning, improves retention, and increases student motivation, satisfaction and enjoyment in learning and is not dependent on human resources to provide the education (Black & Watties-Daniels, 2006; Travale, 2007). This technology fosters student-centered learning and provides for collaborative, flexible and self-paced learning activities. Students can run through a web-based module at their own pace which affords the opportunity to review course materials at any time. Most importantly, 75% of the studies reviewed by Travale (2007) demonstrated a positive effect on skill or knowledge acquisition, and improvements in clinical reasoning and decision making ability.

Another aspect of web-enhanced teaching that should not be overlooked is its use with psychomotor nursing skills. Instead of the traditional nursing skills course where the instructor lectures for a period of time on the theory aspect of the skill followed by demonstration and student practice, the addition of a web-enhanced course could allow for the full period of time to be student practice. A study by Salyers, (2007) researched whether psychomotor skills were learned best via on-line modules or traditional instructor-lead classroom instruction. The author found that examination scores were higher with the students in the on-line module group because all of their lab time could be spent practicing the skills learned on-line before class. The conclusion was that the web-enhanced clinical skills course was both appealing to students and an important teaching tool that targets psychomotor skill acquisition for nursing students.

### ***Limitations***

There are several limitations cited in the literature with respect to web-enhanced learning. The technology can be costly to students and faculty because they may need to purchase specialized hardware and software to view documents, hear and see visual presentations on line and interact in the web-enhanced environment. The initial development of an on-line course is time consuming and students with lower levels of technological skills and modified internet access may not be able to take full advantage of a web course. Another limitation cited in the literature is that students may perceive online communication with the instructor as cold and faceless if it is strictly limited to the on-line environment. Lastly, those who are not self-directed and self-starters may find web-enhanced technology more challenging than traditional classroom lectures (Billings, 2000; Black & Watties-Daniels, 2006; Creedy, Mitchell, Seaton-Sykes, Cooke, Patterson, Purcell & Weeks, 2007; Travale, 2007).

### **BCIT Research Findings with Web-Enhanced Instruction**

In order to test the validity of the current research on web-enhanced teaching a small research project was undertaken at BCIT. Students enrolled in the level 4 clinical techniques course began using an online module to teach the skill of performing a detailed neurological assessment. All students taking the course in the Winter 2007 semester were asked to complete the neurology module for the theory portion of the class. Their test scores were compared to those students in the previous semester who did not use the online neurology module; instead they were asked to read a medical-surgical textbook to learn the skill. Both sets of students were given the same 11 exam questions and the results were analyzed. The 58 students in the Fall

2006 semester who did not use the online neurology module had an average 3 percent lower on those 11 questions than the 55 students who were able to utilize the online module (see Appendix A).

The findings of this small-scale study showed a minimal increase in test scores after using an online module but a big question still remains – would those students who used the online module perform the skill of a neurological assessment more flawlessly in the clinical setting than students who did not use the module? This is where there is a gap in the research. The literature alludes to the fact that web-enhanced learning may help close the theory to practice gap but this it is a very difficult hypothesis to test. The most important findings that came out of utilizing the online neurology module is that students enjoyed the varied learning and they liked the ability to access the module from home at their leisure.

### **Implementing Web-enhanced Teaching**

Designing a successful web-enhanced course requires time, expertise, money and institutional support. To develop the course, it is estimated that 500 hours of faculty member release time would be required per course (Black & Watties-Daniels, 2006). The faculty leader would also require technological support from the institution to create the course and audiovisual support for videotaping skill demonstrations that could be linked into the course. It would also be helpful for a first time instructor of the course to read relevant research on the best way to communicate with students in order to facilitate a supportive and warm environment for the students.

Students involved in the web-enhanced course would need to have computer access, be familiar with the technology and have the required software to run the program. There should be computers at the institution with the capability of accessing the on-line module for those who are unable to purchase a computer or obtain an internet connection. Before registering for the course students should be given ample time to complete a basic computer course allowing them to navigate basic computer functions. During the course there should be a computer help number available for timely technology advice and problem-solving. Students involved in their first web-enhanced course will need adequate instructor support and direction on how best to utilize chat rooms and discussions.

