University of Alberta

Integration of Health Informatics in Baccalaureate Nursing Education: Effectiveness of Face-to-Face vs. Online Teaching Methods

by

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DEDICATION

To mom and dad and all those who have believed in me. Your love and support have kept me going despite the many challenges and obstacles. The journey goes on…

ABSTRACT

Preparedness in informatics among future nurses continues to be a major concern for employers, nurse educators and graduates of undergraduate nursing programs. The purpose of this study was to develop an educational intervention about health informatics for undergraduate baccalaureate nursing students and compare outcomes associated with two formats (online and face-to-face) for delivering this material. The educational intervention was comprised of two learning modules that provided foundational knowledge about health informatics and its applications that nurses use to support clinical practice. The online learning modules were delivered with streaming video presentations, and self-directed exercises. The same content was offered in a face-to-face format with case studies and guided exercises. The study was conducted in two phases. In phase one, a non-equivalent control group design was used to pilot test the intervention, assess the internal reliability of measuring instruments, estimate sample size, and assess feasibility issues. In phase two, a randomized controlled trial design was used to determine whether there was a difference in knowledge gain, perceptions of self-efficacy, and attitudes toward the electronic health record between nursing students who received the intervention through either format, online or face-to-face, and those who did not receive the intervention. Power analysis for a three-group design revealed that 51 participants would be needed per each group, i.e. 153 in total. Baccalaureate nursing students at the University of Alberta and Grant MacEwan University were invited to participate in the study. In spite of several recruitment runs to achieve required sample size, only 42 individuals enrolled in the study and then were randomly assigned to the three study

groups through the study registration site. A questionnaire was used to collect demographic data, perceptions of self-efficacy, attitudes about the electronic health record, and knowledge gain. Data were analyzed using between subjects ANOVA.

Findings showed that students who received the educational intervention did better in terms of knowledge gain than those who did not receive the intervention; therefore integration of informatics education in baccalaureate nursing education is recommended. There was no difference in knowledge gain scores of individuals who received the face-to-face version of the intervention and those who received the online version suggesting that both formats are equally effective for delivering this education. The intervention did not have an effect on perceptions of self-efficacy or attitudes toward the electronic health record. The low response rate significantly impacted the study; therefore replication of this study in other settings and among a larger sample is warranted. In addition, further refinement of the knowledge gain instrument is needed.

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INTRODUCTION

Ensuring a fit between outcomes of education and skill sets required by employers has been a moving target for most institutions of higher education. The changing demographics of the population, globalization, technological enhancements, and evolving knowledge-based economies, not only have shaped societal values, but also imposed more demands on institutions of higher education to be more adaptive and responsive in their approaches to education while striving to preserve the essence of sound pedagogical practices (Myrick, 2005; Moore, Fowler, & Watson, 2007; Kim & Bonk, 2006).

Investing in technology has been considered a defining characteristic of successful and innovative institutions of higher education (Kim & Bonk, 2006; Milne, 2007). In this information age, those with limited or no access to technology are forced to learn within the boundaries of their educational settings, whereas those with access to technology have more opportunities for knowledge sharing regardless of where they reside (O'Neil, Fisher, & Newbold, 2009).

The increased use of technology has also become a common feature in most work settings, including health care. The introduction of complex technologies such as the electronic health record promises to change how health care professionals utilize health information to manage their day-to-day work. However, introduction of these innovations also means that health care professionals are required to develop a new set of skills and competencies to be able to perform safely and competently in these complex environments (Borycki, Kushniruk, Armstrong, Joes, & Otto, 2010; Mitchell, 2006).

Given the central role of technology in modern health care, institutions charged with the education of health care professionals have a responsibility to ensure that future generations of health care professionals are well prepared for working in highly complex, multi-disciplinary, and technologically enabled work environments (Candela, Dalley, & Benzel-Lindley, 2006; Moore, et al., 2007; Ehnfors & Grobe, 2004).

In spite the increased use of technology in educational and work settings, the actual competence level of health care professionals charged with using these technologies is less than desired (Thompson & Skiba, 2008; Ornes & Gassert, 2007). Disparities between actual and desired competency levels raise concerns around the level of preparedness among future generations of health care providers with regards to use of information technology.

The term informatics has been associated with use of information and communication technologies. Informatics refers to the "scientific discipline that studies the structure and general properties of information and the processes of communication (Sackett & Scott-Erdley, 2002, p. 455)." The term 'Health Care Informatics (HCI) refers to the use of informatics in health care. HCI deals with "the study of how health data, information, knowledge, and wisdom are collected, stored, processed, communicated, and used to support the process of health care delivery to clients and for providers, administrators, and organizations involved in health care delivery (Englebardt & Nelson, 2002, p. 528)." As an umbrella term, HCI also reflects the multi-disciplinary nature of the health care field, aiming at meeting the informatics needs of various disciplinary groups such as medicine, nursing, and others. However, with the increasing complexity of technology

and the expanding body of knowledge of various professional disciplines, it was necessary to have sub-specialty areas in informatics that are charged with understanding how information and communication technologies could be employed to better capture the information needs of each of these disciplines.

Nursing has been amongst the first disciplinary groups to embrace informatics, which was evident in the establishment of a specialty practice area in informatics, Nursing Informatics (NI), to help guide the profession in articulating the information and communication technology needs in nursing. The most commonly cited definition of NI is the one proposed by Graves and Corcoran-Perry, which viewed NI as "a combination of computer science, information science and nursing science designed to assist in the management and processing of nursing data, information and knowledge to support the practice of nursing and the delivery of nursing care (Graves & Corcoran-Perry, 1996, p. 15)." Consequently, a vast growth was noticed in the number of formal undergraduate and graduate NI programs and in numbers of nurses with specialized expertise in informatics (Newbold, 2003).

While these were positive accomplishment in nursing, concerns are often raised about the level of informatics preparedness among the general population of nurses, including practicing and future nurses. Of particular concern, reports assessing integration of NI in undergraduate curricula continue to show that future nurses' preparedness to manage in a technologically enabled health care environment is suboptimal (Thompson & Skiba, 2008; Nagle & Clark, 2004). Integration of NI competencies in undergraduate nursing curricula has been proposed as a means to enhance readiness in NI competence among

future nurses (Staggers, Gassert, & Curran, 2001, 2002); however over the past two decades, outcomes of this education have not been tracked and, to date, there is no systematic evaluation. Educational institutions have invested in information and communication technologies to support education (Fetter, 2009; Chaffin & Maddux, 2004); yet, most nursing education programs have not exploited these resources in the teaching of content pertaining to NI or HCI, likely because there is no agreement about the aspects of informatics that should be offered to nursing students (De Gagne, Bisanar, Makowski, & Neumann, 2011).

One of the most worrying misconceptions within the nursing community at large is that NI is often seen as being able to use computers or online learning tools. Informatics does not only mean computer literacy and/or information literacy, but also the ability to use these skills to inform patient care and nursing practice (Thompson & Skiba, 2008). The failure to recognize the links among computer and information literacy, patient care, and nursing practice and to build these links into undergraduate nursing education means that graduates are not fully prepared for clinical practice. In today's multidisciplinary and technology enabled health care environment, nurses' understanding of emerging areas such as informatics, HCI and NI is essential for safe and effective use of health care technology. Because nurses work within a multidisciplinary health care environment, nurses would benefit from a general understanding of HCI and a more focused understanding of NI.

Addressing the needs of nursing students regarding HCI and NI within undergraduate education would help graduates fully understand how information technology intersects

with nursing practice and patient care. However, the large amount of information related to other subjects that must also be included means that those designing undergraduate curricula are challenged to find pragmatic approaches for making this new informatics content accessible to nursing students.

Overview of the Problem

While integration of informatics in baccalaureate nursing curricula has been identified as a key strategy for enhancing competence among future nurses (Staggers, Gassert, & Curran, 2001, 2002; Hebert, 2002; Nagle & Clark, 2004), most of integration efforts so far have been largely focused on either computer or information literacy. In a practice profession like nursing, the lack of systematic integration of health care informatics and nursing informatics impacts graduates' ability to understand how these concepts relate to patient care. Moreover, little is known about the effectiveness of this education and even less is known whether this education prepares graduates with the necessary skill sets required by employers in clinical practice settings.

At the University of Alberta, the Faculty of Nursing identifies informatics as a key graduate competency in the undergraduate-nursing curriculum[1]. Content related to this competency has been threaded through a few courses; however a specific course or unit of study about nursing or health informatics has not been developed[2].

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[1] https://vista4.srv.ualberta.ca/webct/urw/lc5122011.tp0/cobaltMainFrame.dowebct

[2] http://www.nursing.ualberta.ca/en/Undergraduate/ProgramDescriptions.aspx

Purpose of the study

In this study, the term Health Informatics (HI) is used to refer to an educational interventional that provides foundational knowledge about both specialty practice areas, i.e. HCI & NI. The purposes of this study were: 1) to ascertain whether an educational intervention about HI made a difference to learning outcomes (knowledge gain, perceived self-efficacy, and attitudes toward the electronic health record (EHR) by comparing those who received the educational intervention to a group that did not receive the educational intervention, and 2) to compare whether these outcomes differ when this intervention is delivered through an online and face-to-face teaching formats.

Specific Objectives

1. Develop learning modules with about HI for a beginning level of nursing practice to support the learning needs of baccalaureate nursing students.
2. Examine the impact of some demographic variables, namely, age, learning styles, previous education in informatics, on study outcomes.

Significance of the Study

Inadequate content about HI could significantly impact graduates' understanding of HI as it relates to patient care especially at a time when the health care system in Alberta is transitioning to electronic health systems. A systematic and comprehensive approach to informatics education would help assist students obtain an in-depth understanding about this emerging area of practice and ensure they are competent to practice safely in complex and technologically intensive health care work environments.

The intervention design for this study could help future nurses incrementally build experience about point of care technology and its role in supporting patient care as well as in preparing them to use these technologies competently and safely. Findings could be used to inform decisions related to the planning and integration of this education in future baccalaureate nursing education. In addition, the materials developed for this study could be utilized to augment institutional in-service education currently offered to practicing nurses or in the orientation of new nurses at Alberta Health Services facilities[3]. Helping students understand basic concepts about HI and the applications used in the delivery of health care is vital to building their confidence and competence in using health care technology.

Educational Intervention

The intervention developed for this study was comprised of two learning modules that provided foundational knowledge about HI as it related to nursing practice. Content covered in these modules included basic principles about health informatics and an overview of some tools available through health informatics applications that could be used to improve nursing care. The design of these modules was based on constructivist pedagogy. In the face-to-face instructional format, the modules were offered in a 2-hour session. Instructional activities included case studies and guided exercises that required students to access Internet information tools to apply some of the concepts offered in the session. In the on-line format, these two learning modules were broken into four learning units; each was recorded as a 15-minute Vodcast presentation with voice over Power

[3] http://www.albertahealthservices.ca/

Point, and self-directed exercises. The session was offered through the Homer Learning Community, a learning resource at the Faculty of Medicine and Dentistry.

Research Questions

1. Does the educational intervention improve knowledge gain, self-efficacy, and attitudes toward the EHR?
2. Which teaching format (online or face-to-face) would yield better knowledge gain, self-efficacy, and attitudes toward the EHR?

Research Design

This study was conducted in two phases. In phase one, a pilot study was completed using a non-equivalent control group design to: 1) assess feasibility of the study, 2) assess the adequacy of the intervention, and 3) estimate internal reliability of the measuring instruments. Phase two was conducted using a three-group posttest only randomized controlled trial design to compare the effectiveness of the two teaching formats. The design and pilot testing of the intervention are described in detail in chapter 3. The design of the main study is discussed in chapter 4.

Primary and Secondary Outcomes

The primary outcome of this study was knowledge gain related to HI education offered in this study. Secondary outcomes included self-reported self-efficacy and attitudes toward electronic health record. Skills related to using electronic health records were not measured in this study.

Research Hypotheses

The Null Hypotheses (H_0)

1. The intervention has no effect on knowledge gain, self-efficacy and attitudes toward the EHR.
2. The teaching format has no effect on knowledge gain, self-efficacy, and attitudes toward the EHR.

Alternative Hypotheses (H_A)

1. Those who receive the intervention through either teaching format, face-to-face or online modules, will have better knowledge gain, self-efficacy, and more positive attitudes toward the EHR than those who do not receive the intervention (control group).
2. The difference between the mean scores of the online format and the face-to-face format will not be zero

Conceptual and Operational Definitions

Self-efficacy

Self-efficacy is an important predictor of future behavior. It is "concerned with people's beliefs that they can exert control over their motivation and behavior and over their social environment (Bandura, 1990, p. 9). In the context of information technology, Compeau and Higgins (1995) defined computer self-efficacy as "the individual's perceptions of his or her ability to use computers in the accomplishment of a task (P. 191)." Compeau and Higgins developed a Generic Computer Self-efficacy scale that could be used to assess perceptions of self-efficacy in relation to any unfamiliar software.

In this study, the Generic Self-efficacy scale was used to assess perceptions of self-efficacy in relation to the electronic health record. The scale has a 10-item measure of perceptions of self-efficacy in relation to varying levels of assistance that could be available when using a new or an unfamiliar computer/software application, the electronic health record. The "yes/ no" response on the scale reflects the magnitude aspect of self-efficacy in relation to the support needed, if the individual experiences a difficulty completing a task or job using a computer software. The level of self-efficacy confidence is measured on rating scale of 1-10, where 1 indicates "not at all confident," "5 indicates moderately confident," and "10 indicates totally confident." If an individual chooses a "Yes," on one of the item, he/she could then rate the level of confidence according to the above-mentioned categories. If the answer "No" was selected, then rating of the confidence would not be applicable. The scoring of the scale is done by counting the number of "Yes" answers to provide an indication of the self-efficacy magnitude, and summarizing the responses on the confidence scale, and counting 0 for a "No" response (p. 194). Magnitude of self-efficacy was not measured in this study, only perceptions of self-efficacy in relation to the electronic health record.

Attitudes toward the electronic health record

Attitudes are defined as " a disposition or tendency to respond positively or negatively towards a certain thing (idea, object, person, situation).[4]" In this study, attitudes toward the electronic health record were measured using a five-item Likert-type scale that measures nurses' disposition to the electronic health record (Moody, Slocumb,

[4] http://www.instructionaldesign.org/concepts/attitudes.html

Berg, & Jackson, 2004). The scale scores are summed for a total score, which may range from 5 to 25. A high score on the scale indicates positive acceptance or disposition toward use of electronic records, and a low score, more negative disposition toward electronic health record (p. 341).

Knowledge Gain

Knowledge gain refers to eductaion received in this study and was measured by a set of multiple-choice test items that I developed based on the learning objectives specified for each module. In the pilot phase of the study, five multiple choice questions were developed to test the information in module 1 (general informatics knowledge) and four multiple questions were developed to test the information on module 2 (informatics applications). In phase two the study, an additional 11 questions were added for a total of 20 questions to measure knowledge gain.

Chapter Two: Review of the Literature

Concerns around quality of care and patient safety have been key drivers behind the increased interest in improving informatics competencies among health care providers. The increased prevalence of preventable medical errors brought to light the gap between the minimum standards expected of health professionals and the skill sets they bring to the work environment (Institute of Medicine, [IOM], 2003; Cronenwett et al, 2007; Kilbridge & Classen, 2008). In response to these concerns, the IOM outlined five core competencies that health care professionals should possess in order to ensure safe and quality health care practices and care delivery. These competencies were: providing patient-centered care, working as a member of an interdisciplinary team, employing evidence-based practice, applying quality improvement approaches, and utilizing informatics (IOM, 2003).

Nursing's agreement with the IOM approach for enhancing quality and safety of health care practices has been expressed by updating standards outlining requirement of registered nurses upon entry to practice. For example, in the recently revised *Essentials of Baccalaureate Education for Professional Nursing Practice*, the American Association of Colleges of Nursing (AACN), mandated that graduates of BScN programs possess competence in informatics upon entry to practice as stated in Standard IV: "Information management and application of Patient Care Technology (AACN, 2008, p. 17). This work suggests that preparing future nurses in nursing informatics is paramount for ensuring safe and effective clinical practice in technologically enabled health care environments.

Development of Informatics Competence

A competency-based approach had been proposed for helping nurses become comfortable with using informatics. Specifying competency expectations of nurses would also help guide the integration of these competencies in undergraduate and graduate nursing education as well as professional development in this area through continuing education (Staggers, Gassert, & Curran, 2002; Ehnfors & Grobe, 2004). In the United States, Staggers, Gassert, and Curran (2001; 2002) proposed a research-based master list of informatics competencies expected of nurses at four levels of practice: a beginning nurse, an experienced nurse, an informatics nurse specialist, and an informatics innovator (Staggers, et al., 2001; 2002).

In Canada, efforts to encourage development of informatics competence among nurses had also been ongoing since the seminal work of Hebert (2000), who asserted that nurses should be able to "use information and communication technology, interpret and organize data, and combine information to contribute to knowledge development in nursing (p. 3)." In 2006, the Canadian Nurses Association (CNA) published the E-Nursing Strategy for Canada, acknowledging that nurses play a central role in improving health care and patient outcomes; thus their involvement in building the information technology infrastructure in Canada would be key for the success of information technology (IT) initiatives. However, for nurses to be able to do that, nurses need to develop competence in information and communication technologies (ICTs), have access to health information systems, and participate in decision-making related to investments in information technology (CNA, 2006).

The importance of informatics and ICT among nurses in Canada has been evident in the translation of these competencies in the Entry to Practice Competencies for Registered Nurses in Alberta (College and Association of Registered Nurses of Alberta, [CARNA], 2006). More recently, the Canadian Association of Schools of Nursing (CASN) received funding from Canada Health Infoway, an organization charged with developing a pan Canadian electronic health record, to complete a national project titled: "Generating Momentum to Prepare Nursing Graduates for the Electronic World of Health Care Delivery." The project endeavors to achieve three objectives:

1. To promote a national dialogue among nursing educators, informatics experts, faculty, and students on integrating entry to practice competencies in nursing informatics;
2. To increase the capacity of Canadian nurse educators to teach nursing informatics; and
3. To engage nursing key stakeholders in developing nursing informatics outcome objectives in undergraduate nursing curricula. (Canadian Association of Schools of Nursing [CASN], 2012).

The primary goal of identifying informatics competencies in Canada was to provide direction for curriculum development and set a minimum standard for new nurses entering practice. A CASN formed Task Force of nurse educators, practitioners, and employers with strong interest in nursing informatics was involved in the development of a preliminary set of competencies that is currently being evaluated (Canadian Association of Schools of Nursing [CASN], 2012).

In spite of these efforts, utilization of informatics competency lists and integration of informatics in nursing curricula is still not fully developed (Thompson & Gassert, 2008; Nagle & Clark, 2004). Inconsistent integration of informatics theory and clinical practice as well as the relatively slow adoption of informatics in undergraduate nursing education continue to be a major area of concern and contention to many scholars (Fetter, 2009; Elfrink, Pierce, Beyea, Bickford, & Averill, 2005; McNeil, Elfrink, Beyea, Pierce, & Bickford, 2006; Nagle & Clark, 2004). An area of contention pertaining to integration of informatics in undergraduate nursing education is related to getting stakeholders to agree on what informatics content should be included in the curriculum. For employers, basic and advanced or specialized computer skills were identified as critical for new nurses entering the workforce (McCannon & O'Neal, 2003).

Among nurse educators, debates are ongoing as to whether basic computer literacy skills should be taught at the baccalaureate level or be considered a pre-requisite to admission in the nursing program (De Gagne, Bisanar, Makowski, & Neumann, 2011). Some educators feel that in this information age where ICT is already integrated in students' learning experiences in most institutions of higher education, informatics education should build on students' existing ICT skills, if known, and should help students use this existing ICT knowledge in the context of patient care (Jette, Tribble, Gagnon & Mathieu, 2010). Therefore, Jette, et al. proposed that instead of focusing on basic literacy skills, nursing education programs should target skills that students are less familiar with such as searching electronic scientific databases, assessing health related web sites, and exploring issues such as safeguarding electronic data versus patient rights.

Most importantly, Jette et al. proposed that nursing education should focus on application of health informatics systems currently used in health-care facilities (Jette, et al., 2010).

Nursing students have also raised concerns about whether the informatics education they receive would be sufficient to prepare them for the reality of clinical practice (Fetter, 2009). When asked for their feedback, students verbalized that their readiness to practice could be enhanced through: improving faculty knowledge, skills attitudes and behaviors related to informatics; standardizing and documenting student and faculty informatics competency expectations; enhancing access to references, software and hardware relevant to informatics; increasing content related to privacy and security of health information; and mandating hardware and software such as laptops and PDAs (Fetter, 2009).

However, in reality, the majority of nursing programs place less emphasis on informatics knowledge and its application in the context of health care. In a study to evaluate the integration of informatics skills in the curriculum, Ornes and Gassert (2007) examined computer competencies in a BSN program for the purpose of evaluating content related to informatics, and subsequently advised on strategies that could enhance these competencies. Using the work of Staggers, Gassert, and Curran, the authors developed a research-based tool to evaluate course syllabi in the curriculum. Findings revealed that current courses introduced students to computer skills and limited work with computerized information systems, but did not provide opportunities to apply this material.

Additional limitations in current informatics education in nursing curricula were reported in a recent national survey of nursing educational programs (Thompson &

Skiba, 2008). The authors found that information literacy exercises were the predominant example of informatics integration into nursing courses. They also found informatics competencies related to privacy, confidentiality, security and impact were frequently offered in course work, and that faculty members embraced the notion that online course work was the same thing as informatics. A third finding was that handheld devices used for care planning and clinical information systems were rarely integrated into courses. Fourthly, the authors found that graduate programs were found to be far more likely to integrate NI content and other learning experiences than other programs. Clinical exposure to informatics tools was common but highly dependent on resources and cooperation of the clinical facility. With regard to faculty members' competence in informatics, 37% of faculty rated themselves as competent in informatics, with 26% rating themselves as advanced beginners. The majority (82%) indicated that they were self-taught. In responding to this question, there were several instances where faculty members equated being involved in distance learning, online learning and web-based instruction as being prepared in informatics (Thompson & Skiba, 2008).

In light of these observations about informatics education at the undergraduate level, there is a need for learning opportunities that help nursing students understand, appreciate, and use informatics technology in nursing practice. This could be achieved through a systematic approach to NI/HI education with relevant theory and practice components. Enhancing the quality of informatics education could help achieve the goals of NI/HI education at the undergraduate level.

Approaches for Integrating Health Informatics in Baccalaureate Nursing Education

A key approach for helping nurses gain competence in informatics has been through the integration of informatics content in undergraduate nursing education. In a review of literature pertinent to this topic, I have conducted extensive literature searches guided by two questions in order to map out the different approaches used, to date, for integrating informatics in baccalaureate nursing education. These questions were:

- What interventions have been used to promote competence in informatics among baccalaureate nursing students?
- What outcomes have been associated with acquiring competence in informatics among baccalaureate nursing students?

The search criteria were limited to English language only of papers published in the period from 1990 – 2011. Several databases were searched including: CINAHL Plus with Full Text; Academic Search Complete; ERIC; Medline; and Science Direct using several key terms including: computer literacy; information literacy; nursing informatics; health informatics; education; baccalaureate nursing students; integration in curriculum, and educational interventions. Literature searches yielded over 442 hits, and after initial assessment, removing duplicates, and adding additional papers from hand searches and other records from this researcher's collection, there were about 115 papers that have discussed this topic. Based on the initial evaluation of these papers, I classified these records into four categories: (n=38) discussion papers, (n=26) surveys, (n=7) systematic reviews, and (n=44), papers reporting on interventional designs.

The following three themes were identified in this body of literature: 1) Conceptualization of informatics in baccalaureate nursing education, 2) methodological quality of research studies reporting on informatics education, 3) and teaching methods and pedagogical considerations related to planning informatics education. The findings from these studies are highlighted below, and then a framework for the development of NI interventions for baccalaureate nursing education is proposed.

Conceptualization of informatics in baccalaureate nursing education

A number of studies examined the perceived level of computer literacy or basic computer skills and how these skills contribute to enhancing or impeding the learning of nursing students (Yavuz, 2006; Marini, 2000; Stamler, Thomas, & McMahon, 1999). Acquisition of these skills improved over the period of study in a nursing program; however advanced skills such as use of statistical software remained unchanged (McDowell & Xiping, 2007). Other surveys compared computer proficiency skills between senior and junior nursing students (Yavuz, 2006). Outcomes of interest under this focus of research included comfort level and confidence with using computers, access to computers, Internet skills and use, and attitudes toward IT.

Other studies have considered information literacy as a core area in education about informatics (Verhey, 1999; Wallace, Shorten, & Crookes, 2000; Nayda & Rankin, 2008; Jacobsen & Andenaes, 2011). Outcomes of interest in these studies included students' understanding and level of skill and confidence in information literacy skills. Competence in information literacy was considered an essential skill for life-long learning. Some of these research studies showed a lack of understanding of information

literacy among students and faculty members (Nayda & Rankin, 2008), and in other studies a disagreement between students' self-reported level of confidence and faculty's assessment of information literacy skills among students (Verhey, 1999). Such findings led these researchers to speculate about students' ability to employ evidence-based knowledge in future practice (Wallace, et al, 2000; Nayda & Rankin, 2008).

Some studies discussed integration of informatics in baccalaureate nursing education in relation to the utility of mobile technology as a learning tool in clinical education. Mobile tools such as PDAs and iPods have been promoted to facilitate learning through access to patient-related information or evidence-based resources in the clinical setting (Greenfield, 2007; Newman & Howse, 2007; Goldsworthy, Lawrence, & Goodman, 2006; Glasgow & Cornelius, 2005; Ndiwane, 2005; Johnston, Hepworth, Goldsmith, & Lacasse, 2010; Kuiper, 2010). Outcomes examined in these studies included rate of medication errors among those who used PDAs versus those who have relied on a traditional source of information such as a textbook; professional judgment, attitudes, and satisfaction associated with using the PDA as a tool for documentation purposes; preparedness for safe medication administration, perception of self-efficacy, time management and organizational skills associated with using the PDA; and effect of iPods on grades.

Some of these studies found that PDA use improved students' confidence in computer ability, computer self-efficacy, and clinical reasoning skills. In addition, strong correlations were found between user's perceptions and computer self-efficacy (Kuiper, 2010). Other studies showed significant associations between satisfaction with use of

PDA for learning purposes and attitudes toward computerized documentation (Newman & Howse, 2007). However, evidence on the efficacy of PDA use among nursing students remains inconclusive given the level of control imposed in the design of these studies.

A number of studies highlighted the importance of hands-on-practice in hospital information systems during formal education of student nurses (Borycki, et al., 2010; Lucas, 2010; Donahue & Thiede, 2008; Gassert & Sward, 2007; Hilgenberg & Damery, 1994). Students participating in these projects found hands-on-experiences with simulated hospital information systems during formal nursing education helpful in easing transition to future clinical roles (Hilgenberg & Damery, 1994), enhancing students' confidence prior to using these applications in clinical practice (Gassert & Sward, 2007; Lucas, 2010), and in helping students relate to real-life practice (Donahue & Thiede, 2008).

Few studies reported on teaching knowledge or core content related to HI and/ NI at the baccalaureate nursing education level (Travis, Hudak, & Flatley-Brennan, 1995; Vanderbeek & Beery, 1998; Desjardins, Cook, Jenkins, & Bakken, 2005; Kenny, 2002), although basic computer skills and formal informatics education have been found to be significantly associated with informatics competence (Hwang & Park, 2011). In addition, the level of integration reported in these studies varied from laboratory learning experiences (Donahue & Thiede, 2008), to combination of theory and clinical application (Desjardins, et al., 2005; Vanderbeek & Beery, 1998; Travis, et al., 1995). Some offered a theory component alone (Kenny, 2002).

Integration also varied with regards to whether informatics education should be offered as a single unit of study in the curriculum (Vanderbeek & Beery, 1998), or as part of an existing course (Wallace, et al., 2000) or threaded across all years of the nursing program (Travis, et al., 1995, Desjardins, et al., 2005). For example, Travis et al (1995) utilized a sequential approach to introduce informatics courses in the nursing program at the Case Western Reserve University. Theoretical and relevant clinical experiences were integrated using the framework of technology, information, and clinical care processes. This approach for integration allowed for leveling informatics education according to the level of education in the program, i.e. computer and information foci were offered in the first two years of the program and more advanced skills and clinical practice experiences were offered in the last two years of the program. In another study, Desjardins, et al. (2005) utilized the framework proposed by Staggers, et al. (2002) for the purpose of planning and evaluating achievement of beginning level competencies among nursing students.

Variations in the level of integration of informatics in baccalaureate nursing education raise a number of concerns. First, there is a tendency to focus on computer and information literacy within the context of learning and teaching, without linking these skills to actual nursing practice. Secondly, there is inconsistent integration of theoretical knowledge and clinical experiences related to informatics education. Inadequate understanding about informatics limits students' ability to fully understand how informatics relates to nursing (Fetter, 2009; Staggers, et al., 2001).

In two recent reviews of the level of integration of informatics in baccalaureate nursing education, findings from these reviews highlighted similar concerns. In the first review, Gracie (2011) examined literature in the period between 2007 and 2011, with a specific focus on studies within the US baccalaureate nursing students, only 24 articles were found, but four only were relevant to the focus of the review. Other exclusion criteria included conference proceedings/abstracts, and papers lacking peer review. Results of this review identified inconsistencies in definitions of nursing informatics among academic settings, and inadequate computer and informatics skills suitable for today's healthcare environment.

The second review evaluated the published literature on informatics integration in baccalaureate education from 2000-2010. Results yielded 59 papers in total, 25 were reviewed in full, and 19 emerged after application of inclusion/exclusion criteria (De Gagne, Bisanar, Makowski, & Neuman, 2011). Researchers then organized papers using a Matrix approach and Lichtman's three Cs of analysis method (codes, categories, concepts) to identify common themes. Findings showed lack of consensus on informatics concepts that needed to be included in BSN curriculum, which concepts should be considered as a prerequisite to BSN education (e.g. Word-processing, e-mail, internet navigation, statistical software and online literature search skills), and which content should be specifically covered throughout the course of the program (e.g. Simulation software, net-works, databases, telecommunication, security, ethics, EHRs etc.).

Based on a review of this literature, an interesting observation I have found is that the issues that I have outlined and those found in the two recent systematic reviews

mentioned above have already been identified a decade ago by Staggers and her team upon the development of the informatics competencies list (2001). This begs the question as to what has been achieved thus far in terms of enhancing capacity in informatics among nurses. Some calls have been proposed in the literature to abandon assessment of competence and identification of additional lists and to focus on implementation of these lists in educational programs (Gassert, 2008). However, the mere adoption of competency lists would not necessarily guarantee better outcomes of education.

Methodological Quality of Research Studies Reporting on Informatics Education

The majority of the studies reporting on the inclusion of informatics education used descriptive surveys or quasi-experimental designs. While the subjective assessment by participants before and after the intervention is useful, conducting this type of assessment in conditions lacking control of possible known and unknown confounders does not allow for rigorous estimates of the effect of the intervention introduced on outcomes achieved (Shadish, Cook, & Campbell, 2002). Rigor becomes even more problematic when tools used for measuring competence do not adhere to appropriate psychometric measurement to ensure the validity and reliability of instruments used (Hobbs, 2002; Staggers, et al., 2001).

In other studies, reported results yielded inconsistent findings, and in some, despite good intervention planning and design measures, results of the intervention were equivocal (Verhey, 1999). For example, in a study by Verhey, students' and faculty's ratings of information literacy skills remained largely unchanged after four years of integrating information literacy in the curriculum; however the researcher had

acknowledged that many factors could have contributed to this effect given that a randomized design was not used.

Issues related to sample size in each of these studies, the heterogeneity of outcomes measured in these studies, and the inconsistency of results in such a limited number of studies also pose additional challenges with respect to synthesizing evidence about the effect of these interventional studies in enhancing informatics competencies among nursing students. In addition, the lack of evaluation and follow up studies in this domain further contributes to limiting the understanding of the value and overall effect of these interventions. Lastly, few studies utilized a qualitative component and/or mixed methods to evaluate outcomes of informatics education among nursing students. Such methods help provide rich data that could be useful in validating quantitative data. For example, in the study by Nayda and Rankin (2008) to explore students' information literacy, the analysis of content of information literacy courses offered to students showed that learning about these concepts was limited to first year of the program with no additional opportunities to enforce these skills throughout the program.

Teaching Methods and Pedagogical Considerations in Planning Informatics Education

The limited use of theory or models to facilitate systematic planning of instruction and assessment of educational outcomes is a big limitation in current informatics education (Moore, Fowler, & Watson, 2007; Odom, Barnes, & Wicker, 2005; McAlpine, 2004; Hutchinson, 1999; Frisch & Coscarelli, 1986). Few papers reported on using theories as a supporting framework for the planning and development of informatics

educational materials. For example, Perry and King (2009) utilized *the Essentials of Baccalaureate Nursing Education* (AACN, 2008) and Bandura's Social Cognitive Theory to develop a two-unit web-enhanced course to help beginning nurses at a local private school in Southern California enhance computer-literacy skills. The course was aimed at providing nurses with sound basis of fundamental knowledge in relation to navigating an online course, searching sensibly on the Internet, participating proficiently and knowledgably within an online course community, and understanding the importance and purpose of built-in safeguards within patient care technologies. However, no results were reported in this study. Only one paper discussed the use of learning objectives to guide course development (Vanderbeek & Beery, 1998).

Inadequate use of theory to design and assess learning has also been identified in studies reporting on designing simulation. According to Kaakinen and Arwood (2009), in a systematic analysis of the nursing simulation literature between 2000-2007, out of 120 articles, only 16 papers referenced the use of a learning or developmental theory to support the design of simulation learning experience.

The ultimate goal of learning is a change in behavior; however to achieve this goal or the desired outcomes of learning, educators need to appreciate the complexity of the learning process, and have an understanding of a variety of learning theories, philosophies and educational frameworks to inform their thinking regarding the education they provide to their students (McAlpine, 2004; Kaakinen & Arwood, 2009).
Several schools of learning could be utilized to inform the design of online learning. Educators can draw upon behaviorist, cognitivist, and constructivist schools of though in

the design and development of online learning materials and strategies (Ally, 2004). A behaviorist perspective on learning postulates that learning occurs when there is an observable and measurable change in behavior. In this view, the educator specifies the outcomes of learning, and the sequence of learning. Assessment of learning is achieved through testing and feedback to learners on whether they have achieved the goals of learning or not. While the behaviorist approach views learning external to the mind, the cognitivist approach sees learning as an internal process involving cognitive functions to process information such as short and long-term memory, thinking, reflection, abstraction, motivation, and metacognition (Ally, 2004). Educators adopting this perspective design educational strategies that promote information processing of the learner, accommodate various styles of learning, motivate learners, and encourage leaners to use of metacognitive skills. Constructivist school of thought, on the other hand, postulates that learners acquire knowledge by constructing personal knowledge from the learning experience (Ally, 2004). In this view, the educator's role is to facilitate the process of learning. Learners have control over their learning and take an active role in identifying knowledge from various sources and interpreting it in a meaningful way in different contexts. Educators utilizing this approach need to incorporate learning activities that promote higher-order thinking such as collaborative and cooperative learning and reflection (Ally, 2004).

For example, educators with an understanding of adult learning principles provide learning strategies that best match the learning needs, styles, and preferences of these learners. The goal is to create a learning environment where learners take charge of their

learning (Kaakinen & Arwood, 2009; DeYoung, 2009). These actions would be supported by the principles of Adult Learning Theory (Knowles, 1980, 1990), which proposed that adult learners tend to be self-directed and take responsibility for their learning. They have a wealth of life experiences to draw upon, and relate more to the process of learning as opposed to the content of instruction.

Based on the principles of Kolb's experiential theory, educators can provide learning experiences that best meet the various learning styles of their students (DeYoung, 2009). Attempting to match teaching experiences with each and every style of learning may not be realistic or feasible. In addition, evidence on the effectiveness of learning styles on learning outcomes remains inconclusive (Thompson & Crutchlow, 1993). However, educators can plan teaching activities that take into account the characteristics and preferences of learners while ensuring sound pedagogical practices. For example, educators involved with teaching young generations of students, can benefit from knowing that, as learners, millennial students tend to be assertive, optimistic, self-reliant, and inquisitive. They value teamwork and job security, expect and appreciate use of technology in the learning environment, prefer experiential learning and instantaneous feedback (Earle & Myrick, 2009, p. 625). Therefore, when choosing teaching strategies to deliver educational material to this group of learners, educators might choose constructivist teaching strategies such as discussion, online learning, group activities, etc.

In addition to an understanding of some educational theories to inform pedagogical practices, it would also be important to consider theories that relate to use and adoption of technology. One such theory is Bandura's theory of Self-Efficacy. According to Bandura,

self-efficacy refers to the individual's belief or perception in his or her ability to accomplish a certain task successfully. Self-efficacy perceptions directly impact the choice to engage in a task, and how much effort and persistence the individual would expend on the task (Bandura, 1977, 1989, 1990). Four sources influence perceptions of self-efficacy, these are: performance or enactive attainment—actually performing a behavior, vicarious experience—observing a model, verbal persuasion—suggestions and encouragement by others, and the emotional state—physiological state experienced by the individual.

Two factors determine whether an individual will engage in a certain behavior, efficacy expectations or self-efficacy, and outcome expectations (outcome expectations). Because outcome expectations are dependent on self-efficacy expectations, self-efficacy is thought to predict performance. Perceptions of efficacy determine whether an individual engages in certain behaviors or tasks, and how much effort and persistence the individual is willing to expend on it (Bandura, 1977, 1989, 1993; Kinzie, et al, 1994; Compeau & Higgins, 1995). According to Bandura, "when people lack a sense of self-efficacy, they do not manage situations effectively, even though they know what to do and possess the requisite skills (Bandura, 1990, p. 9).

In professional education, the term competence is often used to denote performance expectations. However, the definition of competence in nursing practice is still controversial (Cowan, Norman, & Coopamah, 2007). Based on a focused review of the literature on competence, Cowan, et al. noted that existing definitions of competence present a dichotomy of either behavioral objectives or a psychological construct, and

called for a more holistic conception of competence to reflect the complexity of nursing practice, which "requires the application of complex combinations of knowledge, performance, skills, values, and attitudes (Cowan, et al, 2007, p. 26). Lauder, et al. (2008) examined the relationship between competence, self-reported competence, support, and self-efficacy. With regard to self-efficacy, Lauder et al. found that self-efficacy has little explanatory value in the assessment of competence among pre-registration students, and recommended that a combination of methods be used in the assessment of competence among nursing students such as Objective Structured Clinical Examinations (OSCE), self-reported competence, and self-efficacy (Lauder, et al., 2008).

In a study of nurses' motivation to utilize web-based education as a means for continuing education, Liang, Wu, and Tsai (2011) found that nurses' basic Internet self-efficacy was the most important factor in predicting nurses' motivation. In addition, nurses with higher Internet self-efficacy and less working experience (often, younger nurses) were found to display higher motivations for web-based continuing learning. Other studies found that the lack of computer skills often negatively impacted students' perception and learning experiences in web-based learning environments (Creedy et al., 2007).

Evidence suggests that attitudes contribute significantly to prediction of self-efficacy for computer technologies (Kinzie, Delcourt, & Powers, 1994). Dillon, Blankenship, Lending, and Crews (2003) found that attitudes, higher levels of nursing education, home computer use, and average levels of self-assessed e-mail, Internet search, word processing, and general computer expertise; previous use of home and office electronic

equipment, such as answering machine were all significant predictors of adoption and use of hospital information systems among registered nurses. In another study, Dillon, Blankenship, and Crews (2005) found age to be a significant factor in determining nurses' attitudes toward a new computer system. In a study by Moody, Slocumb, Berg, and Jackson (2004), nurses with expertise in computer use, had a more favorable attitude toward EHRs than those with less expertise. Furthermore, experienced computer users were more favorable toward the use of EHRs than less experienced users. In another study, Chan (2007) found that senior and more highly educated nurses generally held more positive attitudes to computerization, whereas the attitudes among younger and less educated nurses generally were more negative (Chan, 2007). Findings from these studies suggest that attitudes toward technology are important learner characteristics that should be taken into consideration. Positive attitudes do not develop overnight, but rather through a process of engaging in positive learning experiences about informatics and its various applications in education and health care. Therefore, nursing educators should invest in educational resources such as electronic health record simulator to facilitate learning experiences about important healthcare informatics tools during formal years of nursing education so that students develop confidence and competence in using health care technology within the safety of the educational setting prior to joining the work environment.

Variations in pedagogical strategies used in the delivery of informatics education seem also to exist. Some studies utilized didactic approaches to instruction (Marini, 2000), and others used a combination of both, such as hands-on-practice, small group

activities, and lectures (Jacobson & Andenaes, 2011). Self-based tutorials have also been used for enhancement of computer literacy skills, but among graduate students (Fullerton & Gravely, 1998). Mobile technology, such as PDAs and iPods has been utilized to facilitate clinical learning but not for the delivery of health informatics education.

A number of discussion papers, highlighted the importance of providing hands-on-learning opportunities using simulation technology to introduce nursing students to informatics clinical applications such as hospital information systems; however evaluation of the effectiveness of these interventions remains limited due to subjective assessment of competence (Lucas, 2010; Hilgenberg & Damery, 1994). Others reported on integration being in progress (Staggers & Sward, 2007), or discussed strategies that health professions programs and educators could utilize upon planning the integration of such educational experiences (Borycki, Kushniruk, Armstrong, Joe, & Otto, 2010).

Regardless of the level of integration, most students that took part in these learning experiences found prior hands-on-experiences with hospital information systems vital to build confidence in using these technologies in future practice (Borycki, et al., 2010; Lucas, 2010). Clinical exposure and experiences with using clinical information systems applications were found to be critical for students to understand how these applications work and how they impact patient care (Donahue & Thiede, 2008). Without such exposure, graduates' ability to manage day-to-day practice and to safely use these applications would largely be compromised.

However, in most nursing education programs, this is not always the case. Students may not always have the opportunity to develop such skills during their formal years of

education in the program depending on the experiences offered to them in their program of study. For example, in a survey of graduating baccalaureate nurses, graduates rated their level of competence the lowest on "care documentation, planning, valuing informatics knowledge, skills development, and data entry competencies (Fetter, 2009, p 40). Interestingly, these skills are some of the key skills employers expect newly-graduates to possess upon entry to practice (McCannon & O'Neal, 2003).

Graduates entering the workforce with low perceived level of competence are challenged to learn by trial and error during transition into the work experience (Romyn, et al., 2009). The pitfall of such an experience is that graduates end up focused on the technical aspects of technology as opposed to understanding the broad scope of informatics and its value for professional clinical practice and safe delivery of patient care. Equally important, employers feel challenged to provide on-the job-training during hectic hours of work, which they often subsidize to information technology (IT) vendors as part of the cost of IT equipment (Hebda, Czar, & Mascara, 2005). Incorporating learning opportunities that simulate clinical practice within a constructivist pedagogy would be essential to help students develop higher levels of thinking and decision-making in relation to use of technology in health care, both of which are highly desired outcomes of education for effective integration in current complex work environments (Moore, Fowler, & Watson, 2007; Candela, Dalley, & Benzel-Lindley, 2006).

In addition to limitations related to engaging students in constructivist and interactive learning opportunities about informatics, there are also limitations in the use of online learning modalities to facilitate delivery of informatics education at the undergraduate

level. This is perplexing because nursing has long invested in technological learning solutions to support the learning/ teaching processes, both in the classroom and clinical settings. Among the first technological solutions used was the Computer-assisted instruction (CAI) for teaching psychomotor skills, drug calculation, care planning, etc. (DeYoung, 2009). In addition to these applications, in recent years, an increasing number of nurse educators and nursing programs have invested in online learning for the delivery of courses and nursing curricula, sometimes fully-online, or with varying degrees of Web support, and /or a blend of online and face-to-face instruction (DeYoung, 2009).

In terms of efficacy, when compared to face-to-face instruction, online learning has been shown to be equally effective, and in some instances, with better outcomes. For example, in a cluster-randomized controlled trial, McMullan, Jones, and Lea (2011) examined the effect of an interactive e-drug calculations package on drug calculation ability and self-efficacy between two cohorts of second year nursing students. There was a significant improvement in drug-calculation ability for those who used e-learning package, but not for those who used the traditional handout package. Students in the intervention group were overall significantly more satisfied with support material than the control group, especially with the e-packages being easily accessible and user-friendly.

In a randomized controlled trial that compared the effect of an interactive multi-media self-directed CAI module versus a conventional lecture on the acquisition and retention of hand washing theory and skills in pre-qualification nursing students, no differences were found in knowledge gain**,** and retention of hand washing skills between the two

groups (Bloomfield, Roberts, & While, 2010). As such one would expect to see more use of online learning in relation to informatics education at the undergraduate level; however, only one study was found.

This study explored undergraduate nursing students' experiences with a health informatics course aimed at providing students with basic knowledge and understanding of information systems and applications of information technology in healthcare (Kenny, 2002). A WebCT educational learning system was used to create the program and tools within WebCT such as online bulletin boards, chat rooms, quizzes and self-assessment activities were used to facilitate students' online engagement. In this qualitative study, experiences of students with this course (n=21) were elicited through individual and focus group interviews. One theme that emerged from the findings was the ways in which computer confidence enhanced and detracted students from learning. The majority of students had little computer experience and for some students lack of confidence impacted their learning for the entire semester. Other students reported that online learning increased their computer confidence. Nonetheless, several attributes of online learning appealed to participants in this study including accessibility to learning resources and the ability to work on their own pace in an environment suitable to them, which allowed them to study more. Most students indicated that online learning exposed them to a variety of teaching and learning styles and allowed quieter students to participate more in this socially interactive environment (Kenny, 2002). Given the limited research about online learning modalities at the undergraduate level, further research is warranted to

help establish the utility of online learning in the delivery of informatics education among baccalaureate nursing students.

A proposed Framework for Integration of HI Education in Undergraduate Baccalaureate Nursing Education

Based on a review of this literature, a number of concerns have been identified in current approaches to NI education at the baccalaureate level. In order for nurse educators to enhance development of NI competence among baccalaureate nursing students, I propose that educational interventions offered at the undergraduate level be developed based on the framework proposed below, which would allow educators to systematically plan effective educational interventions that are conceptually informed, based on sound pedagogical practices, and rigorously evaluated on the short and long term.

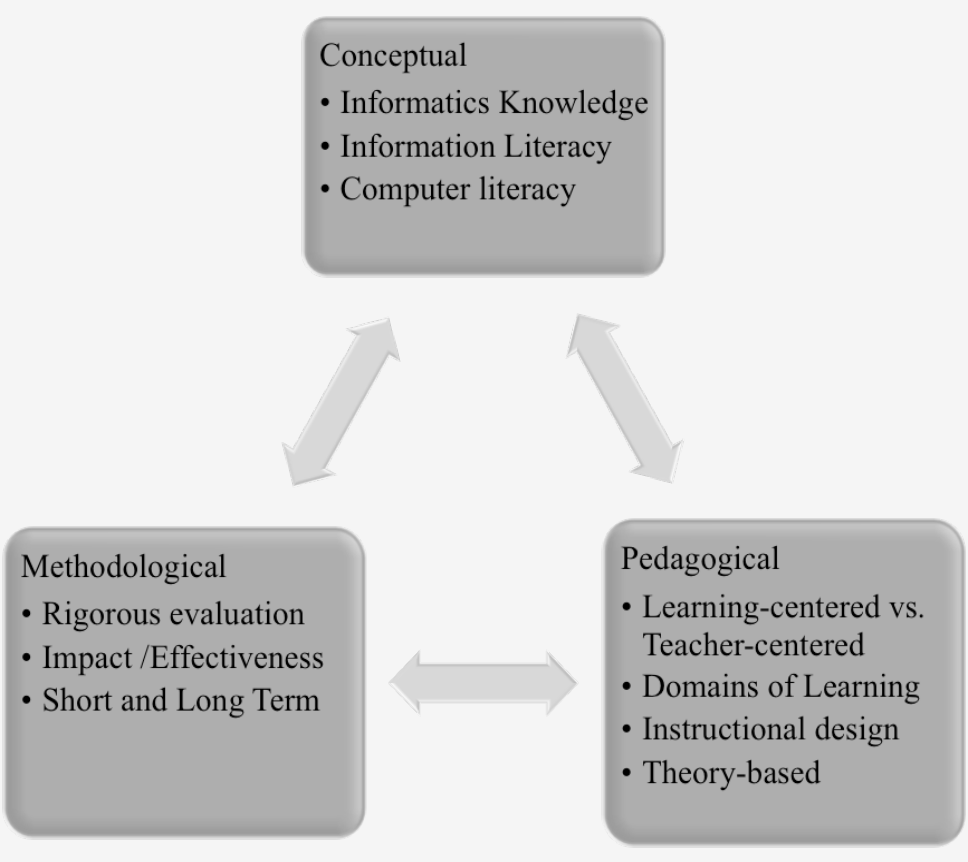


Figure 1. Proposed Framework for Integration of Informatics in Baccalaureate Nursing Education

Summary

A review of the literature on integrating informatics in undergraduate baccalaureate nursing education revealed three themes: conceptualization of informatics in baccalaureate nursing education, methodological quality of research studies reporting on informatics education, and teaching methods and pedagogical considerations related to planning informatics education. With regards to conceptualization of informatics education, there is a tendency to focus on computer and information literacy within the context of learning and teaching, without linking these skills to actual nursing practice.

Secondly, there is inconsistent integration of theoretical knowledge and clinical experiences related to informatics education. Inadequate understanding about informatics limits students' ability to fully understand how informatics relates to nursing (Fetter, 2009; Staggers, et al., 2001).

From a methodological perspective, the majority of the studies reporting on the inclusion of informatics education used descriptive surveys or quasi-experimental designs. There is a lack in evaluation studies that inform of the effectiveness of educational interventions as well as follow up studies that evaluate the relevance of education received in the work life of graduates.

From a pedagogical perspective, there are variations with regards to content, teaching strategies and approaches for integrating this content in the curriculum. In addition, there is limited use of theory or models to facilitate systematic planning of instruction and assessment of educational outcomes associated with current informatics education offered. Other theories that could be applied to understand technology use and adoption behaviors among undergraduate students of technology are also underutilized in the planning of educational interventions. Lastly, there are also limitations in the use of online learning modalities to facilitate delivery of informatics education at the undergraduate level. I have proposed a framework that highlights the importance of considering conceptual, pedagogical, and methodological aspects in the planning of effective educational interventions targeted at enhancing NI/HI competence among baccalaureate nursing students.