### **Simulation**

A human patient simulator is a highly sophisticated, technologically advanced mannequin in adult, child, or infant size. These mannequins fully integrate with computer software that supports the development of pre-planned scenarios that mimic a wide variety of clinical situations (Beyea & Kobokovich, 2004). Features of the simulators include a functioning cardiovascular system with palpable pulses, heart sounds, measurable blood pressure, electrocardiographic output, and invasive parameters such as arterial, central venous, and pulmonary artery pressures. Other functional components include lung and bowel sounds, the ability to respond to medical and pharmacological interventions with expected physiological responses, and programmable verbal interaction with the care provider (Beyea & Kobokovich, 2004).

When describing the accuracy of the simulation system being used the term fidelity is often heard. Fidelity is the precision of reproduction, the extent to which an electronic device

reproduces sound or images (Seropian, Brown, Gavilanes & Driggers, 2004). The goal of simulation is to achieve a high enough fidelity to convince users they are, in fact, using something that resembles what they would encounter in real life. Of course with increasing fidelity comes an increase cost. Simulators can range in price from a few thousand dollars to more than \$150,000 for the high fidelity models.

### ***Strengths***

Simulation has been cited in the literature as being a method of teaching that allows or requires learners to apply theory to practice in an integrated manner (Rauen, 2004). Through simulation, a predictable environment can be created to allow health care providers to practice under realistic conditions using actual clinical supplies (Lowenstein & Bradshaw, 2001).

Benefits include the ability to: experience preprogrammed rare events; repeat procedures and experiences (as in critical incident management); learn by making errors that do not harm a patient; observe different outcomes of a situation that stem from the actions chosen; provide a consistent experience for all learners; and practice teamwork, debriefing, and team interactions (Beyea & Kobokovich, 2004; Lowenstein & Bradshaw, 2001; Nehring, Lashley & Ellis, 2002).

Generally a simulated scenario is set up in a fashion where two students are the care providers, the faculty member serves as the support person and the rest of the group watches the scenario take place. A debriefing session is held after which allows time for participants and observers to engage in group discussion and learning based on the actions taken by the participants (Medley & Home; 2005). Rationales for clinical decisions can be discussed and alternative actions and suggestions can be made. This process allows for active learning to occur throughout the entire simulated exercise.

Adult learning occurs when the environment is both participative and interactive and when the learner receives prompt feedback (Rauen, 2004). Simulation is a method of teaching that allows the learners to apply theory to practice in an interactive manner while learning content in a contextual schema (Lowenstein & Bradshaw; Rauen, 2004). Another perspective of simulated learning is that it facilitates the three domains of learning in one session: cognitive, psychomotor and affective. Scenario participants learn by realistic experience; individuals watching the live broadcast learn as observers; and the debriefing session facilitates learning by the sharing of experiences in group discussion (Seropian et. al., 2004; Nehring, Lashley & Ellis, 2002). Cognitive learning theory also supports clinical simulation as a teaching strategy because “they force the student to be active, they require the student to use previous knowledge and skills, and they are directed toward the goal of providing the patient in the simulation with the best care possible...the student controls the learning situation by interacting with peers to complete the simulation” (Johnson, Zerwic & Theis, 1999).

Chickering & Gamson (1987) developed seven principals of good practice in undergraduate education that can also be related to simulation. Four of these principles that are emphasized in simulated activities are: uses active learning techniques; gives prompt feedback; encourages contact between students and faculty; and develops reciprocity and cooperation among students. Active learning is accomplished in simulation activities because learners are directly engaged in the activity and obtain immediate feedback and reinforcement of learning (Jeffries, 2005). Feedback is constantly being given to students in simulation scenarios by faculty, fellow students or by the human patient simulator. Students find the feedback helpful, informative and encouraging (Jeffries, 2005). Student and faculty interaction is promoted during simulation because faculty set up the scenarios, create content and learning goals and then help

the students achieve these learning goals during the simulation exercise. Lastly, reciprocity and cooperation among students occurs during simulation because the students must work together to solve problems in a situation and share in the decision-making process (Bearnson & Wiker, 2005; Jeffries, 2005). The research also showed three distinct themes in terms of the strength of simulation for learners: confidence building; improvement in competence and consolidation of clinical skills (including psychomotor).