CHAPTER 3

Development and Pilot Testing of Intervention

In this chapter I describe the development and testing of the intervention used in this study. I begin by describing the current undergraduate curriculum in the Faculty of Nursing at the University of Alberta, as this is the pedagogical context for which the intervention was developed. I also discuss the pedagogical principles that needed to be incorporated into the intervention, given the nature of the undergraduate curriculum. Next I discuss the development of the intervention used in this study, in which I have drawn on the experience of the Faculty of Medicine and Dentistry at the University of Alberta so that it reflects what nurses need to know about health informatics. Last, I describe several small pilot tests I conducted to ascertain various feasibility issues.

The Undergraduate Nursing Curriculum at the University of Alberta and the Status of Informatics Integration in the Curriculum

The Faculty of Nursing (FON) employs a context-based learning strategy in the delivery of theory and clinical courses. Some of these courses are offered over 2-13 weeks teaching block or as a combination of two separate teaching blocks/6weeks each. Most courses include four modalities of learning experiences: A fixed resource session (FRS) that is offered as a face-to-face lecture by the course teacher or a guest speaker, a tutorial that takes place through seminar discussion, a clinical placement, and a lab-learning component. Class size varies according to designated learning experiences: a

clinical group (8-10 students), a tutorial (14 students), a laboratory experience (14-16), and a fixed resource session (Lecture-FRS) (50-100 students).[5]

In order to evaluate the level of informatics integration at the Faculty of Nursing, I reviewed course descriptions and graduate competencies and found that the FON identifies informatics as one key graduate competency in all undergraduate programs. Content related to this competency has been threaded in a few courses; however a specific course or unit of study about NI/HI has not been developed yet. Overall, Faculty and students are adept in using technology as most courses offered at the undergraduate and graduate levels have a Web presence through WebCT Vista. In addition, the FON utilizes top of the line simulation technology to support clinical learning of undergraduate nursing students.

Opportunities for using technology for learning purposes are very evident and often integrated within theory and clinical assignments of many courses. For example, a theory course may include an assignment that requires students to apply information literacy skills in navigating library resources and databases while searching for information about a certain topic. Collaboration between Faculty members and librarians is ongoing and aims at facilitating the development of information literacy skills, particularly among undergraduate nursing students. Given that students enrolling in the undergraduate programs are knowledgeable about use of the Internet, there has been no need for a systematic assessment of incoming students' level of computer literacy. However, to

[5] http://www.uofaweb.ualberta.ca/nursing/teachingmethods.cfm.

date, there is no core theory or clinical instruction about NI/HI in the context of nursing practice and/or patient care. Inadequate knowledge about HI significantly impacts graduates' outcomes and future practice, which is of concern, given the fast-paced transition of the health care system in Alberta to e-health. Therefore, helping students understand basic concepts about NI/HI and the applications used in the delivery of health care would be vital for them to build confidence and competence in using health care technology. However, such a transformation is not likely to occur unless misconceptions about informatics are recognized and acted upon. The biggest misconception is that for many educators, informatics means computers and for others it is about using computers to access evidence-based resources. The most worrying misconception, which seems to infiltrate the nursing community at large, is that informatics is often seen as being able to use computers or online learning tools (Thompson & Skiba, 2008). Informatics does not mean only computer literacy and/or information literacy, but also patient care and nursing practice. The failure to recognize these links and build them into undergraduate nursing education means that graduates are not fully prepared for clinical practice.

In acknowledgement of these limitations in the current curriculum and in recognition of the importance of providing baccalaureate-nursing students with information about NI/HI as it applies to nursing practice, the Faculty of Nursing gave full support to this project.

Pedagogical Underpinnings of Context-Based Learning

Teaching practices informed by sound pedagogy are key for achievement of educational goals regardless of the type of teaching medium or strategy used to deliver

the education (Parker & Myrick, 2008; Odom, Barnes, & Wicker, 2005; Adams, 2004). For many decades, education of health care professionals has been rooted in a behaviorist tradition that promoted educators' knowledge and authority over all other sources of knowledge, and viewed students as receptacles of educators' wisdom. In these teacher-centered educational environments, teaching practices that thrived most were those that cultivated less space for questioning the authority of the educators or the knowledge they imparted. In contrast to the behaviorist tradition, evolving educational practices emanating from a constructivist view of knowledge support learning practices in which students actively participate in constructing learning based on prior knowledge, experiences, and interaction with the environment (DeYoung, 2009; Jeffries & Norton, 2005).

In planning educational experiences, the choice of a type of instruction or a teaching strategy is often influenced by the teacher's pedagogical orientation or philosophical beliefs. A teaching strategy that facilitates students' acquisition of the desired knowledge, competencies, behaviors and values through student-centered and engaging learning activities that promote deeper learning reflects a constructivist approach (Moore, Fowler, & Watson, 2007). Teaching strategies that are very structured around content and achievement of tasks, on the other hand, require less engagement of students and hence position the learner in a passive role, the instructor as the center of attention, and the outcomes of learning at the periphery. Examples of student-centered learning strategies that promote active learning include discussion, simulation, and online learning (Moore, et al., 2007; O'Neil, Fisher, & Newbold, 2009). The predominant approach to instruction

within a traditional approach to education has been the lecture, especially when the instructor imparts content and students receive knowledge passively (Jeffries & Norton, 2005; Parker & Myrick, 2008).

Given the complexity of human interaction, educators are expected to choose a teaching method, whether traditional or constructivist, that fits best with the learning material, the learning domain, i.e. cognitive, psychomotor, and affective, the students' attributes and preferences, and, the desired outcome. In addition, formative and summative evaluation of the learning experiences informs the educator about effectiveness of the instructional experience (Jeffries & Norton, 2005).

The intent of this research project was to develop learning opportunities that would help address HI educational needs among baccalaureate nursing students at the University of Alberta. Prior to beginning the project, I conducted an environmental scan to identify similar previous projects developed within the University of Alberta, and found that the Faculty of Medicine and Dentistry (FOMD) had developed a health information literacy curriculum for their undergraduate medical and dentistry students in 2007. Although the curriculum had overarching concepts central to the use of information technology in health care, and the FOMD was willing to facilitate the use of their platform for my research study, the relevance of the FOMD program for nursing students was limited. Therefore, I needed to develop a new content that addressed nurses' roles in relation to health informatics.

Developing an Intervention to Teach Undergraduate Nursing Students about Health Informatics

The intervention in this study was comprised of two learning modules that provided foundational knowledge about HI, particularly as to how this information could be used to improve nursing practice. The first module introduced basic principles about health informatics and the second module reviewed some tools available through health informatics applications that could be used to improve nursing care. I began by developing a set of learning objectives that reflected competencies required of nurses at a beginning level of practice (Staggers, Gassert, & Curran, 2002) to help guide selection of content to be included in the modules as well as the development of knowledge test items (Appendix A.). Then, I reviewed a variety of resources including nursing and health informatics textbooks, peer-reviewed journals, professional associations' publications, and organizational and governmental reports in order to develop the content. The selection of learning materials that I included in these modules provided hands-on opportunities for students to explore relevant web-based resources. Actual care planning applications using simulation technology were not included but will be developed as part of my future research studies. The topic outline I used for organizing the content in each module is shown below:

Table 1. Topic Outline for Learning Module 1: Introduction to Health Informatics.

Learning Module 1: Introduction to Health Informatics
1. Driving forces for health informatics development.
2. The Canadian context and experience with health informatics.
3. Health Informatics and Selected subspecialty areas:
a. Health Informatics.
b. Nursing Informatics.
c. Medical Informatics.
4. Relevance of health informatics to nursing practice, education, research, and administration.
5. Impact of Health Informatics on patient care.
6. Informatics competencies at different levels of nursing practice.

Table 2. Topic Outline for Learning Module II: Health Informatics Tools & Applications to Support Nursing Practice.

Module 2: Health Informatics Tools & Applications in Health Care and Nursing Practice
1. Health Informatics Tools and Applications: • Electronic medical records, electronic health records, & personal health records. • Professional order entry systems. • Clinical decision support systems. • Personal digital assistants. • Automatic dispensing of medications and documentation. • Tele-health. • Monitoring systems. • Key administrative information systems. 2. Paper and Computerized Documentation. 3. Standardized Nursing Language and Nursing Minimum Datasets. 4. Informatics and Nurses' Visibility in Health care.

Learning Outcomes

The primary research question in this study focused on which instructional method promoted better learning outcomes, online or a traditional lecture format. In identifying an instructional strategy for the delivery of the intervention within a constructivist pedagogical framework, Vodcasting[6] was selected as the strategy of choice for several reasons. First, podcasting is a type of mobile learning that "uses technology that allows students to access and listen to recorded classroom audio files from a computer, MP3 player, or iPod (Greenfield, 2011, p. 112), and thus material recorded using this format is available as needed by the student." Various approaches can be used to prepare podcasts. Using a digital recorder and a microphone, a professor can record a classroom lecture and once done, upload the recorded file on a distribution system such as Black Board (Forbes & Hickey, 2008). With advanced recording technologies, it is possible to synchronize

[6] In this study, Vodcasting is used interchangeably with podcasting

Power Point slides and various animations with a lecture. Recordings can be done as either audio (Podcast) or video (Vodcast); however, video podcasts require more prep work and quality digital media to produce desired resolution (Forbes & Hickey, 2008).

Secondly, although the research on the utility of Vodcasting to help students meet instructional objectives is very limited, several studies have reported on various aspects of teaching using podcasting in nursing education. In a descriptive survey study, Forbes and Hickey (2008) evaluated patterns of use of podcasts and perceived benefits among undergraduate nursing students. The podcasting approach was made available to faculty and students in the fall of 2006 in response to students' request. To evaluate experiences with this innovative teaching tool, the authors developed a survey tool with 16 long and short-answer questions. At the end of the semester, the survey was given to all undergraduate students enrolled in 6 nursing core courses where podcasting was being used. Out of 248 students, 170 completed the survey, with a response rate of 68.5%. Results of this survey showed that students most commonly used podcasts to review material, reinforce or clarify content, understand difficult concepts, and facilitate note taking. Podcasts have been found particularly useful for students' whose first language was not English, as it allowed them to work through the material at their own pace. Students reported other benefits of podcasts such as the ability to review podcasts of other professors and evaluate a course prior to making a decision to register in it. Students listened to podcasts mainly through their computers, and less while on the go, which was atypical of mobile learning use.

In another study, Schlairet (2010) examined attitudes toward using computers in nursing, and patterns of podcast use among students in undergraduate and graduate programs in a college of nursing. The sample included 70 volunteer nursing students from undergraduate, second-degree, and graduate level students. The development of the Podcast was guided by the Billing's (2000) framework for teaching and learning in Web-based environments, which is comprised of five concepts: outcomes, educational practices, faculty support, learner support, and use of technology. Podcasts, i.e. live-recorded audio files of classroom lectures were recorded for each classroom lecture and posted on the course website for download by students. Eighty-two percent of the podcasts had corresponding PowerPoint lectures that could be downloaded. Each Podcast was approximately 22 minutes long. A demographic information sheet and a questionnaire: Computering in Nursing (Q-CN), developed by Thomas (2001), were administered prior to the start of the course. The Q-CN had a Cronbach's alpha of .859 and was used to measure attitudes of student nurses toward the use of computers in nursing with a 5-point Likert scale questions. The Student Podcasting Survey developed by Forbes and Hickey (2008) was administered to assess patterns of student podcast use. Results showed that attitudes for the entire sample improved, but that the results were only statistically significant for second-degree students. Significant differences in post-test attitude scores were lowest in Asian and ESL students. Forty-seven percent of students reported accessing podcasts with a larger percentage (57%) of graduate students accessing podcasts. Most students listened to podcasts while at home (94%) to reinforce learning, clarify course content and for examination review. ESL students downloaded

significantly more podcasts. The majority of students in this study reported that podcasts were helpful to their learning. Overall, the authors concluded that Podcasts could be used as a resource to supplement learning with minimal impact on budget, class attendance, and faculty workload.

In a comparative study by Vogt, Schaffner, Ribar, and Chavez (2010), the authors examined the impact of podcasting on the learning and satisfaction of undergraduate nursing students. The effect of podcasting along with PowerPoint presentation on knowledge acquisition and satisfaction was compared against a traditional face-to-face lecture using two groups. One group was comprised of the 2007 class (n=63); these students received some content related to health promotion presented in a traditional lecture format. The second group was comprised of the 2008 class (n=57), which offered the same content but through podcasting or PowerPoint with voice-audio. In both methods, the same instructor taught the course and teaching was evaluated using the same exam questions. A satisfaction survey was gathered from students in the podcast group only. Test results on certain questions were compared between the two classes. Results showed no significant overall difference in test scores between the two groups. In the podcast group, test scores varied between the first and last podcast i.e. Health promotion was the first unit and podcast students scored highest on this unit, immunizations was the last and students scored lowest on this unit. The authors suggested that podcast students might have had more trouble finding time to listen to podcasts as the course went on. Satisfaction with podcasts was generally favorable although a significant number of people still preferred lecture-based instruction. Students mostly appreciated podcasts for

their flexibility, mobility, allowing students to listen to lectures multiple times and review podcasts prior to tests and quizzes.

Podcasts seem to be appealing for many students for their flexibility of use and suitability for different paces of learning. However, evidence on effectiveness of podcasts remains limited and inclusive. Rigorous research methods to establish efficacy of podcasts is needed.

In the study discussed in this dissertation, I evaluated whether HI education delivered using Vodcast technology[7] resulted in improved learning outcomes, compared to a face-to-face lecture format. In the next section, I discuss the design of the lecture and the online learning formats and the procedures I used to pilot test these two interventions.

Development of the Lecture Session

The instructional time for the lecture was approximately forty minutes for each module. Two modules were delivered using two lectures. Instructional activities included a Power Point presentation, use of video clip, and opportunities for question/answer. The presenter was Tracy Shaben, the nursing clinical informatics coordinator at Alberta Health Services. I was the only other person with the background to provide this lecture, but it was considered inappropriate for me to present the lecture because I am also a faculty member involved in teaching of nursing students that were invited to participate in this project. I had several meetings with the speaker and provided her with the study details, the topics to be discussed, and literature sources related to content being covered to ensure that she was comfortable in presenting the material as per

[7] Online learning is used to denote Vodcast Technology and both terms are used interchangeably throughout the document.

the planned instructional strategies. In addition, I developed the PowerPoint slides used during the lecture.

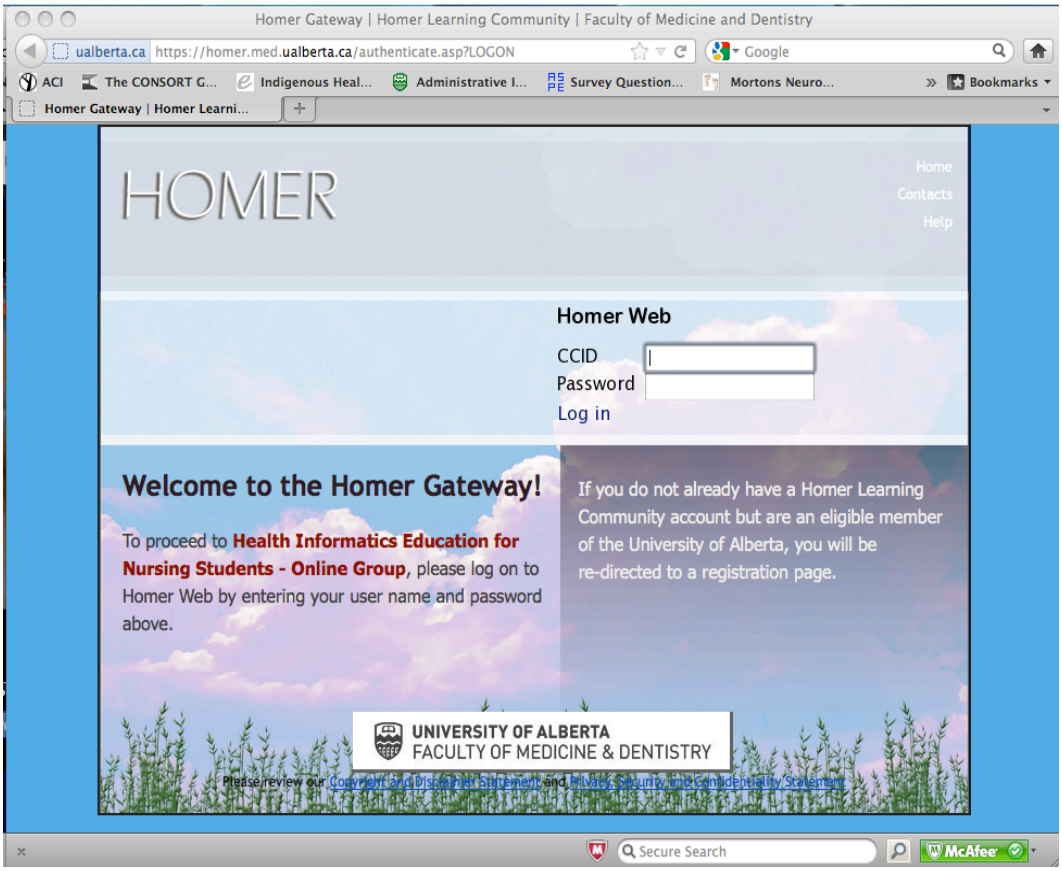
My thesis supervisor, (KO), and (AH), a research assistant, made sure that the educational media and other teaching resources were set up appropriately prior to beginning the lecture to minimize disruption of learning. The guest speaker's background enabled the integration of application examples related to clinical information systems currently used in Alberta health care system.

Development of the Online Modules

I worked closely with FOMD staff to create an online delivery format for the educational intervention. The content for the two modules that comprised the online module was identical to the material used in the lecture format. The material was recorded as a Vodcast presentation, with voice-over- Power Point. Tracy Shaben, the same speaker that presented the lecture format, was invited to narrate the modules. The use of the same speaker and content helped to reduce the possibility that the outcomes of the study could be attributed to other factors, such as the speaker's qualifications (Shadish, Cook, & Campbell, 2002).

The recorded modules were tested for clarity and resolution quality, and then posted on Homer Learning Community Website, a learning resource at FOMD. Students were able to access the Homer Site Web page using a unique ID and password. In addition to the Vodcast presentation, Web links to a variety of provincial and national initiatives about informatics and other informatics resources offered through nursing professional

organizations were provided so that learners can access these resources at any time to augment their learning.



To set up the learning environment of the online module, a combination of online learning community tools (ViviTechnologies) developed at the Centre for Health Evidence, University of Alberta, were used. This technology also facilitated authentication, resource integration, and usage tracking. Key features of the module design and pathways and the functional requirements are described below along with an illustration of the design setup for pilot testing the online module using a before/after design (Figure 2).

1. *Integration of four study components*: demographic information, pre test, module content, and post test.
2. *Controlled progression* of participants in the online environment to prevent contamination of pre and post test results. This prevented study participants from accessing the module content until they completed the pre-survey and prevented study participants from accessing the post survey until they completed the module content. It also prevented non-participants from accessing their pre or post surveys under any circumstances.
3. Inclusion of *branching sequences that allowed multiple "content pathways"* depending on student response (s).
4. Pre and post surveys with *diverse question types* (text response, multiple choice, Likert scale, and self-efficacy rating, and confidence interval rankings).
5. Integrated presentation materials (narrated PPT recording using Camtasia Studio).
6. Integrated link-outs to relevant collections of resources.
7. *Comprehensive data collection and reporting* on participant demographics, completion rates, completion date and time, and survey responses.

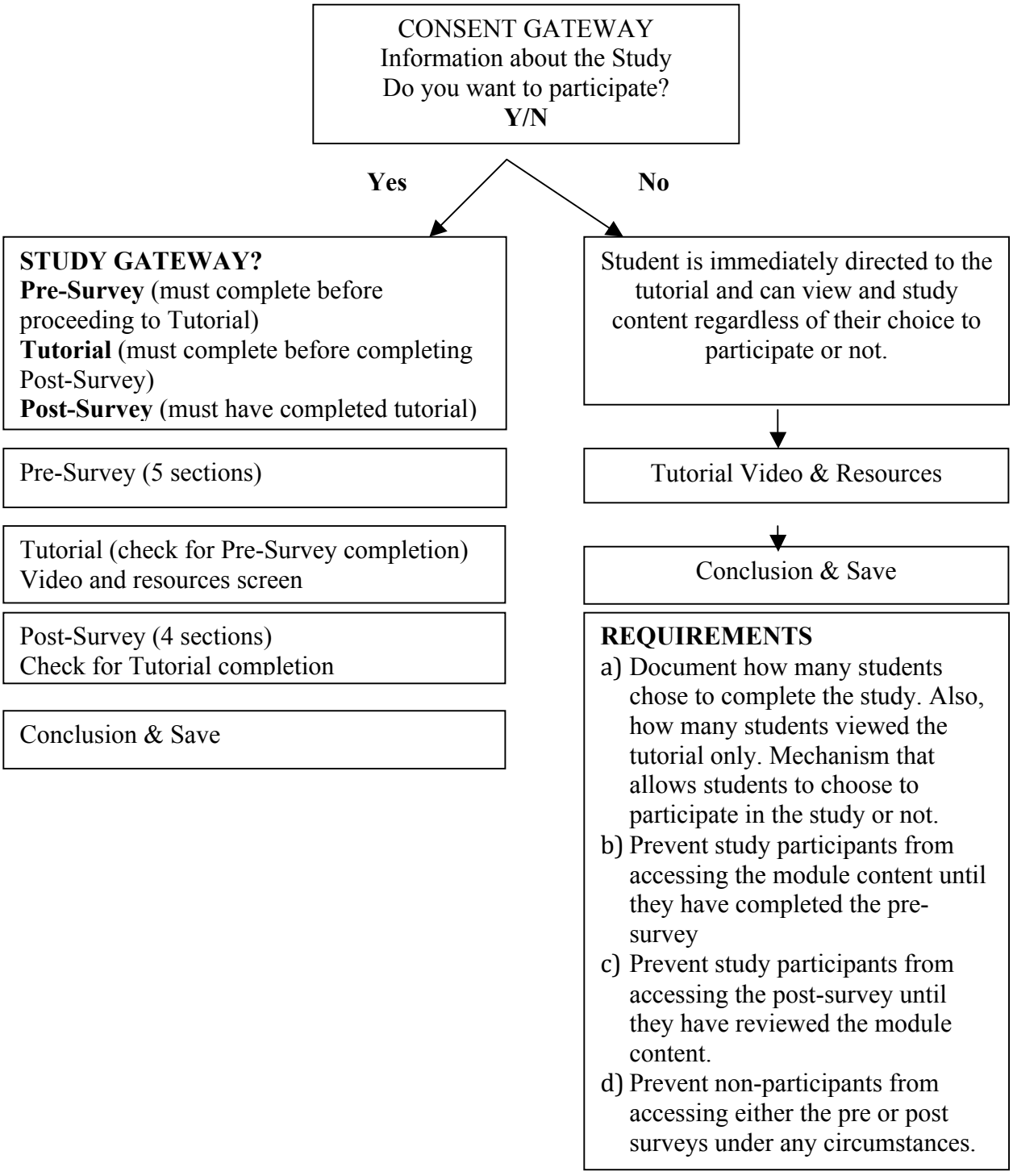
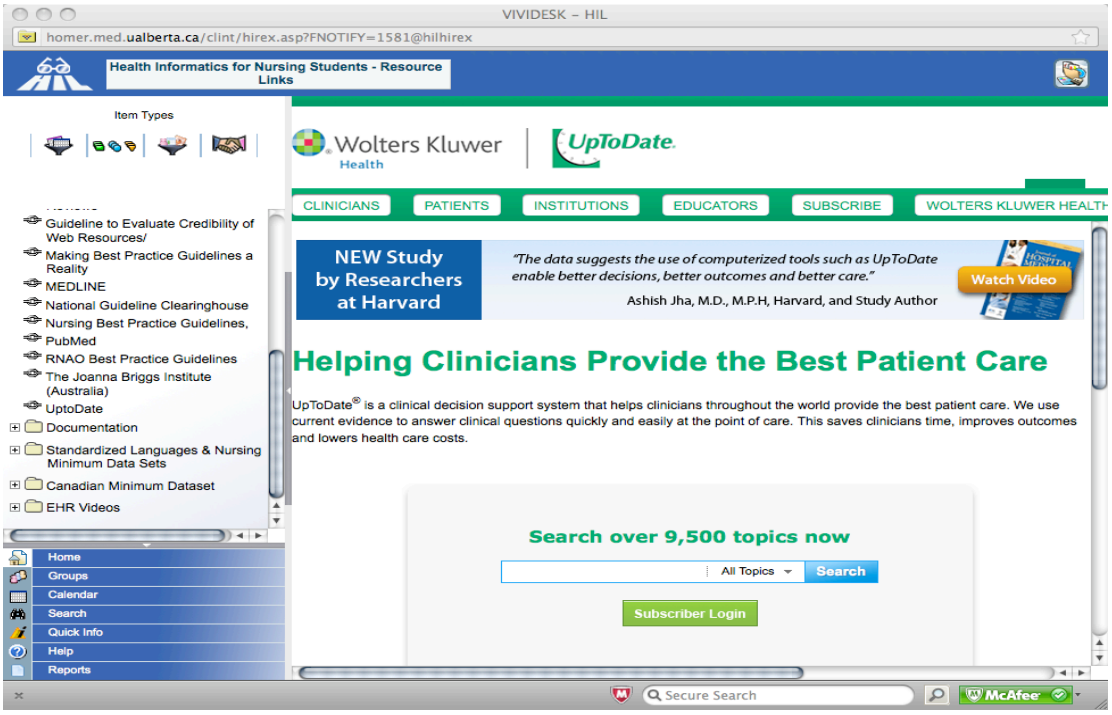


Figure 2. Online Module Design & Pathways


VIVIDESK – HIL
homer.med.ualberta.ca/clint/hirex.asp?FNOTIFY=1581@hilhirex
Health Informatics for Nursing Students - Resource Links
Item Types
Guideline to Evaluate Credibility of Web Resources/
Making Best Practice Guidelines a Reality
MEDLINE
National Guideline Clearinghouse
Nursing Best Practice Guidelines,
PubMed
RNAO Best Practice Guidelines
The Joanna Briggs Institute (Australia)
UptoDate
Documentation
Standardized Languages & Nursing Minimum Data Sets
Canadian Minimum Dataset
EHR Videos
Home
Groups
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Evidence-Based Databases
Documentation
Standardized Languages & Nursing Minimum Data Sets
Canadian Minimum Dataset
EHR Videos
EHR video demonstration
NetCare Benefits video
The evolution of NetCare
What is EHR?
Capital Health
Edmonton + Area, Canada
Bringing the future to Capital Health - In 2004, Capital Health implemented an evolutionary approach to patient care with the development of the electronic health record.
« Back

Pilot Testing of the Intervention

A pilot study informs the researcher about several aspects related to the planning and conduct of research such as adequacy of research instruments, suitability of a research protocol, estimates of sample size, potential recruitment strategies, logistics and feasibility issues, and the opportunity for collecting preliminary data about the effectiveness of a proposed intervention prior to conducting a full-scale study (Feely, et al., 2009; Thabane, et al., 2010). In this study, the purpose of the pilot study was to examine feasibility issues associated with providing health informatics using two teaching formats, lecture and online. Findings informed the design of the main study.

Research Questions & Hypotheses

A number of research questions were proposed in this pilot study. These were:

1. What is the participation rate for each format?
2. What factors influence students' decisions to participate in the study?
3. Does the intervention improve knowledge gain, self-efficacy, and attitudes toward the EHR?
4. Which teaching-format yields better results regarding knowledge gain, self-efficacy, and attitudes toward the EHR?
5. What is the effect size for each teaching format (Lecture vs. Online)?
6. What is the projected sample size for phase two of the study?
7. Do study instruments appear to be internally consistent?

For research questions (3& 4), significant improvements were predicted between pre and post mean scores on all outcome measures regardless of the teaching format. The null

hypothesis was: “There is no significant difference between pre and post intervention mean scores of knowledge test, attitudes, and self-efficacy between students taking the online module and those receiving an in-class lecture.”

Method

Description of Study Design

A non-equivalent control group with pre/post test design was used. This design was relatively weak because it lacked randomization of subjects to study groups. However, the use of a pretest measurement allowed me to determine whether the groups were comparable at the outset, prior to administering the intervention (Loiselle & Profetto-McGrath, 2011). The primary outcome was specified as the difference between pre and post intervention mean scores on Actual and Perceived Knowledge gain. Secondary outcomes in this pilot study included attitudes and perceived self-efficacy toward the electronic health record. Additional data included participants’ age, learning styles, and any previous education in informatics.

Target and Accessible Population

The target population in this study was baccalaureate-nursing students. An accessible population was identified at the Faculty of Nursing, University of Alberta. A convenience sample was drawn from among fourth-year level students, because at this level, students would have had sufficient theoretical and clinical nursing knowledge to integrate concepts related to informatics knowledge and its applications in health care. Based on historical trends, 120 students, on average, registered in fourth-year level courses in the

Collaborative program at the Faculty of Nursing (Personal communication, Director of Undergraduate Programs, Faculty of Nursing, July 10, 2010).

Inclusion and Exclusion Criteria

Students were recruited if they were enrolled in fourth year courses in the Collaborative program at the University of Alberta in the fall term of the academic year 2010-2011. Students enrolled in other undergraduate programs or graduate programs at the University of Alberta were excluded from the study. Students who had previous knowledge in informatics were not excluded but asked to report this information upon participating in the study.

Sample Size

For the purpose of this pilot study, I based sample size calculation on information from two studies in which experimental or quasi-experimental designs were used to assess similar outcomes. In the first study, Desjardins Cook, Jenkins, and Bakken (2005) used repeated-measures, non-equivalent comparison group design to determine differences in self-rated informatics competencies pre-and-post intervention about an evidence-based practice curriculum on nursing informatics competencies between three student cohorts in the combined BS/MS program for non-nurses at the Columbia University School of Nursing. Informatics competencies measured in this study included 5 categories: 1) Computer skills: Documentation; 2) Computer skills: Decision Support; 3) Informatics Knowledge: Data; 4) Informatics Knowledge: privacy/Security; and 5) Informatics: Evidence-based Practice. Findings reporting on the category of "Informatics Knowledge: Data" for the class of 2002 (n=64) was chosen as the closest to the focus of

the educational intervention used in this study. The mean scores and SD of this class were: 2002 ADM (2.5/1.5), and for 2002 GRAD (4.1/1.1). Dividing the difference of mean scores (1.6) by the average of the SD (1.3), the effect size = 1.2. Given the very large effect size, which is not likely achievable in educational interventions, it was not considered.

The second study by Jeffries (2002) used a randomized pretest/posttest experimental design to compare the effectiveness of an interactive, multimedia CD-ROM and a traditional lecture for teaching oral medication administration to nursing students. No significant baseline differences between the computer and lecture groups by education or computer skills were found. Statistically significant differences between the two groups in cognitive gains and student satisfaction ($P = 0.01$) were found, with the computer group demonstrating higher student satisfaction and more cognitive gains than the lecture group by an approximately 10% in the knowledge posttest mean score following the intervention. Based on this information, and assuming that the test scores in this intervention would be out of 100%, with a SD of 20, and an expected difference of 10, an effect size of 0.5 [Δ=10/20 = 0.5], the sample size required to ensure adequate power of 0.8 to detect a difference between the two groups would be 64 in each group [$16/\Delta^2 = 16/0.5^2 = 64$][8]. Given that the calculated effect size corresponds to a moderate effect size as recommended by Cohen, it was adopted for this pilot study (Cohen, 1992; Pallant, 2007).

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[8] Source: http://www.vanbelle.org/chapters/webchapter2.pdf

Sample Recruitment

A recruitment opportunity where the largest number of students could be approached within a regular course teaching time existed within a course titled NURS 490: Nursing in Context D and a course titled NURS 491: Nursing Practice VII. NURS 490 is a five-credit course and NURS 491 is a seven-credit course. Topics covered in NURS 490 included concepts related to triage, correctional nursing, international nursing, management, and epidemiology. Both courses are offered over two blocks of teaching time, designated as 6WK1 and 6 WK2, during the Fall term to fourth year nursing students in the Collaborative program.

Using Bear Tracks, a university-wide electronic registration system, students self-register in either teaching block on first-come-first-served basis. On average, each block of teaching accommodates 50-55 students and closes to Web registration once this number is achieved. Only administrative staff has access to students' registration information. The learning experiences in NURS 490 included tutorial, lab, and FRS. A total of 6 FRS were available for a structured lecture time in this course, which were offered by guest speakers every Tuesday between 12:30 – 1:50 PM. Two FRS sessions were identified in NURS 490, as they were not assigned other content, therefore no course content would have needed to be bumped. With the support of the Faculty of Nursing, the course outline was adjusted with a statement indicating that six FRS would be offered in 6 WK2, Fall 2010 instead of four. The course outline and the class timetable were posted on e-class in on October 1st 2010.

Instrumentation

The pre-survey questionnaire was comprised of five sections (Appendix B). These sections were: Section A: Demographic data, Section B: Computers-Self Efficacy scale developed by Compeau and Higgins (1995), Section C: Attitudes toward EHR scale developed by Moody, Slocumb, Berg, and Jackson (2004), Section D: Perceived knowledge related to informatics competence expected of beginner level nurses developed by (Jarzemsky, Girdley, Murray, & Douglas (2009), and Section E: Knowledge gain related to education delivered in both formats (5 multiple-choice questions) using a researcher-developed test. A detailed discussion of each section of this instrument is discussed later in this chapter.

The post-survey questionnaire included the same five sections and an open-ended question, which asked: *"Given that you have completed this learning unit, we would like to know your thoughts about whether you found the information presented useful and whether it increased your knowledge in this area."* Learners' feedback on aspects related to learning/teaching had been identified as key in effective design of education. In addition, this information would help in validating the quantitative findings of the study (Appendix C).

I used the same questionnaires for the second run of data collection, which involved the teaching of module 2, but with a different set of knowledge test items comprised of 4 multiple-choice questions to reflect new content introduced in this module. In addition, I added another open-ended question to the post survey of the instrument to gain more

insight from students about ways to improve the learning units for the main study. The question was "*what areas can you suggest for improvement in this learning unit?"*

In addition to these questions, I designed a feedback survey tool to get students' insights and suggestions for improving the study planning and design (Appendix D). The feedback survey invited comment on a list of some of the items that could have impacted participation in the study, suggestions as to how the study design could be enhanced for the main study, and a question regarding the year of the study in the nursing program (second or third year) the student thought would best increase chances of students' participation in the study. The research assistant (AH) circulated the feedback survey to participants via e-mail. Upon receiving responses, the research assistant removed information related to the identity of the student from the survey and forwarded the feedback to me.

Reliability and validity of measuring instruments

The quality of the measuring instruments selected in this study was evaluated in relation to two elements, reliability and validity. Reliability of an instrument refers to the "degree of consistency with which an instrument measures an attribute (Loiselle & Profetto-McGrath, 2011, p. 260)." It is also an estimate of how the individual items on a measure are correlated with each other (Runder & Schafer, 2001). There are several types of reliability, but for the purposes of this study I was primarily interested in the internal consistency of the scales that were part of the pre and posttest surveys, which included the self-efficacy scale, attitudes toward the electronic health record scale, and the perceived informatics knowledge scale.

Cronbach's alpha or Coefficient alpha is a common approach for assessing reliability of instruments. Values of Coefficient alpha may range between .00 and 1.00, and "the higher the reliability coefficient, the more internally consistent the measure (Loiselle & Profetto-McGrath, 2011, p. 262." In general, the desired level of internal consistency for instruments used for research purposes is 0.8 or higher (Runder & Schafer, 2001). Validity refers to the "degree to which an instrument measures what it is supposed to be measuring (Loiselle & Profetto-McGrath, 20122, p. 262)." Various types of validity include face validity, content validity, criterion related validity, and construct validity. The validity of the scales in this study was not assessed.

The Generic Computer Self-Efficacy Scale

This scale was included in the second section of the pre and posttest questionnaires. Compeau and Higgins (1995) defined computer self-efficacy as "the individual's perceptions of his or her ability to use computers in the accomplishment of a task (P. 191)." This scale is based on social cognitive theory and is concerned with judgment about future performance of a task, not past accomplishments in relation to computer use. In the development of the computer self-efficacy measure, Compeau and Higgins focused on three dimensions of efficacy: magnitude, strength, and generalizability. Magnitude of computer self-efficacy refers to "the level of capability expected of the individual, i.e. individuals with a high computer self-efficacy magnitude might be expected to perceive themselves as able to accomplish more difficult tasks than those with lower judgment of self-efficacy. The level of confidence an individual perceives when performing a task reflects the strength of his/her computer self-efficacy. Lastly, self-efficacy

generalizability "reflects the degree to which the judgment is limited to a particular domain of activity" as opposed to being comfortable to use a variety of different computer systems and applications in different settings (p. 192).

The resulting scale was a 10-item measure of perceptions of self-efficacy in relation to varying levels of assistance that could be available when using a new or an unfamiliar computer/software application. The "yes or no" response on the scale reflects the magnitude aspect of self-efficacy in relation to the support needed if the individual experiences a difficulty completing a task or job using a computer software. The level of self-efficacy confidence is measured on rating scale of 1-10, where 1 indicates "not at all confident," "5 indicates moderately confident," and "10 indicates totally confident." If an individual chooses a "Yes," on one of the item, he/she could then rate the level of confidence according to the above-mentioned categories. If the answer "No" was selected, then rating of the confidence would not be applicable. The scoring of the scale is done by counting the number of "Yes" answers to provide an indication of the self-efficacy magnitude, and summarizing the responses on the confidence scale, and counting 0 for a "No" response (p. 194).

In a study of 1200 participants, the internal consistency of the scale (Cronbach's alpha) was 0.8 (Compeau & Higgins, 1995). The authors examined several constructs that predicted computer self-efficacy and found that individuals' judgments about their self-efficacy influenced the individual's efforts and persistence to try new applications. Individuals with low perceived computer self-efficacy were more likely to experience anxiety, and less enjoyment in using the new application. Conversely, individuals with

high computer self-efficacy were more comfortable and less anxious when using computers.

In a cross-sectional survey of 121 nursing faculty and students in a Western Canadian college, Kenny, Neste-Kenny, Burton, and Park (2012) adapted the computer-self efficacy scale by Compeau and Higgins to assess participants' self-efficacy related to their potential use of mobile technology in the future to support learning and teaching. The new version of the scale, which they called mobile self-efficacy scale consisted of the same 10-response items from Compeau and Higgins computer self-efficacy scale, but the question stem was changed from "I could complete the job using the software package…" to (for students), "If I had a mobile device such as a smart phone or 3 G phone, I could use it in my nursing program… For example, if there was no one around to tell me what to do as I go." Participants were asked to rate their confidence level from 0-10 about mobile use behavior presented in each question of the scale. If their answer was "No", they selected 0. If their answer was "Yes," they chose between 1 and 10, with "1" indicating only slight confidence and "10" total confidence. A score of "0" on the scale indicated that faculty and students are incapable of learning using mobile devices, whereas a score of "100" indicated that they were highly certain of their ability to learn and use mobile devices for that purpose. The adapted mobile version of the scale was found to be internally consistent with a Cronbach's alpha of .94. The authors concluded that based on participants' score on the self-efficacy scale, they are highly confident in their use of mobile technology and prepared to engage in mobile learning.

In another study, Kuiper (2008) used a comparative descriptive design to assess clinical reasoning of nursing students when personal digital assistants were used as an information source. At the end of the study, Kuiper administered the computer self-efficacy scale to determine if there was a relationship between use of PDAs and computer self-efficacy after adapting the Compeau and Higgins computer self-efficacy scale by substituting the "PDA" in place of "computer" in each item (P. 95). The sample included senior nursing students, 12 PDA users and 9 non-users of PDAs, who volunteered to participate in the study. Although Kuiper did not provide information about the internal consistency measurement of the instrument in this study, the results of the study showed that students were confident in using the PDA resources for assignments, better organization, and improvement in clinical effectiveness, but they were not confident that the device made them less reliant on others. In addition, more frequent users of PDA reported that they would become more confident in completing assignments and familiar with the software with time. In this pilot study, the questionnaire was administered as is, with only specifying the software package as "electronic health record." The scores on the self-efficacy scale in this study were specified as follows: Not at all confident (a score of 1, 2, 3, or 4), moderately confident (a score of 5, 6, or 7), and totally confident (8, 9, or 10).

Based on these studies, and the approach used by the Compeau and Higgins to evaluate the construct validity of the self-efficacy scale using regression analysis, the generic self-efficacy scale could be described as both, reliable and valid, thus suitable for use in this study.

Attitudes toward the electronic health record

The Attitudes toward the Electronic Health Record Scale was included in the third section of the pre and posttest questionnaire. The scale is a five-item Likert-type scale that measures nurses' disposition to the electronic health record (Moody, Slocumb, Berg, & Jackson, 2004). The scale scores are summed for a total score, which may range from 5 to 25. A high score on the scale indicates positive acceptance or disposition toward use of electronic records, and a low score, more negative disposition toward electronic health record (p. 341). Moody et al. have developed the scale as one of the measurement tools they have used in a descriptive, cross-sectional study to assess the functionality, needs and preferences, and attitudes of nurses (RNs, Licensed practical nurses, and nursing assistants) (N=100) with access to clinical documentation system at 23 clinical units at a large Magnet hospital in a metropolitan area of southwest Florida. The researchers assessed the psychometric properties of the scale using item-analysis and Cronbach's alpha for internal consistency reliability. Construct validity of the scale was confirmed using a principal component factor analysis with varimax rotation. The Cronbach's alpha of the scale was moderately high, .7.

I could not find other studies that have used this questionnaire. However, given that the scale was designed to measure disposition to electronic health record among nurses, and that other scales available in the literature mainly measure attitudes toward computers in general, I thought it would be interesting to find whether this scale would capture dispositions of nursing students to electronic health record in this study.

Perceived Informatics Knowledge Scale

The Perceived Informatics Knowledge scale was included in the fourth section of the pre and post test questionnaire. This scale was developed by Jarzemsky et al. (2009) and includes 12 competency statements each measured using a Likert scale of 1 to 5, where 1 = very little and 5 = very much. No psychometric information about this scale is available but it was based on the master list of informatics competencies for the beginning-level nurse, as defined in the work of Staggers et al. (2002), which has been widely used in the literature.

Actual Knowledge Gain Test

Actual knowledge gain based on eductaion received in this study was measured by a set of multiple-choice test items that I developed based on the learning objectives specified for each module. These items were included in the last section of the pre and post test questionnaire. Five multiple choice questions were developed to test the information in module 1 (general informatics knowledge) and four multiple questions were developed to test the information on module 2 (informatics applications).

Data collection

Following administrative approval from the Faculty of Nursing (Appendix E), and ethics clearance from the Health Ethics Board at the University of Alberta to conduct the pilot study, I had a meeting with year 4 Coordinator of the Undergraduate Program in the Faculty of Nursing and leader of the NURS 491course from which recruitment was planned to discuss study procedures and recruitment options. I was the teacher for NURS 490. Because I was a Course Lead and In-charge of teaching the NURS 490 course, it was clearly outlined that I will not have any direct involvement in the recruitment or

delivery of the intervention during this pilot study. For this reason, my thesis supervisor (KO) and a research assistant (AH) facilitated data collection.

Data collection procedures took place from November 1st – December 10th 2010 of the academic year 2009-2010. To introduce the study to students, (KO), thesis supervisor, met with students in NURS 490 and NURS 491 at the beginning of 6WK2 (November 1st & 2nd) during formal course orientations to explain the purpose of this study and provided them with the information sheet and the study poster. At the designated date for the delivery of the intervention, in the lecture arm, KO attended the FRS lecture with the speaker and at the beginning of the session, she read the instructions for completing the survey and administered the coded data collection package to students who volunteered to participate in the study. Each package had a copy of the pre and post surveys, information sheet, and the study poster. Questionnaires were coded so that pre and post scores could be compared without collecting personal information —Student 1 received surveys 1 pre-A and post-B, Student 2 received surveys 2 pre-A and 2 post-B, etc.

In the online arm, the research Assistant (AH) was assigned to send an individualized email invitation to all students enrolled in NURS 491/6WK2 to invite them to participate in the online module of the intervention. The e-mail invitation had a hyperlink that provided access to the learning material as well as a unique ID and Password for each student to access the module on the Homer Learning Gateway Server. The poster and the information sheet were attached as PDF files to the e-mail message. A one-week period was allotted for completing the online module. The same procedure was followed for module two. An email reminder was sent to students with a link to access module two

using the same ID and PW that were given to them for module one. However, given low participation rates, access to module was extended for an additional ten days till December 20th. An E-mail reminder was sent to students again to inform them about the new deadline for closing the module.

A certificate of completion was issued to all participating students at the end of each learning unit (Appendix F). The research assistant (AH) contacted students in the lecture arm via e-mail and distributed certificates to those who have attended the lectures. For those in the online arm, certificates were built within the module design. Upon completion of the posttest, the student keyed in his/her name, and printed a pre-signed certificate.

Data from pre and post surveys for students in the online arm were handled solely by an RA from the Faculty of Medicine and Dentistry (FOMD), (BJ), who was in charge of the technical aspects of the design and delivery of the online module. Following completion of the pilot study, (AH) contacted participants in the online arm via e-mail to obtain their feedback on the module and any suggestions they may have for improving the study using the Post Data Collection Survey Form. The dates of the delivery of two interventions are shown below.

Online Format (N 491) 1 week/module	**Lecture Format (N 490): 12:30 – 1:20 PM**
Module I: November 15th – 21st 2010 Introduction to Health Informatics	**Lecture I:** November 16th 2010 Introduction to Health Informatics
Module II: December 6th – 20th 2010 Informatics tools and applications used in health care	**Lecture II:** December 7th 2010 Informatics tools and applications used in health care.

Ethical Considerations

Participants had the option of choosing whether to attend the session and complete pre and post surveys, and thus participation in the study sessions implied consent. For this reason, formal written consent was not required. In both modes of the intervention (lecture and on-line), participants were informed that educational content provided in this study was part of course requirements but would not be included in the exam; however completion of research surveys was optional and had no impact on their course grades. To ensure anonymity of participants' data, a unique code was issued for each participating student.

No monetary incentives were provided in this pilot study, but students were given a certificate of completion was provided at the end of each unit. For students taking the lecture mode, the intervention was offered within regular teaching time; therefore students did not have to undergo extra curricular work on top of their existing course requirements. For the online mode, the module was one-hour long. While this may be considered as an extra work for students, access to the online module was available for a period of one week; hence students had much flexibility to access the learning material from anywhere and at any time during weekdays and weekend. In addition, students who might not have had access to computers at home could have used computer terminals at the University campus, which provides 24 hours access with Internet support.

The two Research Assistants (AH) and (BJ) were asked to sign a confidentiality agreement prior to commencing the project (Appendix G). In addition, both received a

two-hour orientation session regarding management and confidentiality of participants' data. I had access to data only at the end of all data collection procedures.

Analysis of Data

I analyzed data from each teaching block separately. I created a codebook for all survey items, and then calculated average scores (pre and post intervention) for self-efficacy, attitudes to EHR, and perceived competence in informatics knowledge scales. I used sum of scores for pre and posttest actual knowledge scores. Frequency statistics were computed to summarize the data. Descriptive statistics including mean, minimum, maximum, and standard deviation (SD) were calculated using average scores. A paired-sample t-test was conducted to assess if there was a statistically significant difference between pre and post mean scores of knowledge, attitudes, and self-efficacy for lecture and online groups in each time period (6WK1 and 6WK2). The related null hypothesis was: "There is no significant difference between pre and post intervention mean scores of knowledge, attitudes, and self-efficacy between students taking the online module and those receiving an in-class lecture."

Using pretest scores, assessment of reliability of scales was applied for the perceived informatics knowledge, attitudes, self-efficacy scales and actual knowledge test. Effect size was calculated using Cohen's D approach. Accordingly projected sample size for the main phase of the study was estimated using the smallest effect size. Given the small sample size, regression analysis was not conducted. As well, content analysis for narrative feedback was not performed given the small number of responses to the open-ended questions.

Pilot Study Findings & Discussion

Information related to respondents' demographics in the two teaching formats is presented first. Next, findings and relevant discussion are presented according to each of the following research questions:

1. What is the participation rate for each teaching format?
2. What factors appear to influence students' decisions to participate in this study?
3. Does the intervention improve knowledge gain, self-efficacy, and attitudes toward the EHR?
4. Which teaching-format yields better measures of knowledge gain, self-efficacy, and attitudes toward the EHR?
5. What is the effect size for each teaching format (Lecture vs. Online)?
6. What is the projected sample size for phase two of the study?
7. Do study instruments appear to be internally consistent?

Characteristics of the Sample

The lecture/FRS arm had 22 participants, whereas the online arm had 9 participants. The age of participants in both groups was between 20-29 years. In the lecture/FRS arm, the preferred learning styles were: Visual (22.7%) and kinesthetic (77.3%). With respect to previous education/learning about informatics, results were: None (45.%), a little (27.3%), moderate (18.2%), and quite a bit (9.1%). For the online arm, the preferred learning styles were: Auditory (22.2%), Visual (33.3%), and kinesthetic (44.4%). In terms of previous education in informatics, results yielded: None (11.1%), a little (55.6%), moderate (22.2%), and quite a bit (11.1%).

Research Question 1: What is the participation rate for each teaching format?

Participation in each teaching format was relatively low, especially for the second half of the intervention. Response rate for each module in each time period is presented below; followed by students' responses on the Post Data Collection Feedback Survey, which was sent via e-mail to students to get their suggestions for improving recruitment and participation rates for the main study.

Table 3. Response Rate for Phase 1 Pilot Study

Year: 2010	Nov 16	Nov 15 -21	Dec 7	Dec 7 -20
Teaching Format	Lecture 1	Module 1	Lecture 2	Module 2
Course: NURS 490/491	N = 54	N = 56	N 54	N 54
Number of Respondents	22	10	9	5*
Response Rate	40.7%	18.5%	16%	3.5%

** 2 valid responses only*

Research Question 2: What factors appear to influence students' decisions to participate in this study?