### ***Confidence building***

One of the overwhelming themes that can result from a simulation scenario is an increase in student confidence around critical thinking and decision-making (Bearnson & Wiker, 2005; Childs & Sepples, 2006; Haskvitz & Koop, 2004; Mole & McLafferty, 2004; Jeffries, 2005; Jeffries & Rizzoli, 2006). Students are able to practice skills and interventions without the fear of causing harm to their patient and this facilitates the development confidence in the clinical setting when implementing interventions. Furthermore, they have the potential to help reduce the risk of adverse events, thereby facilitating increased positive patient outcomes (Wilson, Shepherd & Pitzner, 2005). Simulation integrates the theory from classes and readings, as well as the psychomotor skills from the skills laboratory and lessons learned from clinical practice. The “patient” is able to provide instant feedback and students can see how their interventions work “A participant indicated that she knew patients requiring narcotic agents could experience a cardiopulmonary depression following administration, but her awareness of the importance of monitoring vital signs...was heightened by her participation in a scenario with a rapidly decompensating patient (Lasater, 2007, p.273).

### ***Improvement in clinical competence***

Simulation has been shown as an effective method to help student struggling in clinical (Haskvitz & Koop, 2004). The authors of this study recognized that some students struggle to apply knowledge learned in lecture or didactic formats to clinical practice. This was the only study found that researched simulation as a tool for remediation although it was speculated that many schools are probably already doing this. Students that are struggling in clinical and receive poor performance evaluations from their preceptors or instructors are scheduled into a simulation session with their instructor. Students are then able to “redo” assigned clinical tasks and skills as many times as needed so that confidence could be restored and evidence of improvement could be found. Simulation as a tool for remediation has proved to reduce anxiety and improve self-reported confidence levels.

### ***Consolidation of clinical skills***

It has been well documented in the literature that newly graduated nurses display skill deficiency, particularly in the areas of organizational, managerial and clinical, skills (Mole & McLafferty, 2004). Reasons for this are cited as inadequate clinical placements, limited instructor supervision due to large clinical groups and increased workloads of registered nurses. Mole & McLafferty (2004) decided to study whether a simulated surgical ward exercise for students in their last clinical placement would help the students consolidate the essential core skills needed to nurse. All 133 senior nursing students were required to participate in the ninety-minute session simulation session. The students were placed into groups of 10-12 on a simulated surgical ward which included simulated patients, telephone calls, a shift report, charts, medication records etc.. Surveys were given out to all participants with a return rate of 100%.

Sixty-seven percent of the students agreed that the simulated clinical environment allowed them to consolidate their clinical skills and 84% agreed that the exercise was beneficial.

Many studies have reported that the students participating in the clinical simulations find them beneficial and enjoyable (Mole & McLafferty, 2004; Johnson et. al., 1999; Feingold et. al., 2004; Childs & Sepples, 2006; Jeffries & Rizzolo, 2006) but not necessarily realistic (Feingold et. al., 2004; Mole & McLafferty, 2004). It is very important for the clinical simulation to mimic clinical reality, be process based, and have established validity (Jeffries, 2005). A completely realistic simulation is rare but with the introduction of high fidelity mannequins realism can be easier to achieve. Since there is no convincing research to date showing that simulated learning translates into better clinical performance, simulation needs to be viewed as a teaching tool that should only be used in conjunction with clinical placements, and not used to replace clinical time (Bearnson & Wiker, 2005; Mole & McLafferty, 2004; Seropian et. al., 2004).

### **BCIT Research Findings with Simulation**

BCIT purchased one high-fidelity simulator that was utilized in the level 4 clinical techniques course to teach students about chest tubes. The students were given the scenario ahead of time and placed into groups to go through the simulated chest tube scenario. A total of 114 students were involved in the simulation. The students were asked to complete a post-scenario survey and their test scores were analyzed and compared to students in the previous semester who were not involved in the simulations, rather learned the content through a traditional lecture and small group discussion format. 108 students completed the survey and 8 test questions were analyzed (see Appendix B). The students who were involved in the simulation exercise had an average 3% higher on the 8 chest tube questions on the final exam.

Again, this difference was minimal but the most important information came from the student surveys.

A five point Likert scale was used and ranged from strongly disagree, disagree, neutral, agree and strongly agree (see Appendix C). The overall survey results were positive as 72% of the students agreed that the simulation was a valuable learning experience. The students reported that the simulation helped them gain confidence (59%), clinical competence (57%), clinical decision making skills (70%) and improved their technical skills (55%). An overwhelming 79% of the students reported that the simulation exercise helped them link theory to practice. This small study reiterated exactly what the literature was showing, simulation does not necessarily increase new knowledge development as it is designed to improve synthesis and application of knowledge which is crucial to closing the theory to practice gap (Jeffries & Rizzolo, 2006).