In the research instruments, students were asked to respond to two open-ended questions related to the usefulness of knowledge gained from attending the lectures or completing the online modules, as well as any suggestions they had for improving the educational intervention. Most responses were received from participants in the FRS/ lectures arm (8 students). Only 2 students in the online arm provided feedback. Given the

small number of responses, I did not perform thematic content analysis. The feedback provided by students in both arms is presented below.

Feedback from Participants in the Online Format

- "There should have been more information in the second module and less on the first. This would be beneficial if it was condensed further and presented in an FRS format in second or third year to better prepare for graduation and entering a future computerized workforce."
- "I found the information useful and learned from it. The presentation was very difficult to pay attention to because it did not offer a lot of stimulation."
- "Shorten the first module and lengthen the second module by cutting out the videos and including their information onto power point slides."
- "Find some way to make the presentation more interesting. I found my mind wandering a lot."

Feedback from Participants in the Lecture Format

Lecture 1/FRS 1	Lecture 2/FRS 2
- "I didn't realize I knew more about health informatics than I thought. Informative FRS." - "It did increase my knowledge about informatics, but it had many useless points (i.e. the definition and origin of informatics, the many associations of informatics), and the lecture was long. It should be limited to 30 minutes or less." - "I think it got me to realize that even though I had not had previous education on health informatics I still have been using it in my nursing practice." - **"**The first set of survey questions was confusing to answer, because of the	- "I definitely increased my knowledge in this area. The video helped a lot." - "Yes, the information was useful in knowing/preparing for what we will be working with in the future." - "The second module was more interesting than the first module and I was able to learn more and understand the possibilities for health informatics." - "The information in the second module was interesting and applicable and my knowledge increased. The first module was not found to be useful." - "Yes, it has. I feel more knowledgeable, but it is only a small aspect." - "Useful and increased my knowledge in

type of scoring system. Presentation was a bit dry. Good length."
- **"**I don't think the info was appropriately shared in FRS, as not a good use of time for students. This info presented was so general in module 1, I feel it only slightly increased my knowledge in this area."
- "It was somewhat useful. I know what health informatics is now."
- "Knowledge increased but not sure about usefulness"
- "Confusing rating scales in questionnaire; videos were interesting."
- technology use in the nursing field"
- "Info was useful and increased my knowledge in informatics. I was unaware how much informatics actually involved."
- **"**I am still confused about medical vs. health records."
- "I suggest it stay as is, it was better than the first part; you need to make the questionnaire" more simple and easy to understand.

Responses on Post Data Collection Feedback Survey

While the number of responses was quite low in this set of feedback (2 participants only), the feedback they provided was very helpful. The factors that might have limited students' participation as identified by these two students were: Timing of the pilot study during (N490 & N 491), content of the questionnaires, length of the questionnaires, pre-post design, technical issues in the online module, and "Content was not testable." Responses to the open-ended questions included in this survey were as follows:

Q.1 How do you think we could enhance the participation rate of students when we conduct the full study?

- "Offer module starting in 3rd year to encourage greater participation; include in course requirements (not voluntary)."
- "Make slides for online module bigger."
- "Offer more in-depth information on the second module and include examples from clinical practice, e.g. electronic charting, planning etc."

- "The biggest issue for students was the fact that it wasn't going to be tested. 490 is a busy course and many students felt that it wasn't worth their time to sit through 2 lectures that would not be tested when they could be working on testable items. This was seen as soon as it was explained the material wouldn't be tested many left."
- "A way to enhance participation might be a course requirement that requires participation in at least one research study as a pass/fail component (many opportunities available on campus) and then many might choose this study."

Q. 2 Do you think the participation rate would have been higher if we conducted the study with students in second or third year instead of fourth year?

Responses received on this question were: 1 participant (YES), and 1 participant (NO).

Research Question 3: Does the intervention improve knowledge gain, self-efficacy, and attitudes toward the EHR?

A paired-samples t-test, a repeated measure test, was applied to compare pre and post intervention mean scores on knowledge gain, self-efficacy, and attitudes toward the EHR within each block of data (online and lecture formats). The assumptions for t-tests were met: the dependent variables were all continous, and the difference between the two scores obtained for each subject were normally distributed (Pallant, 2007).

The null hypothesis was: There is no significant difference between pre and post mean scores on of knowledge gain, self-efficacy, and attitudes toward EHR. The alternate hypothesis was: There is a significant difference between pre and post mean scores of knowledge gain, self-efficacy, and attitudes toward EHR. Results of the paired t test showed that there was a statistically significant increase in all outcome measures in the

lecture group as shown below. Therefore, the null hypothesis was rejected.

Table 4. Descriptive Statistics Regarding Pre and Post Intervention Mean Scores on the Four Study Outcomes in the Lecture Format

Lecture Format	Pre-intervention mean (SD)	Post-intervention mean (SD)	t-value	p-Value
Self-efficacy	5.70 (1.307)	6.44 (1.300)	- 5.697	.0005
Attitudes	3.54 (.621)	4.05 (.644)	- 3.521	.002
Perceived Knowledge	3.37 (.718)	4.05 (.413)	- 6.081	.0005
Actual Knowledge	1.95 (1.09)	2.77 (.972)	- 2.961	.007

For the online group, results showed no statistically significant difference between pre and post outcome scores on any of the outcome measures. Therefore, the null hypothesis was accepted.

Table 5. Descriptive Statistics Regarding Pre and Post Intervention Mean Scores on the Four Study Outcomes in the Online Format

Online Format	Pre-intervention mean (SD)	Post-intervention mean (SD)	t-value	p-Value
Self-efficacy	7.16 (1.342)	7.17 (1.498)	-.010	.992
Attitudes	3.53 (.520)	3.60 (.520)	-.816	.438
Perceived Knowledge	3.34 (.798)	3.59 (.497)	-1.510	.168
Actual Knowledge	3.00 (1.225)	3.67 (1.000)	-1.512	.169

Research Question 4: Which teaching format yields better measures of knowledge gain, self-efficacy, and attitudes toward the EHR?

According to the above analysis, the lecture format yielded better outcomes in perceived self-efficacy, attitudes toward the electronic health record, perceived informatics knowledge, and actual knowledge than the online format.

Research Question 5: What is the effect size for each teaching format?

Effect size was calculated based on independent samples t-test data using Cohen's regular and pooled standard deviation as shown in below. Effect size for each of the dependent variables was calculated as: attitudes (.74), actual knowledge related to informatics (.9), self-efficacy (.54), and perceived knowledge related to informatics (1.05).

Table 6. Effect Size of the Intervention for each of the Study Outcome Variables

	Cohen's D Effect Size	
Outcome Variable	(SD_{pooled})	(Regular SD)
Self-efficacy	**0.54**	0.56
Attitudes	0.74	0.69
Perceived Informatics Knowledge	1.05	1.1
Actual Informatics Knowledge	0.9	0.9

Research Question 6: What is the projected sample size for phase two of the study?

Based on the above calculation of the size of intervention effect on all study outcomes, I adopted a conservative approach for calculating sample size for phase two of the study by using the smallest effect size achieved, which was .54. Then, I applied this effect size for two possible scenarios, a two-group and a three-group study designs. These projected estimates were:

a. A two-group study design with sample size based on an effect size of .54, and setting the risk of type I error at .05 and the power at .8, the required sample size would require 110 participants, i.e. 55 per group.

b. A three-group study design with sample size based on an effect size of .54, and the risk of type I error at .05, and the power at .8, the required sample size would require 153 participants, i.e. 51 per group.

Research Question 7: Do the study instruments appear to be internally consistent?

Cronbach's alpha was calculated for all measuring instruments using pretest scores in both FRS lectures, and module 1 of the online arm. An overall average of values calculated was produced for each instrument. Cronbach's alpha was acceptable for all measuring instruments except the actual knowledge test.

Table 7. Coefficient Reliability Statistic for all Study Instruments

	Cronbach's Alpha			
	Self-Efficacy Scale	Attitudes Scale	Perceived Knowledge Scale	Actual Knowledge Test
Reported Alpha	**0.8**	**0.77**	Not reported	
Module 1-FRS	0.88	0.67	0.88	- 0.197
Module 2-FRS	0.78	0.51	0.77	0.78
Module 1-Online	0.94	0.63	0.92	0.23
Cronbach's Alpha	**0.9**	**0.6**	**0.8**	

The low reliability of the actual knowledge test could be attributed to the number of questions used in each test; test 1 had five multiple-choice questions, and test 2 only four multiple-choice questions. Another factor that could explain the low reliability of the actual knowledge test could be related to the instructional time that was allotted for the

lecture format. Perhaps students needed a longer period of time to synthesize knowledge and comprehend information provided in the lecture. However, if this was a reasonable explanation, the Cronbach's alpha of the knowledge test should have been higher for the online group given that students in this arm of the intervention have had one week to complete the module. Nonetheless, given that there was no tracking data to inform about students' access and the time they spent on each module in the online arm, such a conclusion cannot be made. Another contributing factor could be related to the sequence of the pretest and post-test measuring instruments especially in the lecture (FRS) arm.

With regard to the Generic Computer Self-Efficacy scale, the scale had two components; the magnitude of self-efficacy, which required a "yes/no" response, and the self-efficacy confidence aspect rated on a scale of 1-10. The scale should be completed by first choosing "Yes", then rating the level of confidence. If the answer "No" was selected, then rating of the confidence would not be applicable. Upon cleaning data for the purpose of data analysis, it was noted that responses of students on the magnitude part of the scale were varied, for example, a student would choose a "No" on one item, then would complete the confidence scale. Or, they would leave the response on yes/no blank and just complete the confidence scale. It is important to consider the possible effects of the lack of clarity by students about the instructions on the reliability and validity of the data that were obtained as well as the effect size. Potentially, the lack of clarity could have had an impact on all of these important parameters. I am not concerned about reliability, because the Cronbach's alpha was .9, which was excellent. The impact on validity and effect size is more difficult to determine and this point will be explored in

more detail in my future research.

It is not clear why students had misinterpreted the procedure for completing this part of the survey instrument although in the actual survey, I provided clear instructions as well an example showing how to respond to the questionnaire. However, based on the narrative feedback from students, some students have pointed out that the self-efficacy scale was difficult to understand, and suggested simplifying it further. Based on that and for the purpose of data analysis in this pilot study, I had to exclude the magnitude part of the questionnaire and use only the 10-items scale measuring the strength of confidence.

Summary of Phase 1 of the Study

The educational intervention offered in this pilot phase was comprised of two learning modules on health informatics. These modules and were offered in two formats, a traditional lecture and online using Vodcast technology. The first unit introduced basic principles of health informatics and the second unit reviewed some tools available through health informatics applications that could be used to improve nursing care.

Using a non-equivalent 2-group block design, a convenience sample of 128 nursing students were recruited from two required fourth year undergraduate nursing courses, with one group receiving the lecture format and one group receiving the online format of each learning unit. Outcomes assessed included actual and perceived knowledge gain, attitudes, and perceptions of self-efficacy toward the electronic health record. Actual knowledge gain was measured using a 9-ietm multiple choice test that was developed by the prinicipal invetigator based on content covered in the learning units. Perceived knowledge outcomes related to informatics competencies was measured using the

informatics competency self-assessment survey developed by, Jarzemsky et al. (2009). Self-efficacy was measured using the generic computer self-efficacy scale developed by Compeau & Higgins (1995), (Cronbach's alpha = 0.8). Attitudes were assessed using an existing instrument from the literature, (Cronbach's alpha = 0.77). Questionnaires were administered before and after each learning unit. In addition, participants were asked to complete some open-ended questions. The difference between pre and post intervention scores on knowledge gain (actual and perceived) was identified as a primary outcome. Attitudes and self-efficacy were considered as secondary outcomes. Additional data collected included age, learning styles, and previous education in informatics.

In spite of the low participation rate, overall, findings showed that there was an interest in learning about informatics among students. Many factors have negatively impacted participation rates in both formats including the lack of incentive to participate, students' workload, and the facts that the material was not testable. While some of these factors are legitimate, not participating in this educational intervention because the material was not testable in FON course official exams raises many concerns and warrants further evaluation.

Students in the online and lecture components differed with regard to learning styles and demographic characteristics, which made it difficult to compare the results clearly. There was a statistically significant improvement between pre and post intervention mean scores on all outcome measured for the lecture format but not for the online format. With the exception of the actual knowledge gain scale, all measurement instruments appeared to be internally consistent for the lecture format but not for the online format. Based on

the above findings and narrative feedback obtained from participants in that phase, the intervention and the study design needed improvements prior to moving ahead with the main study.

Implications for the Main Study

Study Design and Sample Size

To achieve a more rigorous measurement of the effect size of the intervention, I evaluated two potential study designs, a posttest only control group design, and a randomized controlled trial design, for use in phase two of the study. The first design was seen as a relatively strong design but it would not have allowed answering the research question as to whether the intervention makes a difference at all. Therefore, and after obtaining an ethics approval to include a control group, I modified the study design to a randomized controlled trial with three groups, online, face-to-face, and control. A posttest only design was selected because the time between the pretest and the posttest was quite short and thus it was difficult to know whether the scores on the posttest were related to the pretest or the intervention.

Effect size for each of the dependent variables was calculated as: attitudes (0.74), actual knowledge related to informatics (0.9), self-efficacy (0.54), and perceived knowledge related to informatics (1.05). Accordingly, sample size was reviewed and recalculated for a three-group design using the lowest effect size (0.54), and setting the risk of a type I error to 0.05 and the power to 0.8. The new sample size was 153, i.e. 51 participants per group.

Given low participation rates, ethics approval was obtained to include students from all years of the BScN programs at the University of Alberta, the BScN program at the Grant MacEwan University, and Registered Nurses employed at University Alberta Hospital, either on Full time or Part-time basis.

Study Instruments

Slight modifications were introduced to the questionnaire prior to using it in the main study. The modifications introduced per each section of the instrument were:

1. *Demographic Information:* Questionnaire fields related to demographic information was populated with new categories of participants and their relevant information including, role (student vs. nurse), university (University of Alberta vs. Grant MacEwan University), Program (Collaborative, Bilingual, or AD), and year of study (1st through 4th year). For Nurses, fields added included being a FT vs. PT RN, work setting and title, experience with using informatics applications in the clinical site, and previous training offered by employers, if any.
2. *The Generic Computer Self-efficacy Scale:* The section of questionnaire pertaining to magnitude was removed.
3. *Perceived Informatics Knowledge Scale:* Although this scale had a high reliability coefficient (0.8), I decided to exclude it from the instrument based on narrative feedback from students who indicated that the instrument was too long. In addition, with the use of a knowledge test, keeping this scale would have been redundant. Nonetheless, participants were given the opportunity to complete this scale as an optional self-assessment learning activity.

4. *Actual Knowledge Gain Test:* In order to enhance reliability of this measure, test items from module one and two were combined (total 9 questions), and additional 10 test items were developed based on the learning objectives.

Educational Intervention

Several adjustments were introduced in order to enhance the potency of the intervention. First, both modules were collated in one package that was referred to as "Learning Module or Learning Session." Secondly, to facilitate synthesis of knowledge among participants, several higher-order learning activities were developed and tailored for use in either teaching format (Appendix H). Thirdly, instructional time for both formats was increased to four hours in order to facilitate completion of these activities and enhance interaction and discussions among students about content being learned. Fourthly, the designation 'lecture format' was changed to 'a Face-to-Face workshop format'. Lastly, the researcher developed an evaluation tool for evaluating various aspects of the learning experience, namely: module content, module design, presentation format, perceived value of the session, and suggestions for improving the module, and/or overall learning session. The tool was adapted for use in online and Face-to-Face formats (Appendix J). In both formats, the evaluation form was posted to the respective groups (Online and Face-to-Face) as optional activity.

CHAPTER 4

Design and Methodology

This section reports on the design and methodology that guided the main study. I begin this chapter with a brief summary of the purposes of the study, the intervention, and the guiding research questions and hypotheses. The purposes of this study were to develop an educational intervention about health informatics and evaluate effectiveness of online and face-to-face instructional methods for delivering this education to undergraduate baccalaureate nursing students using a three-group randomized controlled trial design. The intervention was comprised of learning modules that provided foundational knowledge about health informatics as it related to nursing practice. Content covered in the module included basic principles about health informatics and an overview of some tools available through health informatics applications that could be used to improve nursing care. In the face-to-face instructional format, the module was offered in a 2-hour session. Instructional activities included case studies and guided exercises that required students to access Internet information tools to apply some of the concepts offered in the session. In the On-line format, the learning module was broken into four learning units; each was recorded as a 15-minute Vodcast presentation with voice over Power Point, and self-directed exercises. The session was offered through the Homer Learning Community, a learning resource at the Faculty of Medicine and Dentistry.

Research Questions

Two research questions were examined: (1) Does the educational intervention improve knowledge gain, self-efficacy, and attitudes toward electronic health records

(EHR), and (2) which teaching format (online or face-to-face) yields better knowledge gain, self-efficacy, and attitudes toward the EHR? In addition to the method of instruction, a number of independent variables, namely, age, university, program of study, year of study in the program, learning style, and previous education in informatics, were also examined.

Study Hypotheses

The Null Hypotheses (H_0)

1. The intervention has no effect on knowledge gain, self-efficacy and attitudes toward the EHR.
2. The teaching format has no effect on knowledge gain, self-efficacy, and attitudes toward the EHR.

Alternative Hypotheses (H_A)

1. Those who receive the intervention through either teaching format, online or face-to-face, will have better knowledge gain, self-efficacy, and more positive attitudes toward the EHR than those who do not receive the intervention (control group).
2. The difference between the mean scores of the online format and the face-to-face format will not be zero.

Method

Study Design

A three-group posttest only randomized controlled trial design was used in this phase of the study. This experimental design provided better control of threats to internal validity that were encountered during the pilot phase of the study. Random assignment of

participants to study groups ensured that the groups were similar/equivalent at the start of the experiment. The use of a delayed control group facilitated comparisons between those who have received the educational intervention in two forms of instructions with those who have not received any education. Both measures enabled isolation of treatment effect; thus more confidence that any differences in the posttest measurement between groups was attributed to the intervention. Using the random assignment technique allowed the researcher to equalize the groups without having to use a pre-test, which contributed to a testing effect during the pilot phase of the study. Moreover, it ensured that all participants had an equal chance of being selected in any study group; thus the threat of selection bias was also controlled.

Population/Sample

The target population in this study was primarily undergraduate baccalaureate nursing students in Edmonton. The two main providers of this degree level education are the University of Alberta, and the Grant MacEwan University. The nursing program at the University of Alberta is part of a Collaborative agreement, and is offered in other three sites across the province of Alberta. These sites are: Keyano College, Grande Prairie College, and Red Deer College. The Grant MacEwan University was one of these Collaborative partners, but in 2009, it was granted university status, and therefore was no longer in the Collaborative. The UofA site in Edmonton is the largest of these sites and it has other subset of programs leading to a baccalaureate degree in nursing, including: The After Degree program (ADP), which is offered in Edmonton and Camrose, the Bilingual

program, Honors program, Post Registered Nurse program (Post RN), and Post Registered Psychiatric Nursing program (RPN), which are offered in Edmonton.

Sample Size

Based on the estimated effect size of the intervention in the pilot study carried out in the fall of 2010, I calculated a power analysis to determine the required sample size for a three-group design for ANOVA. Using an effect size of .54 and setting the power (1-Beta) at .8, and the possibility of type I error (alpha) at .5, it was estimated[9] that 51 participants would be needed per each group, i.e. 153 in total. Individual students in each group were specified as the unit of analysis in this study.

A convenience sample was recruited from among 3rd and 4th years at four of the undergraduate programs, namely, the Collaborative, Bilingual, After Degree Program (ADP), and the Honors program, in the University of Alberta. My plan was to access other Collaborative sites, and/or the Grant MacEwan University students as necessary, i.e. in the event of attrition of participants or low participation rate.

Protection of Human Rights

Participants were informed that participation in the study was completely voluntary and has no impact on their academic performance in the program in any way. In addition to the educational benefit students would gain by attending or completing required learning activities, each participant was given a $10 coffee gift card in appreciation of their time. Participants who have successfully completed learning material in either teaching format were eligible for a certificate of completion. The certificate of

[9] Source: http://www.stattools.net/SSizAOV_Pgm.php

completion was provided for acknowledgement purposes only; students who completed the study did not receive credit for any course requirements.

Ethical Considerations

Informed Consent

A written informed consent procedure was not required for this study because consent was implied by overt action; students' choice to access the study Registration Portal (Website) and sign up for a learning session about health informatics. Students were informed that upon completing the registration process, the registration portal site would automatically generate their assignment in any of the study groups (online, face-to-face, or control) based on random assignment principles.

Confidentiality and Anonymity

All data collection was done online through a unique Website that had been set up for each study group. To ensure anonymity of participants' data, a unique ID and password were issued for each participating student. Since the researcher was also a faculty member at the faculty of nursing at the time of data collection, it was necessary to create a procedure that would prevent access of the researcher to any students' identifying information. Therefore, funds have been generated through a Teaching and Learning Enhancement Fund to support two research assistants to help with the data collection and management. The first research assistant, (BJ), is a PhD student from the Center for Evidence-Based Medicine who assisted with the technical aspects of the on-line module and the management and retrieval of online data for all three groups. The second research assistant, (AH), is a Master's student from the Faculty of Nursing, assisted with data

collection for the face-to-face format of the intervention, prepared and distributed certificates to participants who have completed the online or face-to-face modules, and distributed coffee passes to all study participants.

AH and BJ have coordinated a procedure whereby, when a group of participants completed study requirements, BJ would hand in a list of participants' names and contact information to AH, then, AH would prepare the certificates and send them via email to students. AH, then, had arranged to meet with participants in person to hand them the coffee passes. I had access to data only at the end of all data collection procedures.

Instrumentation

The study questionnaire was pilot tested during phase one of the study (See Chapter 3). Cronbach's alpha for the self-efficacy scale was found to be .9, and .6 for the attitudes toward the electronic health record scale. Although the perceived knowledge scale had a high reliability index (.8), it was not used in this phase of the study because the instrument was thought to be too long. Instead, it was offered to participant as a self-assessment tool. Actual knowledge based on education received in this study was measured by a multiple-choice test that I developed on educational objectives and content covered in the module. In the pilot study, the reliability of the knowledge test was very low, possibly due to low number of test items used during the pilot phase (4 questions for module 1, and 5 questions for module 2). To enhance reliability of the knowledge test, I combined both modules and added another 10 questions to enhance reliability of the test. Some of the newly added questions were adapted from study questions used in some

informatics textbooks, and some were developed by me based on content offered in the intervention (Appendix K).

The components of the final instrument used in this phase of the study were: Section A: Demographic data, Section B: Computers-Self Efficacy scale, Section C: Attitudes towards EHR scale, and Section D: Knowledge gain related to education delivered in the study (20 multiple-choice questions with 4 distractor items per questions) (Appendix L)

Data Collection

Data collection for this phase of the study took place over two academic terms during 2011/2012. This section reports on procedures carried out for each run of data collection. The first run of data collection was completed during the fall term, 2011, and the second run of data collection was completed in the winter term 2012.

First Run of Data Collection: Fall, 2011

Following ethics clearance from the Research Ethics Board at the University of Alberta and administrative approval by the Faculty of Nursing to proceed with phase two of the study, I began recruitment among all 3rd and 4th year students in three undergraduate programs at the University of Alberta. Recruitment strategies included a poster, a study information sheet, word of mouth, and a Web site that facilitated navigation of study information online. With regards to the poster and information sheet, these were sent via e-mail to all students in the 3rd and 4th year of the undergraduate programs at the Faculty of Nursing as well as posted on Learning Management System, known as WebCT Vista or E-class, as a pop up announcement. Upon logging on to E-class to access courses they were registered in, students would immediately notice the

pop announcement. A URL link to the study Web site was embedded in the body of the e-mail message and the announcement. I sought assistance of Year and Program Coordinators in the undergraduate programs to spread the word of mouth about the study to their Course Leads and Faculty members and students, particularly those in clinical settings.

Using a Website for recruitment purposes and dissemination of information about the study was pursued to facilitate communication with potential participants who relied heavily on electronic communication for personal and study needs. In addition, the Website included all the information that was presented in the information sheet and a detailed description of procedures for random assignment to the three study groups.

The procedure for random assignment in this run of data collection was done manually. After participants have arrived to a common location that I announced in the invitation, I provided a brief overview of the study and asked participants to draw a card from a hat. Each card had a unique ID and PW for each participant, which they had to use to be able to access the groups they have been randomized to. Several meeting rooms with computer stations and access to the Internet were booked at the University campus to accommodate all groups. The location of the rooms was very convenient and within a close distance to transit service. Refreshments were also provided.

For participants assigned to a control group, they were asked to complete a questionnaire, which took about 15 minutes. As a delayed group, these participants were aware that they would have access to study material through the format found most effective at the end of the study. Participants assigned to the online group were able to

begin self-study of the learning module immediately following registration. Upon completion of the learning session, participants were asked to complete a questionnaire. Participants assigned to a Face-to-Face group were able to attend the session and complete study materials immediately in the location they have been randomized in.