### **Implementing Simulation**

The equipment required to build a simulation laboratory is very expensive and needs a proper simulation room that mimics a hospital ward. This complex technology also requires a warranty, laptop computers, scenario builder, a stretcher, and a faculty champion who would be willing to attend training sessions on how to use the technology. A detailed budget is outlined in Appendix D. It is recommended that at least one faculty member work full time with the simulation technology in order to help implement this mode of teaching into the curriculum (Nehring, Lashley & Ellis, 2002). This faculty member would need to offer information sessions for course instructors and act as a resource person during the running of a scenario. Once funding is in place, the next big hurdle is getting faculty on board with the new technology.

Recommendations on how to set up a simulation session include the following: allowing adequate time for planning and developing the simulation scenario; using one voice only to serve as the simulators voice; allowing adequate time for simulations and debriefing; keeping the groups sizes small; having each simulator in its own room; and having an adequate number of faculty and staff available during the simulation (Childs & Sepples, 2006). The average time allotted for a simulated exercise in the literature was 90 minutes and of that time at least 10 minutes were needed for debriefing. Group sizes averaged from a one-on-one interaction for a remediation exercise to groups of 10-12. Since simulation is a new learning experience for students they require learning objectives, information about the activity, process, amount of time required, role expectations, and outcome expectancies (Jeffries, 2005).

### ***Faculty Perceptions***

High fidelity simulators are very sophisticated thus faculty members need time and instruction to become familiar with such models. Research has shown that faculty are generally receptive to using the technology in their courses but less than 25% actually used it (Feingold et. al, 2004; Medley & Horne, 2005; Nehring & Lashley, 2004). The reasons given were: fear of the technology; fear of change in teaching practices; the perception that the technology is too advanced; that a relatively small number of students can use the simulators at one time; and the need to learn the technology themselves. Faculty need to be shown how to work with the technology including: methods of administration; scenario development; and how to program the simulation computer with scenarios. Faculty need to have strong clinical and teaching backgrounds in order to develop scenarios that are realistic, challenging and that allow the students to practice critical decision making (Medley & Horne, 2005). It needs to be stressed that simulation does not decrease faculty assignment time because there is a steep learning curve for

successful operation of the simulator (Nehring, Lashley & Ellis, 2002). The majority of faculty believe that using a high fidelity simulator for clinical simulation and assessment requires more preparation time than traditional experiences (Feingold et. al., 2004). Because of this faculty need extra preparation time and technology support so that the simulators can be used to their full potential. It is expected that the support of a full time faculty member who is knowledgeable about high fidelity mannequins and capable of preparing and setting up scenarios would increase their use (Feingold et. al., 2004).

### **Conclusion**

In conclusion, the use of technology in nursing education is initially a costly initiative but is one that may reap long term rewards. It is a way to allow flexible, student-driven learning using real life clinical events. Simulation and web-enhanced learning fit into adult learning principles because they encourage active learning. Students are able to participate in the learning process with immediate feedback, faculty interaction and collaborative learning. Web-enhanced teaching and simulation allows nursing students to gain confidence, consolidate their clinical skills, practice organization, time management and decision-making, decrease anxiety in their clinical placements, and improve their psychomotor skills. In this era of critical nursing shortages educational institutions must do everything in their power to attract students into the profession and to create a curriculum that produces confident, competent and qualified nursing graduates. The new generation of nursing students is well suited to embrace these new forms of technology because they have grown up with computers and want their educational environment to mimic the real work setting. Now is the time to capture this audience and begin to close in on the theory to practice gap.

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## Appendix A

### Comparison of Test Scores between Text Book Preparation and Neurology Module

*Figure 1: Average Mark (Percentage) Scored per Question on Final Clinical Skills Exam*

*Related to Neurology Content*

Question#	Theory via Text Book	Theory via Module
1	63.8	90.9
2	91.3	81.8
3	79.3	69
4	75.9	85.4
5	37.9	30.9
6	98.2	98.1
7	63.7	76.3
8	79.3	92.7
9	82.7	96.3
10	93.1	78.1
11	81	80
Cumulative Average	76.92727273	79.95454545

## Appendix B

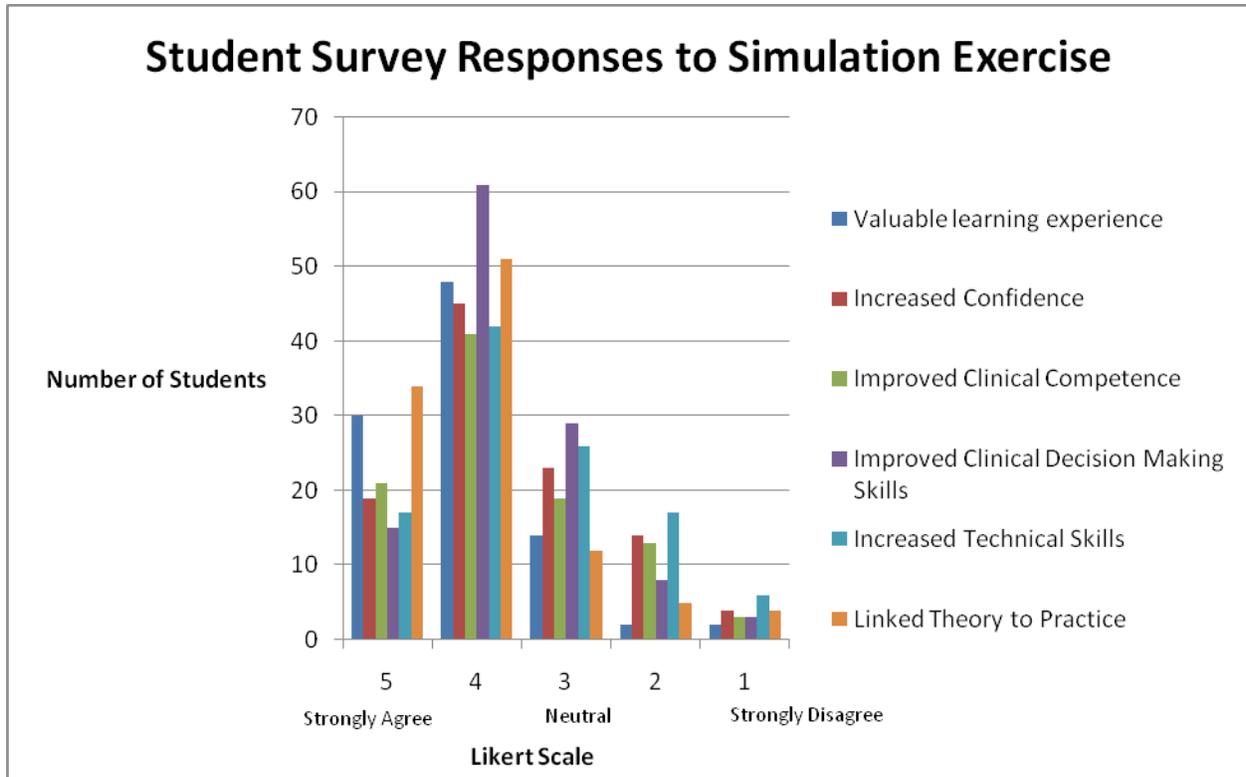
### Comparison of Test Scores between Traditional Lecture and Simulation Exercise

*Table 1: Average Mark (Percentage) Scored per Question on Final Clinical Skills Exam Related to Chest Tube Content*

Question#	Without Simulation	With Simulation
1	96.5	100
2	84.5	90.9
3	36.2	52.7
4	93.1	98.1
5	93.1	92.7
6	74.1	70.9
7	65.5	80
8	98.3	85.4
Cumulative Average	80.1625	83.8375

### Appendix C

#### Student Survey Responses to Chest Tube Simulation Exercise



## Appendix D

### Simulation Proposed Budget

Equipment Required	Cost
<b>METI ECS Simulator and Compressor</b>	\$ 54,000.00
<b>METI PNCI (scenario builder)</b>	\$ 33,000.00
<b>METI Extended Warranty</b>	\$ 5,000.00
<b>Laptop (wireless with related software)</b>	\$ 6,000.00
<b>Faculty Member Release Time</b>	\$ 65,000.00*
<b>TOTAL EXPENSES</b>	<b>\$163,000.00</b>

\*cost would be per year

This budget does not include any renovations that may need to occur to existing infrastructure

### **Author Note**

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