I ensured that students have a good understanding of benefits and risks involved in the study and that they have full choice for taking part in the study. All contact information for personnel involved in the study including session facilitators, technical support, ethics officers, administrative personnel were listed on the Website through active Web links. The research assistant, (BJ), constantly monitored the Website and ensured that all questions, if any, were addressed promptly after consulting with the researcher. In addition, in the pilot phase of the study, it was noticed that students experienced difficulty logging on to the online module site using the *Homer Gateway* log on page. Therefore, I made arrangements with the research assistant (AH) to provide a brief orientation to participants on how to log on to the site and navigate the module requirements, if they have been randomized to the online module group.

Two data collection dates were scheduled for data collection on the AM and PM of September 15th and October 1st of 2011. One of these dates (Sept 15th) was during weekdays, and the other, Oct 1st was on a weekend. The rationale for offering the sessions on weekend and weekdays was based on feedback gathered from students during the pilot phase of the study, in which they have mentioned that most students take shifts on weekends, so by offering both options, students would more likely be able to attend.

On September 1st morning session, and based on Registration site data, I was expecting 6 participants, but only one student showed up. The participant drew from the hat and was found to be in the face-to-face group. I offered the session to the student and other benefits associated with taking part in the study. On the afternoon session of September 1st, I was expecting four participants, but only one participant showed up, and based on her draw, she was assigned in the online group. The research assistant offered a brief orientation to the Website and how the student can log on. The student completed the online learning module from home and received all benefits associated with participation in the study. Reminders were sent out again and recruitment continued till the next session date on October 1st, but rates of participation remained low. On October 1st session, I was expecting 7 participants, but only two students showed up. Given low participation rates to that date, I asked these two students whether they would be willing to enroll as control group in order to test that learning environment, and they agreed. The two participants received all benefits associated with participation expect the certificate, because they have not completed any of the learning material. While the response rate for this first round of data collection was strikingly low, feedback obtained from the 4 participants was very helpful in testing the learning environment again prior to proceeding with further requirement and data collection.

However, it became clear to me that the recruitment pool should be expanded beyond the University of Alberta students. Accordingly, the researcher obtained ethics clearance and administrative approval from Grant MacEwan University to invite their students to participate in the study. In addition, I obtained approval from the University of Alberta to

invite participants from all years of the program including year one, two, three, and four in the three designated undergraduate programs. Moreover, I tried to obtain administrative approval to access registered nurses at the University hospital in Alberta, but it was not granted.

Second Run of Data Collection: Winter, 2012

For the second run of data collection, which took place during the month of February 2012, I introduced a new approach to enhance recruitment, which involved facilitating random assignment at the point of registration through a Registration Portal. Upon receiving the invitation to participate in the study via email invitation or view it on E-class, the participant was able to click on the link for registration embedded in the body of the e-mail message or in the body of the announcement posted on E-class directly. Upon clicking on the link: http://homer.med.ualberta.ca?hinurse, the student was able to review key information related to participation in the study in a brief bullet-form format to encourage them to learn about the study. To ensure that participants fully understand that agreement to participate in the study involves random assignment to any of the study group, the Web site page was controlled so that the participant can not proceed with further activities or navigation unless they have read the instructions regarding randomization clearly and indicated their understanding by clicking on the statement: "Yes, I understand that participation in this study involves randomization to any of the study groups."

Once the participant had completed this step, he/she was able to navigate the Website, immediately, and provide demographic information, namely, university, program, year of study, age, previous education in informatics, and their preferred learning style. After this step, the Registration Portal ran the randomization. Those assigned to the online group were able to access the learning module immediately using a unique ID and PW. Students in this group were given one-week period to complete the module beginning of the date of their registration. Students randomized to the control group were asked to provide the same demographic information, and complete the posttest. Students randomized to the face-to-face group were able to view and choose from a list of session dates that best worked for them. With these enhancements, the researcher began recruitment again in the last week of January throughout February. The same procedure for sending out posters and email messages were followed again for the University of Alberta students. With regard to Grant MacEwan University recruitment, it was not possible for me to obtain ethics clearance to contact students via e-mail. However, I coordinated with the Chair of the nursing program at this university to make sure that the study poster and information

sheet were made accessible to potential participating students through electronic postings on the Black Board (Learning Management System) as well as in print format in students' common areas at the Grant MacEwan University.

I assigned different days and times for the face-to-face learning sessions, both in the morning and afternoon times, as well as during weekdays and weekends. Upon planning of sessions dates and times, I made sure that the sessions were not offered at a time that would conflict with students' scheduled course activities, such as exams, term papers, etc. In addition, and in consideration of students' workload, and in agreement with the session speaker, I was flexible in modifying some of the initially announced dates/times in order to accommodate as many students as possible. I also tried to reach participants in their own educational facilities to make it more appealing for them. However, most of the sessions ended up at the UofA campus, except for one session, which was initially scheduled at the Grant MacEwan University, but was then cancelled due to no show-ups. Sessions at the University of Alberta were booked at the Edmonton Clinic Health Academy, which has top of the line teaching/learning resources and constant access to Internet. In all forms of communication with potential participants, I clarified to participants that while some of the proposed session dates may not work for them, students still should consider registration through the study registration portal because they have an equal chance for being randomized to any of the study groups.

In spite of the many sessions I had scheduled, the majority of students who have been randomized to the face-to-face group could not attend. To address this situation, I created an option of *"a waiting list"* whereby a participant was asked to provide their e-mail

address for the purpose of contacting them to schedule alternate sessions. There were 15 participants on this list. In order to reschedule a session or two that would work for the majority of these participants, the research assistant, BJ provided the list of email addresses of these 15 participants to another research assistant, AH, who have created a Doodle poll and surveyed the 15 participants regarding alternate dates/times that would work for them.

The largest number of registrations was achieved during the first week of February, but by second week of the month, registration slowed down considerably. Therefore, a number of reminders and pop-up announcements were sent out thereafter. By almost end of February, and given that no registrations were occurring, I asked BJ to close the site for further registration. Students who have already been registered in the online arm but have not completed their study requirements were reminded again and given till March 5th 2012 to complete the modules. By end of February, a total of five Face-to-Face sessions were provided, and the sixth session (at Grant MacEwan University) was cancelled due to no registrations.

Storage of Data

Data were collected electronically using the Homer Gateway server at the FOMD. At the end of the project, I will request retrieval of participants' data from the server on a password-protected CD format. The CD will be stored at the Faculty of Nursing Research Repository for seven years in accordance with university policy.

Data Analysis

Data entry was not required since all data were collected online through a unique website for each group on the Homer Gateway Server at the Faculty of Medicine. Each subject had a unique code generated by the Homer system. The research assistant, BJ, supervised the retrieval of data from the three websites into an excel data file. The codes attached to subjects were kept intact to maintain the anonymity and data were then transferred into the SPSS program. The following computations were done to enable statistical analysis of data:

- A total score was created for the 20 knowledge gain test items.
- An average score and a total score were created for the attitudes scale.
- An average score and a total score were created for the self-efficacy scale.

Univariate Analysis

A Univariate analysis was applied for the purposes of cleaning and checking the data, examining the variability of data, describing the sample, and checking statistical assumptions (Munro, 2005, p. 11). Normality of distribution of data was assessed using the function 'Explore' in SPSS for the dependent variables knowledge, self-efficacy, and attitudes toward electronic health record for the sample as a whole. Skewness and kurtosis provide information about the distribution of scores on continuous variables that will be used in the analysis of variance. If the distribution was perfectly normal, the value of a Skewness and kurtosis should be zero, but this uncommon in social studies (Pallant, 2007, p. 56). The **Shapiro-Wilk test** is another approach for assessing normality of data, especially when the sample size is small. If the significance value of the Shapiro-Wilk

test is greater than 0.05, then the data are considered normal. If it is below 0.05, then the data significantly deviates from a normal distribution. The Shapiro-Wilk test for all outcome variables was above 0.05, thus confirming normality of data in this study.

Frequency and descriptive statistics were applied. Descriptive statistics are performed to describe the characteristics of the sample, check variables for any violations of the assumptions underlying the planned statistical techniques, and to address the specific research questions (Pallant, 2007). In this study, background/demographic data provided by each subject were summarized using frequency and descriptive statistics. Frequency statistics involved counts and percentages for categorical variables: Group, university, program of study, year of study, previous education in informatics, and learning style. Descriptive statistics involved calculating the mean, standard deviation, range of scores, Skewness, and kurtosis using summary statistics (i.e. number with valid responses (n) for the following continuous variables: Age, self-efficacy confidence, attitudes, and knowledge gain. In addition, the scores on the self-efficacy and attitudes scales were summarized using descriptive statistics by calculating a total and average scores.

Normality of data was also assessed graphically using Q-Q plots to determine if data were close or stray from the diagonal line. In all plots, the data points appeared close to the diagonal line in a linear fashion, which meant that data was normally distributed.

One-Way ANOVA

The analysis of variance involves one independent variable, which has a number of levels that correspond to the different groups or conditions. The test allows comparing the variance between different groups with the variability within each of the groups (Pallant,

2007, P. 242). The resulting F ratio represents the variance between the groups, divided by the variance within groups. "A large F ratio indicates that there is more variability between the groups (caused by the independent variable) than there is within each group (referred to as the error term) (Pallant, 2007, P. 242).

ANOVA is used to determine whether there are any significant differences between the means of three or more independent groups. Specifically, ANOVA tests the null hypothesis: [H0: M1 = M2 = M3 = … = Mk], where M = group mean and k = number of groups. However, when applying ANOVA analysis, one cannot tell, which groups were significantly different from each other. To determine which groups differed from each other, I performed another test of ANOVA was conducted using Post Hoc Analysis (Laerd Statistics, 2012).

Several assumptions should be fulfilled to legitimately perform the analysis of variance. First, the dependent variable (s) should be comprised of interval or ratio data. In this study, the dependent variables were: knowledge gain, self-efficacy, and attitudes toward the electronic health record. All three variables were continuous variables and measured at the ratio level, which met the first assumption. Secondly, the independent variable should consist of two or more categorical independent variables. In this study, the independent variable was the teaching format, and it had three levels: online, face-to-face, and no intervention (control). Thirdly, the dependent variable should be approximately normally distributed for each category of the independent variable. The Shapiro-Wilk test was applied again to assess the distribution of other independent variables (possible covariates), namely, learning styles, previous education in

informatics, program, and year of study. Results showed that all independent variables were normally distributed except for two values (the P value corresponding to the first year of study in the program n=5, and the program value corresponding to the Bilingual program, which actually has been excluded from the analysis (n=1). Fourthly, there should be equality of variance between the independent groups, i.e. homogeneity of variances. Finally, the cases should be independent of each other. Based on these results, I was assured that, overall, data was normally distributed for the purpose of further statistical analyses.

Correlation Matrix

A correlation matrix was created using Spearman's Rho measure of association to investigate the correlations between the primary outcome variable and possible covariates, namely, age, group, university, year of study in the program, and learning styles. Based on the strength of correlations between variables, the variables that showed moderate to strong correlations were identified for the purpose of including them in the regression model. The correlation coefficient, r, can take a range of values from +1 to -1. A value of 0 indicates that there is no association between the two variables. A value greater than 0 indicates a positive association, that is, as the value of one variable increases so does the value of the other variable. A value less than 0 indicates a negative association, that is, as the value of one variable increases the value of the other variable decreases (Pallant, 2007).

Multiple-Linear Regression

Based on findings from the correlations matrix, I identified two variables to be included in regression analysis in order to determine how much each variable contributed to the variance in the outcome variable. Then, I applied a multiple linear regression analysis.

CHAPTER 5

Findings

In this chapter, I present findings relevant to the evaluation of an educational intervention to increase BScN nursing students' knowledge, self-efficacy and attitudes toward the EHR. The primary study outcome was knowledge gain. Apriori sample calculation to achieve a power of .8 was 153 participants, i.e. 51 participants per each group (online, face-to-face, and control). Due to a very low turn out to the initial test of the intervention, a second test was scheduled. Results presented here are based on the data obtained during the second test of the intervention, which yielded 42 individuals. Demographic data included age, university, program and year of study, previous informatics education, and learning styles of participants.

Results are organized as per the following sections: 1) findings related to demographic data presented using descriptive statistical techniques, 2) descriptive analyses of study outcomes per study sample and each study group, 3) reliability and internal consistency of measuring instruments to provide an overview of the quality of data, 4) findings related to each research question, 4) effect size of the intervention, and 5) re-assessment of the power of the study based on effect size information achieved in this study to determine whether the study was adequately powered or underpowered. A summary of findings is presented at the end.

Response Rate

The response rates at each time point are presented below. Given the small number of participants in the fall of 2011, only the data for winter 2012 were analyzed.

Table 8. Response Rate for Phase 2 Main Study

	Fall 2011 September-October	Winter 2012 January-February
Registration portal	6 participants	60 participants
Actual participation	4 participants	42
Online Group	1	9
Face-to-Face Group	1	13
Control Group	2	20
Response Rate	2.6%	27.4%

Characteristics of the Sample

Detailed information about individuals who completed the study requirements is provided in table 9. Characteristics of individuals who registered in the study but did not complete requirements are not discussed because demographic data of individuals were obtained as part of the posttest; therefore no data were available for those who did not do the posttest.

Table 9. Characteristics of Individuals Who Completed Study Requirements

Demographic Characteristics per Group	% Online	% Face-to-Face	% Control
N	9	13	20
Age			
20 – 29 years	100	61.5	60
30 – 39 years		23.1	35
40 years & above		15.4	5
University			
MacEwan	11.1	15.4	25
UofA	88.9	84.6	75
UofA Programs			
Collaborative	22.2	38.5	60
ADP	77.8	38.5	35
Bilingual			5
Year of Study			

One	22.2	7.7	10
Two	22.2	30.8	50
Three	33.3	23.1	30
Four	22.2	30.8	10
Previous Informatics Education			
None	11.1	23.1	25
A little	22.2	30.8	50
Moderate	55.6	23.1	20
Quite a bit	11.1	23.1	5
Learning Style			
Auditory	11.1	7.7	10
Visual		23.1	15
Kinesthetic	88.9	61.5	75

Descriptive Analyses of Study Outcomes

Overall descriptive statistics of the sample in relation to study outcomes are shown in table 10. In addition, descriptive statistics per each teaching format in comparison with control group are presented in table 11.

Table 10. Overall Descriptive Statistics of Outcome Measures

	N	Mean	Standard Deviation	Min-Max
Self-Efficacy	42	7.16	1.40	4-10
Attitudes	41	3.80	.69	3-5
Knowledge	41	12.46	2.81	5-18
Total	41			

Table 11. Descriptive Statistics of Outcome Measures per Teaching Format in Comparison with Control Group

Group (N)	Online (9)			Face-to-Face (13)			Control (20)		
Posttest Measures	M	SD	Min-Max	M	SD	Min-Max	M	SD	Min-Max
Self-Efficacy	7.18	1.47	4-9	7.05	1.24	4-9	7.22	1.54	5-10
Attitudes	3.82	.76	3-5	3.94	.574	3-5	3.68	.749	3-5
Knowledge Gain	14.33	2.5	11-18	14.08	1.49	12-17	10.47	2.34	5-14

Perceptions of Self-efficacy

Responses on the Self-efficacy scale were summarized as follows: Not confident (scores of 1, 2, 3, or 4), moderately confident (5, 6, or 7), and totally confident (8, 9, or 10). An average score was used to measure responses on the self-efficacy scale (M = 7.16, SD = 1.41). Frequency statistics were used to calculate percentages to describe respondents' self-reported level of confidence in relation to using the electronic health records (Table 12.).

Table 12. Perceptions of Self-Efficacy for Study Sample

I could complete the job using the electronic health record …	% Not confident	% Moderately confident	% Totally confident
… if there was no one around to tell me what to do as I go.	23.81	54.7	9.6
… if I had never used a package like it before.	50	47.6	2.4
… if I had the software manuals for reference.	12	31	57.1
… if I had seen someone else using it before trying it myself.	7.2	35.7	57.2
… if I could call someone for help if I got stuck.	2.4	26.1	71.4
… if someone else had helped me get started.	7.1	21.4	71.4
… if I had a lot of time to complete the job for which the software was provided.	2.4	42.8	54.7
… if I had just the built-in help facility for assistance.	19	26.2	54.8
… if someone showed me how to do it first.	4.8	11.9	83.4
… if I had used similar packages before this one to do the same job.	2.4	9.5	88.1

Results showed that participants' perceptions of self-efficacy toward using an unfamiliar software, in this case an electronic health record that they have not used

before, were highest if they had someone to show them how to use it first (83.4%), or if they have used similar packages in the past to do the same job (88.1%). A large percentage of participants thought that they would feel more confident if they could call someone for help if they got stuck (71.4%), or if someone had helped them get started (71.4%). More than half of the participants felt that they would feel more confident if they had the software manuals for reference (57.1%), if they had seen someone else using the software before trying it themselves (57.2%), if they had the built-in facility for assistance (54.8%), or if they had a lot of time to complete the job for which the software was provided (54.7%). Participants felt least confident if they had never used a package similar to the electronic health record before (2.4%), and when they thought that there was no one around to tell them what to do as they go (9.6%).

In order to assess whether perceptions of self-efficacy differed according to group membership: online, face-to-face, or control, I repeated the analysis for each group separately after grouping scale items under two broad categories: 1) Responses on items one and two were grouped in one category to represent least level of assistance and use, and 2) Responses on items nine and ten were grouped under another category to represent highest level of assistance and previous use. Results showed minor differences between the three study groups, but individuals in the three groups indicated higher level of perceived self-efficacy when the conditions of demonstration by others and previous use of a similar software package were met. Conversely, individuals in the three study groups indicated lower perceptions of self-efficacy when no help was provided or when they had no previous use of the software package. Perceptions of self-efficacy were highest

among face-to-face group, (92.3%) and (1000%), followed by those in the control group (100%) and (95%), and those in the online group (88.9%) and (100%) respectively. Details are shown in table 13.

Table 13. Perceptions of Self-Efficacy per each Teaching Format in Comparison with Control Group

	Degree of Assistance and Use							
	Q.1 No Help		Q.2 No Previous Use		Q. 9 Demonstration by others		Q. 10 Previous use of similar package	
Perceptions of Confidence (%)	Low	High	Low	High	Low	High	Low	High
Online	44.5	55.5	45.5	55.5	11.1	88.9		100
Face-to-Face	30.8	69.2	46.2	53.2	7.7	92.3		100
Control	35	65	55	45		100	5	95

Attitudes toward the Electronic Health Record

Scores on the attitude scale were summed to yield a total attitude score toward the use of electronic health records. Total scores ranged from 12 -25 (M = 18.98, SD = 3.460). Overall, the majority of participants held a positive view about electronic health record (64.3%) and its potential for improving patient care in time (76.2%). A small percentage (35.7%) perceived electronic health records to be less a threat to privacy than paper records. Percentages of agreement on the five items of the scale are shown in table 14, followed by table 15, which shows differences in degree of attitudes according to group membership.

Table 14. Attitudes toward the Electronic Health Record per Study Sample

Electronic Health Record Documentation and Patient Care: Scale Item	% Agreement
1. Use of electronic health records is more of help than a hindrance to patient care.	64.3
2. Use of computerized charting has helped to improve documentation of the clinical record.	76.2
3. Electronic health records pose less threat to the patient's privacy than do paper records.	35.7
4. Computerized charting has decreased the workload of nurses and other personnel.	50
5. In time, the use of electronic health records will lead to improved patient care.	76.2

Table 15. Attitudes toward the Electronic Health Record per Study Group

	Electronic Health Record Documentation and Patient Care				
Attitudes toward EHR (%)	Help or Hindrance	Improved Documentation	Threat to Patient Safety	Decreased Workload	Improved Patient Care
Online	66.6	77.7	22.2	44.4	88.9
Face-to-Face	84.6	92.3	38.5	61.5	92.4
Control	50	65	40	45	60

To determine whether any of the participants' demographic variables might have influenced participants' attitudes toward the electronic health record, mean scores of participants on the attitudes scale were summed, and a total mean score of attitudes was correlated with all possible demographic variables of participants, namely, age, program, year of study in the program, learning style, and previous education about informatics. Results of bivariate correlation between all possible demographic variables and participants' mean scores on attitudes scale yielded no positive correlations. Strong positive correlations were found between mean scores of attitudes and self-efficacy (r =

.469, p = .002). These results indicate that attitudes toward electronic health records tend to be more positive when perceptions of self-efficacy in relation to electronic health records are high.

Descriptive Statistics Related to Knowledge Gain

Table 16. Descriptive Statistics Regarding Students' Performance on Knowledge Test

Question	% Incorrect	% Correct
16	23.8	73.8
17	47.6	50
18	38.1	59.5
19	52.4	45.2
20	21.4	76.2
21	19	78.6
22	31	66.7
23	45.2	52.4
24	26.2	71.4
25	61.9	35.7
26	52.4	45.2
27	7.1	90.5
28	66.7	31
29	9.5	88.1
30	42.9	54.8
31	--	97.6
32	45.2	52.4
33	50	47.6
34	40.5	57.1
35	54.8	42.9

Reliability and Validity of Measuring Instruments

The Generic Computer-Self-Efficacy Scale

According to Compeau and Higgins (1995), the Computer Self-efficacy Scale has a good internal consistency, with a Cronbach's alpha coefficient reported of 0.8. In the

current study, Cronbach's alpha for the self-efficacy scale was .925. This statistic falls within acceptable ranges for this test, as reported in previous studies.

Attitudes toward the Electronic Health Record Scale

According to Moody, Slocumb, Berg, and Jackson (2004), the Attitude toward Electronic Health Record Scale has a good internal consistency, with a Cronbach's alpha coefficient reported of 0.7. In the current study, Cronbach's alpha was calculated for the attitude toward the electronic health record scale after checking for any negatively worded items. No negatively worded items were found; therefore reversing of items was not necessary. The Cronbach's Alpha for this scale was **.76.** This statistic falls within acceptable ranges reported in previous studies.

Actual Knowledge Gain Test

Internal consistency reliability of the knowledge test was measured using the Cronbach's Coefficient Alpha, and the Kuder-Richardson 20 (KR 20) internal consistency reliability measures. The Cronbach's Coefficient Alpha internal consistency measure, based on a sample of 41 baccalaureate-nursing students in this study, was **.51.** However, because the knowledge test had dichotomous/binary data, i.e. correct vs. incorrect, another calculation was performed using the Kuder-Richardson coefficient of reliability (K-R 20). The calculation was done excluding one test item (question 31) because all respondents had answered the question correctly. The K-R 20 of the knowledge was **.52**. Both statistics fall below the acceptable ranges reported in the literature for acceptable reliability of a measuring instrument. I developed this test for the purposes of this study. The low internal consistency suggests that the items within the

scale may measure more than one construct. Further refinement of this instrument is warranted.

Analyses of Data Related to the Study Questions

Two research questions were addressed in this study: 1) does the educational intervention improve knowledge gain, self-efficacy, and attitudes toward the EHR and (2) which teaching format (online or face-to-face) would yield better knowledge gain, self-efficacy, and attitudes toward the EHR? The related null hypotheses for these two questions were: 1) The educational intervention has no effect on knowledge gain, self-efficacy, and attitudes toward the electronic health record, and 2) the teaching format has no effect on knowledge gain, self-efficacy, and attitudes toward the electronic health record. A three-group posttest-only randomized controlled trial design was used.

Research Question One: Does the educational intervention improve knowledge gain, self-efficacy, and attitudes toward the EHR?

The approach used to analyze data related to this study question included a one-way between group analysis of variance to determine whether there were any differences between the three study outcomes, knowledge gain, self-efficacy, and attitudes toward EHR. In addition, a Univariate General Linear Model analysis of variance test, which is similar to a standard one-way ANOVA, was also conducted because it yields more data that inform about the normality of distribution of data for each outcome measure such as mean, SD, and confidence intervals. A linear multiple regression analysis was also conducted.

First, I present information related to the assumptions of the one-way between groups ANOVA for the three outcome variables, then I discuss results of ANOVA for each of these outcomes, beginning with outcomes that had no significant findings. For outcomes with significant findings, additional analyses were carried out to determine which groups differed, the effect size of the intervention using eta squared method, and variations in the effect size after controlling for possible covariates using multiple linear regression. For each of the outcome measures under analysis, descriptive statistics and ANOVA analysis data pertinent to each outcome variable are provided.

Violation of the assumptions of ANOVA is established by assessing the value of the Levene's test. The Levene's test of homogeneity of variance tests whether the variance in scores is the same for each of the three groups. The significance value for Levene's Test should be greater than 0.05, otherwise the assumption of homogeneity of variance would be violated. The Levene's test significance for the study outcomes was: knowledge gain (.230), perceived self-efficacy (.478), and attitudes toward the EHR (.534). All three values of the Levene's test were greater than 0.05, confirming that the assumption of the homogeneity of ANOVA test has not been violated.

One-Way between groups ANOVA: Perceived self-efficacy.

For the Self-efficacy outcome, there was no significant difference among the mean scores of self-efficacy variable for the three groups ($P = .951$). Because, there was no significant difference, post hoc comparisons were not performed.

Table 17. Descriptive Statistics of Secondary Outcome Variable: Perceived Self-efficacy

		Mean	SD	95% Confidence Interval for Mean	
				Lower Bound	Upper Bound
Self-Efficacy	Online	7.18	1.470	6.205	8.150
	F2F	7.05	1.243	6.245	7.863
	Control	7.22	1.544	6.563	7.867
	Total	7.16	1.409		

Table 18. One-Way ANOVA—Self-Efficacy toward the EHR

		Sum of Squares	*Df*	Mean Squares	F	Sig.
Self -Efficacy	Between	.209	2	.105	.050	.951
	Within	81.133	39	2.080		
	Total	81.343	41			

One-way between groups ANOVA: Attitudes toward the EHR.

For the attitudes outcome, there was no significant difference among the mean scores of attitudes variable ($P = .600$). Because there was no significant difference, *Post hoc* comparisons were not performed.

Table 19. Descriptive Statistics of Secondary Outcome Variable: Attitudes toward EHR

		Mean	SD	95% Confidence Interval for Mean	
				Lower Bound	Upper Bound
Attitudes	Online	3.82	.758	3.349	4.295
	F2F	3.94	.574	3.545	4.332
	Control	3.68	.749	3.359	4.010
	Total	3.80	.692		

Table 20. One-Way ANOVA—Attitudes toward EHR

		Sum of Squares	*Df*	Mean Squares	F	Sig.
Attitudes	Between	.507	2	.254	.517	.600

Within	18.652	38	.491
Total	19.159	40	

One-Way between groups ANOVA: Knowledge gain.

The one-way between subjects ANOVA test yielded a statistically significant difference at the $p < 0.05$ level in knowledge scores for the three groups: $F(2, 38) = 15.201$, $p = .001$. When compared against a table of values for a theoretical F distribution, the calculated F value for 2 and 38 [*df]* with an alpha of .05 was 3.25. Because the obtained F value of 15.201 exceeded 3.25, the null hypothesis that the "The teaching format has no effect on mean scores of knowledge, attitudes and self-efficacy" was rejected. Therefore, I accepted the alternative hypothesis that students who received the educational intervention will have more knowledge gain about health informatics compared to those who do not receive the intervention, i.e. control.

Table 21. Descriptive Statistics of Main Study Outcome Variable: Knowledge Gain

		N	Mean	SD	95% Confidence Interval for Mean	
					Lower Bound	Upper Bound
Knowledge	Online	9	14.33	2.500	12.882	15.784
	F2F	13	14.08	1.490	12.870	15.284
	Control	19	10.47	2.342	9.475	11.472
	Total	41	12.46	2.812		

The analysis showed significant difference among the groups ($F(2, 38) = 15.201$, $p < .001$), which means that there is a significant difference among the mean scores on the primary outcome variable, knowledge gain, but it does not tell which group is different

from which other group. To identify which groups differed, the mean scores of each group were compared against each other. As shown above, the online group had higher knowledge gain (*M* =14.33, SD = 2.5); the face-to-face group had somewhat less knowledge gain (*M* = 14.08, SD = 1.49), and control group the least knowledge gain (*M* =10.47, SD = 2.81).

Table 22. One-Way ANOVA—Knowledge Gain

		Sum of Squares	*Df*	Mean Squares	F	Sig.
Knowledge	Between	140.535	2	70.268	15.201	.000
	Within	175.660	38	4.623		
	Total	316.195	40			

In addition, the *Post hoc Scheffe* tests showed that the online group differed significantly from the control group, the face-to-face differed significantly from the control group, but the difference between the online and face-to-face was not statistically significant.

Effect size of the intervention on primary outcome: Knowledge.

The effect size is a measure of the magnitude of the treatment effect. The most commonly used statistics to compare groups using analysis of variance are eta squared and partial eta squared. The difference between the eta squared and Cohen's d effect size statistic is that the eta squared effect size indicates the proportion of variance of the dependent variable that is explained by the independent variable, whereas, Cohen's d presents a difference between groups in terms of standard deviation units as shown below (Pallant, 2007, P. 208).

Eta Squared, also known as Classic eta squared, represents the proportion of the total variation attributable the factor and it ranges from 0 to 1. Eta squared can be calculated as the ratio of the effect variance (SS_{effect}) to the total variance (SS_{total})[10], i.e. $\eta^2 = SS_{effect} / SS_{total}$ (Pierce, Block, & Aguinis, 2004; Richardson, 2011). It can also be calculated based on data from ANOVA analysis using the equation: Sum of Square between Group/Total sum of Squares.

Partial Eta Squared on the other hand refers to the variation attributable to the factor, excluding other factors from the total non-error variation (Pierce, et al., 2004, P.918). The partial eta^2 is calculated by the SPSS program as part of the output for analysis of variance using Univariate General Linear Model statistic (Pallant, 2007; Richardson, 2011). The formula for partial eta^2 is: $\eta_p^2 = SS_{effect} / (SS_{effect} + SS_{error})$.

Typically, partial eta squared is greater than the classical eta squared for a source of variance, except in one condition where the design has only one factor (Pierce, et al., 2004, p. 918). In this study, there is only one factor, which is the group, therefore the eta squared and partial eta squared results are equivalent. Pallant (2007) reported that for comparison with Cohen D values, both the eta squared and the partial eta squared could be used.

Table 23. Acceptable Effect Size Values Reported in the Literature

Size	Eta squared (% Of variance explained)	Cohen's d (Standard deviation Units)
Small	.01 or 1%	.2

[10] SS_{effect} = the sums of squares for an effect of interest
SS_{total} = the total sums of squares for all effects, interactions, and errors in ANOVA

Medium	.06 or 6%	.5
Large	.138 or 13.8%	.8

Source: Pallant, J. (2007, p. 208).

According to these values, the effect size of the knowledge outcome calculated in this study was .444, which corresponds to a large effect size as shown above. In other words, the independent variable group predicted 44.4% ($\eta^2 = 0.444$) of the variability in knowledge gain. Therefore, I rejected the null hypothesis that the educational intervention has no effect on knowledge gain toward the EHR, and accepted the alternative hypothesis that: "those who receive the intervention will have better knowledge gain than those who do not receive the intervention." Providing health informatics education to undergraduate nursing students significantly enhances their knowledge about health informatics.

I created a correlation matrix using the Spearman rho Correlation method to investigate the correlations between the main outcome variable and possible covariates, namely, age, group, university, year of study in the program, and learning styles. The variables that showed moderate to strong correlations were included as independent variables in a regression model testing their ability to predict knowledge gain. The Spearman's Rho was used because it is preferred when the sample size is small. The strength of association (r) can take a range of values from +1 to -1. A value of 0 indicates that there is no association between the two variables. A value greater than 0 indicates a positive association, that is, as the value of one variable increases so does the value of the other variable. A value less than 0 indicates a negative association, that is, as the value of one variable increases the value of the other variable decreases.

Table 24. Correlation Matrix using Spearman's rho Correlation Coefficient

	Group	University	Program	Study Year	Prev. Ed. Informatics	Age	L. Style	Efficacy	Attitudes
Group									
University	-.149								
Program	-.309	**.432****							
Study Year	-.127	**-.317***	-.229						
Prev. Ed. Informatics	-.283	-.039	.187	-.006					
Age	.255	-.241	.163	.083	**-.312***				
Learning Style	-.067	**.357***	.303	-.033	-.045	-.243			
Self-Efficacy	.057	-.268	.021	-.024	**.399****	.089	-.304		
Attitudes	-.103	-.251	.080	.039	.225	.167	-.245	**.469****	
Knowledge	**-.640****	.149	**.462****	.216	.195	.095	.031	.079	.203

Based on these correlations, group (Online, face-to-face, and control) and program (UofA—Collaborative, ADP, and Bilingual) were selected for inclusion in the regression equation. Although the correlation between knowledge gain and age was small, it was included in the regression model based on the literature.

I specified the hypothesis for the regression model as: Change in R^2 is zero, and then I applied multiple linear regression analysis to assess the ability of group, program, and age to predict. Preliminary analyses were conducted to ensure no violation of the assumptions of normality, linearity, multicollinearity and homoscedasticity. The independent variable group (face-to-face group and control group) was entered at Step 1, and explained 41.5% of the variance in knowledge gain. Age and program of study at Step 2, explained an additional 12.3% of the variance in knowledge gain. R squared

change = .123, F change (4, 34) = 2.417, $p < .001$. The model as a whole predicted 49.1% of the variance in knowledge gain, F (6, 34) = 7.434, $p < .001$. Therefore, I rejected the null hypothesis that R^2 change equals zero. In the final model, the only measure that was statistically significant was the group, which had a beta value of -.686, $p < .001$). Program (beta = .244) and age (beta = .232) were not statistically significant predictors of knowledge gain.

Effect size of the intervention on secondary outcomes: Self-efficacy and attitudes.

Although no significant effect was found in self-efficacy or attitudes toward EHR, I calculated the effect sizes for these outcomes. For the self-efficacy outcome, the value of $\eta^2 = .209/81.343 = .003$. The size of the effect of perceived self-efficacy was very small; the intervention predicted only .3% ($\eta^2 = .003$) of the variability in perceived self-efficacy. The low effect could be at least partly attributed to the small sample size. Similarly, the size of the effect for attitudes was very small, too; the intervention predicted only 2.6% ($\eta^2 = .026$) of the variability in attitudes toward the electronic health record, which could also be attributed to the small sample size. Although there was no statistically significant difference, a comparison of mean scores showed that the online group mean scores ($M = 3.82$, SD = .758) and the face-to-face mean scores ($M = 3.94$, SD = .574) were slightly higher than those of the control group ($M = 3.68$, SD = .749) suggesting that a statistically significant difference could have been achieved with a larger sample size.

Research Question Two: Which teaching format (online or face-to-face) would yield better knowledge gain, self-efficacy, and attitudes toward the EHR?

Results of the one-way between subjects ANOVA test were used to answer research question two. According to the analysis, the test yielded a statistically significant difference at the $p < 0.05$ level in knowledge scores for the three groups: $F(2, 38) = 15.201$, $p = .001$. No statistically significant results were found in relation to self-efficacy and attitudes. Therefore, I rejected the null hypothesis that "The teaching format has no effect on mean scores of knowledge," and accepted the alternative hypothesis that the teaching format, online and face-to-face, has an effect on knowledge gain about the electronic health record. The mean scores of the online group (M =14.33, SD = 2.5) were slightly higher than those of the face-to-face group (M = 14.08, SD = 1.49), but knowledge gain of these two groups was much higher than that of the control group (M =10.47, SD = 2.81), which indicates that both teaching formats are equally effective for teaching health informatics.

Re-assessment of the Power of the Study

An a priori power calculation for Analysis of Variance was performed based on the effect size obtained in the pilot phase for the study. Because there were issues related to the number of items testing knowledge gain in the pilot phase of the study, I used the effect size of the self-efficacy outcome to estimate required sample size. Using a web-based sample size calculator[11], I calculated required sample size by setting the probability

[11] Source: http://www.stattools.net/SSizAOV_Pgm.php

of Type I error (alpha) at .05, power at .8, and an effect size of .54, which yielded a sample size of 51 participants per each group for a three-group ANOVA design.

To determine the power of the main phase of the study and calculate sample size, the effect size obtained in this study was compared to effect sizes obtained using the approach described by Cohen (1992). An effect size of 0.44 represents a large effect size. If power is set at 0.8, and alpha is set at 0.05, the sample size per group for an effect size of 0.44 would be 52. The power analysis for a three-group ANOVA design was shown to be .40, which suggests that study was underpowered and this may have influenced the researcher's ability to detect differences in self-efficacy and attitudes toward EHR.

Summary

The findings of this study suggest that while the intervention improved participants' understanding about the EHR, there was no difference between scores of individuals who received the face-to-face version of the intervention and those who received the online version. In addition, the intervention did not have an effect on either self-efficacy or attitudes toward EHR. Univariate analysis suggested that program of study may have influenced knowledge gain and the literature suggested that age could influence knowledge gain, but when these two predictors were entered into a regression equation after the effect of the intervention; they were not significant predictors of knowledge gain. The two standardized instruments used to collect data pertaining to self-efficacy and attitudes toward electronic health records were internally consistent, but the instrument designed by the researcher to measure knowledge gain requires further refinement.

CHAPTER 6

Discussion, Limitations, and Implications

This chapter provides a discussion of study findings, and limitations. I begin with a discussion of methodological and measurement issues pertinent to the study findings. Then, I discuss findings related to descriptive analyses of study outcomes and those related to each research question. Where possible, I will compare findings of this study to the findings of other studies. This chapter concludes with a set of implications for nursing education, nursing research, nursing practice, and policy.

Methodological Issues

Response Rate

In spite of successive recruitment attempts in this study, the response rate was quite low. The intervention was offered during the regular academic term, but I tried to be flexible as evidenced by the number of sessions offered during weekdays and on weekends for a period of one month. In addition, registration in the session was provided online in order to encourage participation. Nevertheless, students had busy schedules given course requirements and extracurricular activities and thus the time available for participation in the study was likely limited. As adult learners, most of these students likely had other personal and family responsibilities, which might have further precluded them from participating in the study.

Low participation rates could also be attributed to a lack of interest among student nurses to learn about informatics. In both universities, formal education about informatics

is not offered, which could have contributed to a perception that this learning session was not relevant to their future nursing practice, and that they could, therefore, dismiss it.

Participation was higher among 1st, 2nd and 3rd year students (28.6%, 38% and 28.6% respectively) than among 4th year students (19%). For senior nursing students, taking the opportunity to learn more about informatics would have been very relevant to them because upon employment, most employing agencies require an evidence of some knowledge and skills in using computers. This information was shared with students upon recruitment in order to draw their attention to the utility of this education for their future clinical practice, but participation was still low.

Because the delivery of the intervention in this study has coincided with important events taking place in the province to implement an electronic health record, I anticipated that most nursing students would be interested in attending the session. However, the low participation rate suggests that students were either unaware of these events, or that they did not see how these events related to nurses' work. Another possibility could be related to nursing students' interest in participating in research activities. At the present time, there are no incentives to encourage students to take part in research activities except for those that are offered by researchers conducting a study. In some faculties at the University of Alberta, participation in research activities is rewarded as a percentage of course work.

Measurement Issues

Low Reliability of Actual Knowledge Scale

With regard to the low internal consistency on the knowledge gain instrument, the knowledge test had items pertaining to several objectives; therefore the scale as a whole may not be internally consistent. Future research could examine whether developing more items for each set of learning objectives could enhance the reliability of the scale, and then test these items for internal consistency separately.

Control of Potential Confounding Variables

One of the issues of concern during the design of this study was the lack of information about factors that could confound the results of the study. This was due to the relative newness of the topic of study. Therefore, I opted for a randomized design to increase the likelihood that any such factors were distributed among all three groups of participants. In addition, I checked for correlations among possible confounders and the primary dependent variable, and included variables as predictors in the regression equation if they were moderately correlated with knowledge gain in this data set or had been reported by others to be related to knowledge about EHR.

Findings related to Descriptive Analysis of Self-Efficacy and Attitudes toward the Electronic Health Record

Findings showed that participants' perceptions of self-efficacy toward using unfamiliar software, in this case an electronic health record that they had not used before, were highest if they had someone to show them how to use it first (83.4%), or if they have used similar packages in the past to do the same job (88.1%). Participants felt least confident if they had never used a package similar to the electronic health record before (2.4%), and when there was no one around to tell them what to do as they go (9.6%).

In this study, students were not provided with an opportunity to have hands-on practice of the knowledge they received about health informatics and health records due to lack of an electronic medical record (EMR) or EHR simulator at the Faculty of Nursing or in the clinical facilities where students take their practicum courses. However, from an educational perspective, the literature supports the importance of providing students with learning opportunities to enhance their confidence in using health care technology such as hands-on-training on hospital information systems (Hilgenberg & Damery, 1994; Gassert & Sward, 2007; Borycki, Kushniruk, Armstrong, Joe, & Otto, 2010). Students who have had such opportunities felt that it would help ease their transition from a student nurse to a registered nurse (Hilgenberg & Damery, 1994). From an employment perspective, findings in this study also support the need for providing new graduates with learning opportunities, support, and mentorship should they be required to use a new software such as the EHR (Compeau & Higgins, 1995).

With regard to attitudes toward the EHR, in this study, the majority of participants held a positive view about the electronic health record (64.3%) and its potential for improving patient care in time (76.2%). These findings are encouraging and should be promoted among the undergraduate nursing students because positive attitudes have been shown to influence adoption behavior and use (Kinzie, Delcourt, & Powers, 1994). When attitudes were compared among the three groups, the scores of students in the online group (92.4%%) and face-to-face group (88.9%) were higher than those in the control group (60%). These positive views suggest that students who have completed the educational intervention had a better understanding of how the EHR contributes to

improving patient care. The inability to detect a difference in attitude was likely affected by the small sample size.

Improving NI/HI Knowledge among Baccalaureate Nursing Students

Competence in health and nursing informatics has been identified as a core competency for professional nursing practice (AACN, 2008; CARNA, 2006; Ehnfors & Grobe, 2004). Nurses who are able to utilize informatics tools and applications competently not only contribute to improved patient outcomes but also to the overall significance of nursing practice and knowledge development (Orchard, Reid-Haughian, & Vanderlee, 2006; CNA, 2006; Skiba, 2011). Therefore, strategies that aim at enhancing competence and confidence in HI among nurses are a key priority to the nursing profession. The problem addressed in this study is the lack of content related to NI or HI in the undergraduate nursing programs at the University of Alberta, which led me to develop an educational intervention to increase undergraduate nursing students' knowledge about HI.

The first research question addressed whether an educational intervention could improve knowledge gain, self-efficacy, and attitudes toward electronic health record. Although knowledge gain was the primary outcome, self-efficacy was also included as an outcome because it is an important predictor of future behavior. Other authors have reported that perceptions of efficacy determine whether an individual engages in certain behaviors or tasks, and how much effort and persistence the individual is willing to expend on it (Bandura, 1977, 1989, 1990; Kinzie, et al, 1994; Compeau & Higgins, 1995). Attitudes toward the EHR were included as an outcome because attitude has been

identified as an important predictor of self-efficacy, adoption, and use of technology (Kinzie, et al., 1994; Compeau & Higgins, 1995, 1999; Dillon, et al., 2003). Interestingly, the findings in this study showed that while the intervention improved knowledge, it did not improve self-efficacy or attitudes of students toward the electronic health record. Although there was no statistically significant difference in relation to attitudes, the online group mean scores (M = 3.82, SD = .758) and the face-to-face mean scores (M = 3.94, SD = .574) were slightly higher than those of the control group (M = 3.68, SD = .749) suggesting that a statistically significant difference could have been achieved with a larger sample size. No similar studies were found to compare the finding generated in this study against.

A significant difference was found in relation to knowledge gain. The size of the effect of the intervention on knowledge gain was very large; the type of instruction predicted 44.4% ($\eta^2 = 0.444$) of the variability in knowledge gain. According to findings in this study, students who received the intervention had better knowledge gain than those who had not received the intervention (control group).

Adding an evaluation perspective to the existing descriptive body of literature about informatics education at the baccalaureate level increased understanding about the effect of HI educational interventions in enhancing competence in HI, specifically about the EHR, among baccalaureate nursing students. The literature reveals that this is the first empirical study that introduced HI education at the undergraduate baccalaureate level utilizing a rigorous research design to ascertain the effectiveness of education provided as well as the effect of new online strategies for facilitating the delivery of HI education at

the undergraduate level. Lack of faculty expertise in HI and limited opportunities for integrating HI in nursing curricula that are already fully scheduled with classes on other important material has been recognized as a key barrier for integrating informatics at the undergraduate level (Axley, 2008; Curran, 2008). Therefore, this research with its emphasis on online learning has important implications for enhancing NI and HI education at the undergraduate level.

Choosing the Best Format for Providing HI Educational Intervention about EHR

In this study, the second research question was, "which teaching format (online or face-to-face) yields better knowledge gain, self-efficacy, and attitudes toward the electronic health record?" Findings showed a significant difference in relation to the effect of intervention on knowledge gain meaning that both teaching formats were effective for enhancing knowledge outcomes about HI. Findings related to this question are consistent with findings in other studies in the literature (Schmidt, et al., 1991; Bloomfield, et al., 2010; Abdelaziz, et al., 2011). However, these findings should be interpreted with caution given the variations in the modalities of online learning employed between these studies. It should be noted also that only a few studies were found that actually reported on content similar to or close to the content that was offered in this intervention.

Being connected through online communication has become a feature of modern life. Most institution of higher education have invested in advanced learning technologies such as learning management systems, and simulation technology to advance educational goals and meet the needs of millennial generations of students of young and returning

students (Milne, 2007; Chaffin & Maddux, 2004). Evidence continues to support that online learning is equally effective to face-to-face or conventional instruction (Cook, et al., 2010; Bloomfield, Roberts, & While, 2010; Abdelaziz, Kamel, Karam, & Abdelrahman, 2011; Schmidt, Arndt, Gaston, & Miller, 1991); therefore it would be appropriate to utilize this modality in achieving the goals of HI education at the undergraduate level. Additional evidence has been demonstrated through this study, which showed that online learning through the use of Vodcast technology was equally effective as face-to-face instruction about EHR.

It has been proposed in the literature that use of technology for learning purposes enhances overall confidence in using computers or other technological devices such as mobile learning tools (Kinzie, et al., 1994; Adams & Timmins, 2006; Kuiper, 2008; Kenny, et al., 2012). However, Compeau and Higgins (1995) argued that when the learning dimension is introduced, self-efficacy related to computer use takes a different dimension and therefore further research would be needed to examine these two constructs (p. 205). In an integrative review of literature on self-efficacy in Internet-based learning environments of research published between 2009 and 2011, Tsai, Chuang, Liang, & Tsai (2011) identified three themes that characterized research in this area, these were: Internet self-efficacy, the interplay between academic self-efficacy and Internet-based learning, and the Internet-based learning self-efficacy. Of relevance to this discussion, findings from Tsai, et al. showed that high self-efficacy was associated with better learning outcomes, although in most of the studies reviewed the most investigated outcome was that of search strategies. Consistent findings have also been reported in

research studies investigating the relationship between psychological factors such as attitudes, anxiety, and usefulness and Internet self-efficacy. However, no studies were identified in this review with regards to the relationship between Internet-based learning or Internet-based self-efficacy and future use of technology in other contexts (Tsai, et al. 2011).

Other authors have argued that while the construct of self-efficacy had been shown to be fairly stable in assessing academic achievement in face-to-face learning environment, research on its role within online learning environments remains inconclusive, especially with emerging new technologies (Hodges, 2008; Burkhard & Roldan, 2009). It remains unclear how generic computer self-efficacy and general use of computers interplay in other contexts such as health care settings or in relation to use of complex health technology such as the EHR. In this study, the impact of the educational intervention on self-efficacy related to EHR was not found to be statistically significant. In addition, although computer literacy skills or previous use of computers or Internet were not assessed at the beginning of the study, these factors did not seem to be significant predictors because students in this study were fairly comfortable in using technology including advanced educational and social media applications. Information and communication technologies as well as educational technology are built in the theory and practicum learning experiences throughout the four years of education in the nursing program.

The relationship that seems to be clear in current research about self-efficacy is that positive experiences with using technology influence attitudes of users, and that

experiences associated with positive attitudes contribute to increasing perceptions of self-efficacy related to future behavior, for example adoption and use of technology (Kinzie, et al.; 1994; Compeau & Higgins; 1995, 1999), or enhanced performance on selected tasks or learning outcomes. For example, research among undergraduate nursing students showed that higher perceptions of self-efficacy were associated with the use of computer-assisted instruction such as online learning packages or human patient simulator technology in the delivery of health teaching or providing nursing care (Madorin & Iwasiw, 1999; Goldenberg, et al., 2005; Sinclair & Ferguson, 2009; McMullan, et al., 2011).

Although no significant differences were found in relation to students' self-efficacy or attitudes toward the EHR, the online learning modality, Vodcasting, offered in this study appeared to provide a beneficial learning opportunity for the students. Vodcasting technology proved to be a convenient and cost-effective tool for recording content related to HI. By using narration with Voice-Over-Power Point (VOP), the researcher made this education available to nursing students at any time and from anywhere. Tools within the online environment enabled integration of additional resources for students to navigate important information related to evidence-based practice and a wide array of HI and health informatics web resources, therefore it promoted self-directed learning and students' construction of knowledge about HI (Kaakinen & Arwood, 2009). In addition, the learning environment supported the integration of many learning activities that promoted higher order thinking related to knowledge about HI and the EHR (DeYoung, 2009). However, given this is the first study about Vodcasting specifically applied to

learning about HI and EHR, it would be important that future research examines these outcomes in other settings.

Study Limitations

The main limitation in this study was related to low response rate, which limited the external validity, i.e. generalizability of the findings. Therefore, while this study had strong internal validity, it is important to replicate the study in other settings and with larger samples. Another limitation was related to the low internal consistency of the knowledge scale, which I developed for the purpose of this study. Although half of the test items were piloted in the first phase of the study, there was no opportunity to pilot test the additional eleven items that were added to the scale. Lastly, my intention was to offer this intervention over a four-hours period, however, it was difficult for students to commit this much time given other educational commitments they have; the short time for the intervention may have been insufficient for participants to sufficiently integrate the content provided.

Implications

Implications are offered based on findings from this study and the literature on integration of informatics in undergraduate baccalaureate nursing education. Implications are discussed in relation to nursing education, research, practice, and policy.

Implications for Nursing Education and Nurse Educators

Findings from this study could be used to help educators plan ways to integrate HI into undergraduate educational programs. Regardless of the instructional design or

learning theory educators choose to adopt when planning HI education, educators need to consider the following essential elements in this process:

- Offering content guided by specific learning outcomes that address all domains of learning including knowledge, skills, and attitudes. Content about informatics should address nursing roles in using informatics applications in a variety of clinical practice settings (Vanderbeek & Beery, 1998; Travis, et al., 1995).
- Providing foundational content beginning in year one of the nursing program and progressing toward more complex concepts toward the final years in the program. By scaffolding learning experiences from simple to complex, students are more likely to develop a better understanding of informatics without being overwhelmed (Travis, et al, 1995; Staggers, et al., 2001).
- Combining various teaching strategies to help augment learning and synthesis of knowledge about HI. Nursing educators need to explore ways to include both, online and face-to face teaching formats, as they appear to be equally effective for teaching undergraduate nursing students about HI. Online learning offers an array of possibilities for facilitating the delivery of informatics education to a large number of nursing students at the undergraduate level. Online education as a means for educating undergraduate nursing students about informatics could help streamline faculty resources and counteract limitations related to shortage in qualified faculty members with expertise in nursing or health informatics.
- Combining quantitative and qualitative measures to evaluate learning outcomes on formative and summative basis (Travis, et al., 1995).

By taking these steps, educators ensure a systematic approach in the planning, implementation, and evaluation of HI education offered to increase knowledge about the EHR. Finally, nursing educators need to advocate for teaching resources that would facilitate the delivery of informatics education to undergraduate nursing students, for example, an electronic medical record simulator or electronic sandbox. Simulated informatics experiences could be developed with a focus on nursing informatics, or a focus on health informatics in which various interprofessional roles in using technology are explored. In addition, providing opportunities for hands-on-practice through structured clinical experiences in practice settings that have different modalities of informatics applications, e.g. electronic health records, tele-health, etc. would be important (Travis, 1998; Borycki, et al., 2010).

Implication for Clinical Practice and Nursing Practice Leaders

In order for learning experiences to be relevant to nursing clinical practice, it would be prudent for clinical agencies to create opportunities for clinical placements of undergraduate baccalaureate nursing students in settings with informatics applications. Another possibility would be to offer shadowing experiences with nurses or health informatics specialists whereby nursing students could take part in the planning, design, implementation, and evaluation of informatics projects in the clinical setting (Travis, et al, 1998).

In addition to opportunities for student nurses, clinical agencies and clinical leaders should create similar opportunities for professional development in nursing informatics among practicing nurses for them to be able to keep abreast with advancements in this

field, especially new graduates. A systematic orientation at the beginning of employment is key for helping newly hired nurses to understand the organizational goals in relation to informatics. Then, structured learning experiences using face-to-face or online learning formats could be offered. HI education offered to nurses should be comprehensive and relevant to nursing practice with the goal for engaging nurses to think about technological application in a more critical way as opposed to learning how to operate the technology. It would be helpful to conduct an initial assessment of the level of competence of the nurse, especially new graduates as they may have received some knowledge about HI during their nursing program, then accordingly offer learning experiences that best meets nurses' needs regarding HI. For example nurse leaders could utilize resources developed within Canada to assess the level of competence among nurses such as the professional development web resource developed by June Kaminski© (2000), http://www.nursing-informatics.com/kwantlen/. Another course that can be utilized is the course developed by Richard Booth for registered nurses in Ontario. The course is accessible to nurses across Canada through the RNAO website. In addition, clinical leaders could collaborate with educators to utilize educational resources developed for nursing students such as the modules developed in this study at the Faculty of Nursing, University of Alberta.

Implications for Nursing Researchers and Future Research in Informatics

This study contributes significantly to the body of knowledge as the first empirical study that has utilized a rigorous research method to test the efficacy of a new technology within the context of HI education at the baccalaureate nursing education level. In addition, it emphasized the importance of developing educational interventions about

HI/NI that emphasize the role of informatics in nursing clinical practice; thus it brought back the focus on the context of care.

For researchers, a replication of this study is needed, preferably with a larger sample and in other settings in order to enhance the generalizability of results. Future research could utilize tools developed in this study such as the learning modules and study website and registration portal to offer this educational intervention online to a wider population of baccalaureate nursing students in Canada.

There is a need for follow-up studies that examine the effectiveness of education related to HI and/or NI among undergraduate nursing students. However, there is a need to shift focus from comparing effectiveness of different types of instruction such as face-to-face and traditional, toward more evaluation of other factors that impact outcomes of informatics education. Some of the outcomes that could be assessed include ease of use of health care technology, perceptions of self-efficacy, and other behavioral factors such as user adoption and use of health care technology. Tracking graduates who have participated in this study would help shed some light as to whether this education had helped them engage more with health care technology.

Future research should also consider rigorous research methodology with a focus on evaluation to better capture the impact and value of informatics education at the undergraduate baccalaureate level. Mixed methods studies can help generate evidence on the effectiveness of informatics education from multiple perspectives. Lastly, because most existing measurement tools have been developed in reference to computers in general and technological innovations continue to evolve, there is a need for new

measuring instruments that are able to reflect these advancements in technology. Reliability and validity of these instruments would need then to be evaluated to ensure proper psychometric measurement.

Implications for Policy and Decision-makers

One of the purposes of this study was to develop recommendation for decision-makers at the FON regarding the inclusion of HI in the undergraduate nursing programs. Findings from this study showed that education about informatics makes a difference in enhancing nursing students' understanding of informatics, and that both teaching formats, online and face-to-face are equally effective for achieving this goal. Therefore, I strongly recommend the inclusion of this content in the undergraduate curriculum using either teaching format or a combination of both. However, given that these two modules were specifically designed to provide an introductory and foundational knowledge about HI, I would recommend that the Faculty of Nursing expand on this work by building additional HI learning modules.

In order to support the development of informatics competence among future nurses, it would be important for policy and decision-makers to allocate resources to create a supporting infrastructure, e.g. health technology labs and sandbox simulator, to assist undergraduate nursing programs design and offer appropriate education in health informatics for nursing students.

Similar infrastructure is needed to help increase awareness and build capacity in health informatics among faculty members (Melo & Hodson, 2008; Gassert, 2008). In addition, resource allocation and streamlining between resources used for educating

health care professionals about health informatics and mechanisms for facilitating collaboration between academia and service agencies would be pivotal for achieving this goal. Lastly, policy makers could initiate dialogue with stakeholders to arrive at a consensus or national standards regarding informatics education at the undergraduate level. Such standards would help educational program articulate health informatics education in a more systematic way.

Concluding Remarks

Chapter 6 offered a discussion of study findings and limitations followed by a number of implications for nursing education, practice, research, and policy. Recommendations for future research were proposed. This study demonstrated the effectiveness of an educational intervention in increasing knowledge about EHR among undergraduate baccalaureate nursing students. It also demonstrated that this education could be delivered with similar outcomes via two teaching formats, online and face-to-face. Further research is recommended to allow for greater generalizability of these findings to other educational settings in Canada. Implications for nurse educators, nurse leaders, researchers, and policy makers were proposed.

References

Abdelaziz, M., Kamel, S., Karam, O., & Abdelrahman, A. (2011). Evaluation of E-learning program versus traditional lecture instruction for undergraduate nursing students in a faculty of nursing. *Teaching and Learning in Nursing, 6*(2), 50-58. DOI: 10.1016/j.teln.2010.10.003.

Adams, A. M. (2004). ISSUES AND INNOVATIONS IN NURSING EDUCATION pedagogical underpinnings of computer-based learning. *Journal of Advanced Nursing, 46*(1), 5-12. DOI: 10.1111/j.1365-2648.2003.02960.x.

Adams, A., & Timmins, F. (2006). Students' views of integrating web-based learning technology into the nursing curriculum: A descriptive survey. *Nurse Education in Practice, 6*(1), 12-21. DOI: 10.1016/j.nepr.2005.05.005.

Ally, M. (2004). Foundations of educational theory for online learning. In T. Anderson & F. Elloumi (Eds), *Theory and Practice of Online learning*. Retrieved from http://cde.atabasca.ca/online_book/index.html.

American Association of Colleges of Nursing (AACN) (2008). The Essentials of baccalaureate education for professional nursing practice. Washington, DC. Retrieved April 20, 2012, from www.aacn.nche.edu/education-resources/BaccEssentials08.pdf.

Axley, L. (2008). The integration of technology into nursing curricula: Supporting faculty via the technology fellowship program. *Online Journal of Issues in Nursing, 13*(3), 12-12.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84*(2), 191-215.

Bandura, A. (1989). Human agency in social cognitive theory. *American Psychologist,* 44 (9), 1175-1184.

Bandura, A. (1990). Perceived self-efficacy in the exercise of control over AIDS infection. *Evaluation and Program Planning*, Vol. 13, 9-17.

Billings, D. M. (2000). A framework for assessing outcomes and practices in web-based courses in nursing. *Journal of Nursing Education, 39*(2), 60-67. Retrieved from http://login.ezproxy.library.ualberta.ca/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=rzh&AN=2000025314&site=ehost-live&scope=site.

Billings, D. M., Skiba, D. J., & Connors, H. R. (2005). Best practices in web-based courses: Generational differences across undergraduate and graduate nursing students. *Journal of Professional Nursing, 21*(2), 126-133. DOI: 10.1016/j.profnurs.2005.01.002.

Bloomfield, J., Roberts, J., & While, A. (2010). The effect of computer-assisted learning versus conventional teaching methods on the acquisition and retention of hand washing theory and skills in pre-qualification nursing students: A randomized controlled trial. *International Journal of Nursing Studies, 47*(3), 287-294. DOI: 10.1016/j.ijnurstu.2009.08.003.

Borycki, E., Kushniruk, A., Armstrong, B., Joe, R., & Otto, T. (2010). Integrating electronic health records into health professional and health informatics education: A continuum of approaches. *Acta Informatica Medica, 18*(1), 20-24.

Burkhard, R. & Roldan, M. (2009). Task context and computer self-efficacy in the Era of Web 2.0 Tools. *Journal of Online Learning and Teaching*, 5 (1).

Chan, M.F. (2007). A cluster analysis to investigating nurses' knowledge, attitudes, and skills regarding the clinical management system. *CIN: Computer, Informatics*, Nursing, 25 (1), 45-54.

Chaffin, A. J., & Maddux, C. D. (2004). Internet teaching methods for use in baccalaureate nursing education. *CIN: Computers, Informatics, Nursing, 22*(3), 132-144. Retrieved from http://login.ezproxy.library.ualberta.ca/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=rzh&AN=2004117968&loginpage=Login.asp&site=ehost-live&scope=site.

Canadian Nurses Association. (2006a). *ENursing strategy for Canada.* Retrieved, April 20, 2012 from: http://www.cna-

aiic.ca/CNA/documents/pdf/publications/E-Nursing-Strategy-2006-e.pdf.

Candela, L., Dalley, K., & Benzel-Lindley, J. (2006). A case for learning-centered curricula. *Journal of Nursing Education, 45*(2), 59-66. Retrieved from http://login.ezproxy.library.ualberta.ca/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=rzh&AN=2009123955&site=ehost-live&scope=site.

Cohen, J. (1992). A power primer. *Psychological Bulletin, 112*(1), 155-159.

College and Association of Registered Nurses of Alberta (CARNA). *Entry to practice competencies for the registered nurses profession.* Retrieved April 20, 2011 from: www.nurses.ab.ca/carna/Entry-to-Practice%20Competencies.pdf.

Compeau, D. R., Higgins, C. A. (1995). Computer self-efficacy: Development of a measure and initial test. *MIS Quarterly*, 19,189-211.

Compeau, D. R., Higgins, C. A. (1999). Social cognitive theory and individual reactions to computing technology: A longitudinal study. *MIS Quarterly*; 23 (2), 145-158.

Cook, D. A., Levinson, A. J., Garside, S., Dupras, D. M., Erwin, P. J., & Montori, V. M. (2008). Internet-based learning in the health professions. *JAMA: The Journal of the American Medical Association, 300*(10), 1181-1196. DOI: 10.1001/jama.300.10.1181.

Cowan, D.T., Norman, I., & Coopamah, V. P. (2007). Competence in nursing practice: A controversial concept—A focused review of literature. *Accident and Emergency Nursing*, 15, 20-26. DOI: 10.1016/j.aaen.2006.11.002.

Creedy, D. K., Mitchell, M., Seaton-Sykes, P., Cooke, M., Patterson, E., Purcell, C., & Weeks, P. (2007). Evaluating a web-enhanced bachelor of nursing curriculum: Perspectives of third-year students. *Journal of Nursing Education, 46*(10), 460-467.

Cronenwett, L., Sherwood, G., Barnsteiner, J., Disch, J., Johnson, J., Mitchell, P., . . . Warren, J. (2007). Quality and safety education for nurses. *Nursing Outlook, 55*(3), 122-131. DOI: 10.1016/j.outlook.2007.02.006.

Curran, C. R. (2008). Faculty development initiatives for the integration of informatics competencies and point-of-care technologies in undergraduate nursing education. *Nursing Clinics of North America, 43*(4), 523-533.

Curran-Smith, J., & Best, S. (2004). An experience with an online learning environment to support a change in practice in an emergency department. *CIN: Computers, Informatics, Nursing, 22*(2), 107-110. Retrieved from http://login.ezproxy.library.ualberta.ca/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=rzh&AN=2004079271&site=ehost-live&scope=site.

De Gagne, J. C., Bisanar, W. A., Makowski, J. T., & Neumann, J. L. (2011). Integrating informatics into the BSN curriculum: A review of the literature. *Nurse Education Today,* (0) DOI: 10.1016/j.nedt.2011.09.003.

Desjardins, K. S., Cook, S. S., Jenkins, M., & Bakken, S. (2005). Effect of an informatics for evidence-based practice curriculum on nursing informatics competencies. *International Journal of Medical Informatics, 74*(11-12), 1012-1020. DOI: 10.1016/j.ijmedinf.2005.07.001.

Dillon, T.W., Lending, D., Crews Jr, T.R. & Blankenship, R. (2005). Nursing self-efficacy of an integrated clinical and administrative information system. *CIN: Computers, Informatics*, Nursing, 21 (4), 198-205.

Dillon, T.W., Blankenship, R., & Crews Jr, T., (2003). Nursing attitudes and images of electronic patient record systems. *CIN: Computers, Informatics, Nursing*, 23 (3), 139-145.

DeYoung, S. (2009). *Teaching strategies for Nursing Educators* (2nd Ed.). Upper Saddle River, NJ: Pearson Education, Inc.

Donahue, B., & Thiede, K. (2008). Innovative strategies for nursing education: Enhancing curriculum with the electronic health record. *Clinical Simulation in Nursing, 4*(1), e29-e34. DOI: 10.1016/j.ecns.2009.05.053.

Earle, V., & Myrick, F. (2009). Nursing pedagogy and the intergenerational discourse. *Journal of Nursing Education, 48*(11), 624-630. Retrieved from http://login.ezproxy.library.ualberta.ca/login?url=http://search.ebscohost.com/logi

n.aspx?direct=true&db=rzh&AN=2010467042&loginpage=Login.asp&site=ehost-live&scope=site.

Ehnfors, M., & Grobe, S. J. (2004). Nursing curriculum and continuing education: Future directions. *International Journal of Medical Informatics, 73*(7), 591-598.

Elfrink, V. L., Davis, L. S., Fitzwater, E., Castleman, J., Burley, J., Gorney-Moreno, M., . . . Martin, A. (2000). A comparison of teaching strategies for integrating information technology into clinical nursing education. *Nurse Educator, 25*(3), 136-144.

Englebardt, S.P., & Nelson, R., (Eds) 2002. *Health Care Informatics: An Interdisciplinary Approach (*1st Ed.), St. Louis: MI: Mosby.

Fetter, M. S. (2009). Graduating nurses' self-evaluation of information technology competencies. *Journal of Nursing Education, 48*(2), 86-90. Retrieved from http://login.ezproxy.library.ualberta.ca/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=rzh&AN=2010179899&loginpage=Login.asp&site=ehost-live&scope=site.

Fetter, M. S. (2009). Baccalaureate nursing students' information technology competence--agency perspectives. *Journal of Professional Nursing: Official Journal of the American Association of Colleges of Nursing, 25*(1), 42-49.

Forbes, M. O., & Hickey, M. T. (2008). Podcasting. *Nurse Educator, 33*(5), 224-227.

Frisch, N., & Coscarelli, W. (1986). Systematic instructional strategies in clinical teaching: outcomes in student charting. *Nurse Educator, 11*(6), 29-32.

Fullerton, J. T., & Graveley, E. (1998). Focus on nursing education. Enhancement of basic computer skills: Evaluation of an intervention. *Computers in Nursing, 16*(2), 91-94. Retrieved from http://login.ezproxy.library.ualberta.ca/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=rzh&AN=1998033500&site=ehost-live&scope=site.

Gassert, C. A. (2008). Technology and informatics competencies. *The Nursing Clinics of North America, 43*(4), 507.

Gassert, C. A., & Sward, K. A. (2007). Phase I implementation of an academic medical record for integrating information management competencies into a nursing curriculum. *Studies in Health Technology and Informatics, 129*, 1392-1395.

Glasgow, M. E., & Cornelius, F. H. (2005). Benefits and costs of integrating technology into undergraduate nursing programs. *Nursing Leadership Forum, 9*(4), 175-179.

Goldsworthy, S., Lawrence, N., & Goodman, W. (2006). The use of personal digital assistants at the point of care in an undergraduate-nursing program. *Computers, Informatics, Nursing: CIN, 24*(3), 138-143.

Gracie, D. (2011). Nursing informatics competencies and baccalaureate nursing students. *ANIA-CARING Newsletter, 26*(2), 7-10.

Graves, J. R., & Corcoran Perry, S. (1996). The study of nursing informatics. *Holistic Nursing Practice, 11*(1), 15-24.

Greenfield, S. (2007). Medication error reduction and the use of PDA technology. *Journal of Nursing Education*, 46 (3), 127-131.

Greenfield, S. (2011). Podcasting: A new tool for student retention? *Journal of Nursing Education, 50*(2), 112-114. DOI: 10.3928/01484834-20101230-06

Hart, M. D. (2008). Informatics competency and development within the US nursing population workforce: A systematic literature review. *CIN: Computers, Informatics, Nursing, 26*(6), 320-329.

Hebert, M. (2000). A national education strategy to develop nursing informatics competencies. *Canadian Journal of Nursing Leadership, 13*(2), 11-14. Retrieved from http://login.ezproxy.library.ualberta.ca/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=rzh&AN=2000048512&site=ehost-live&scope=site

Hebda, T., Czar, P., & Mascara, C. (2005). *Handbook of Informatics for Nurses & Healthcare Professionals (*3rd Ed.), NJ: Prentice Hall.

Hilgenberg, C., & Damery, L. (1994). Introduction to an automated hospital information system in baccalaureate education: A pilot project. *Journal of Nursing Education, 33*(8), 378-380.

Hill, J. R., Song, L., & West, R. E. (2009). Social learning theory and web-based learning environments: A review of research and discussion of implications. *American Journal of Distance Education, 23*(2), 88-103. Retrieved from http://www.informaworld.com/openurl?genre=article&id=doi:10.1080/08923640902857713.

HITS pilot a success health informatics training system (2008). *Canadian Nurse, 104*(5), 16-16. Retrieved from http://login.ezproxy.library.ualberta.ca/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=rzh&AN=2009933928&site=ehost-live&scope=site.

Hobbs, S. D. (2002). Measuring nurses' computer competency: An analysis of published instruments. *CIN: Computers, Informatics, Nursing, 20*(2), 63-73.

Hodges, C. B. (2007). Self-efficacy in the context of online learning environments: A review of the literature and directions for research. *Performance Improvement Quarterly, 20*(3), 7-25. DOI: 10.1002/piq.20001

Hutchinson, L. (1999). Evaluating and researching the effectiveness of educational interventions. *BMG*, 318, 1267-1269.

Hrastinski, S. (2008). Asynchronous & synchronous E-learning. *EDUCAUSE Quarterly, 31*(4), 51-55.

Hwang, J., & Park, H. (2011). Factors associated with nurses' informatics competency. *CIN: Computers, Informatics, Nursing, 29*(4), 256-262.

Institute of Medicine (IOM) (2003). *Health professions education: A bridge to quality*: Washington, DC: National Academic Press.

Jacobsen, H. E. & Andendaes, R. (2011). Third year nursing students' understanding of how to find and evaluate information from bibliographic databases and Internet sites. *Nurse Education Today*, 31 (1), 891-903. DOI: 10.1016/j.nedt.2011.01.003.

Jarzemsky, P., Girdley, D., Murray, M.E., & Douglas, S. (2009). Assessment of informatics competencies among nursing students. Retrieved August 7, 2010, from *http://www.qsen.org/definition.php?id=6.*

Jeffries, P. R. (2001). Computer versus lecture: A comparison of two methods of teaching oral medication administration in a nursing skills lab. *Journal of Nursing Education*, 40 (7), 323-329.

Jeffries, P. & Norton, B. (2005) (2nd Ed.). Selecting learning experiences to achieve curriculum outcomes. In D. M, Billing, & J. A. Halstead (Eds). Teaching in nursing: A guide for faculty (pp. 187-212). St Louis, MI: ELSEVIER SAUNDRESS.

Jette, S., Tribble, D. S., Gagnon, J., & Mathieu, L. (2010). Nursing students' perceptions of their resources toward the development of competencies in nursing informatics. *Nurse Education Today, 30*(8), 742-746. DOI: 10.1016/j.nedt.2010.01.016.

Johnston, R., Hepworth, J., Goldsmith, M., & Lacasse, C. (2010). Use of iPod[TM] technology in medical-surgical nursing courses: Effect on grades. *International Journal of Nursing Education Scholarship, 7*(1). DOI: 10.2202/1548-923X.2092

Kaakinen, J. & Arwood, E. (2009). Systematic review of nursing simulation literature for use of learning theory. *International Journal of Nursing Education Scholarship*, 6 (1), 1-20. DOI: 10.2202/1548-923X.1688.

Kenny, A. (2002). Online learning: Enhancing nurse education? *Journal of Advanced Nursing, 38*(2), 127-135. Retrieved from http://login.ezproxy.library.ualberta.ca/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=rzh&AN=2002073697&loginpage=Login.asp&site=ehost-live&scope=site.

Kim, K. & Bonk, C. (2006). The future of online teaching and learning in higher education. *EDUCAUSE Quarterly*, 4, 22-30.

Kilbridge, P. M., & Classen, D. C. (2008). The informatics opportunities at the intersection of patient safety and clinical informatics. *Journal of the American Medical Informatics Association, 15*(4), 397-407. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=rzh&AN=2009977562&loginpage=Login.asp&site=ehost-live&scope=site.

Kinzie, M.B., Delcourt, M.A., & Powers, S.M. (1994). Computer technologies: Attitudes and self-efficacy across undergraduate disciplines. *Research in Higher Education*, 35 (6), 745-768.

Kuiper, R. (2010). Metacognitive factors that impact student nurse use of point of care technology in clinical settings. *International Journal of Nursing Education Scholarship, 7*(1), 15p-15p. DOI: 10.2202/1548-923X.1866.

Laerd Statistics (2012), Accessed at: https://statistics.laerd.com/

Lauder, W., Holland, K., Roxburgh, M., Topping, K., Watson, R., Johnson, M., et al (2008). Measuring competence, self-reported competence, and self-efficacy in pre-registration students. *Nursing Standard*, 22 (20), 35-43.

Liang, J., Wu, S., & Tsai, C. (2011). Nurses' Internet self-efficacy and attitudes toward web-based continuing learning. *Nurse Education Today, 31*(8), 768-773. DOI: 10.1016/j.nedt.2010.11.021.

Loiselle, C. G., Profetto-McGrath, Polit & Beck (2011). *Canadian essentials of nursing research* (3rd Ed.). Philadelphia: Lippincott Williams & Wilkins.

Lucas, L. (2010). Partnering to enhance the nursing curriculum: Electronic medical record accessibility. *Clinical Simulation in Nursing, 6*(3), e97-e102. DOI: 10.1016/j.ecns.2009.07.006.

Madorin, S., & Iwasiw, C. (1999). The effects of computer-assisted instruction on the self-efficacy of baccalaureate nursing students. *Journal of Nursing Education, 38*(6), 282-285. Retrieved from http://login.ezproxy.library.ualberta.ca/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=rzh&AN=1999074316&site=ehost-live&scope=site.

Marini, S. D. (2000). Introduction of nursing informatics in the nursing baccalaureate program at the American university of Beirut. *Computers in Nursing, 18*(5), 240-247.

McAlpine, L. (2004). Designing learning as well as teaching: A research-based model for instruction that emphasizes learner practice. Active Learning in Higher Education, 5 (92), 119-134, DOI: 10.1177/1469787404043809.

McCannon M, Neal PV. Results of a national survey indicating information technology skills needed by nurses at time of entry into the work force. *J Nurs Educ*. 2003; 42:337-340.

McDowell, D. E., & Ma, X. (2007). Computer literacy in baccalaureate nursing students during the last 8 years. *CIN: Computers, Informatics, Nursing, 25*(1), 30-36.

McMullan, M., Jones, R., & Lea, S. (2011). The effect of an interactive e-drug calculations package on nursing students'™ drug calculation ability and self-efficacy. *International Journal of Medical Informatics, 80*(6), 421-430. DOI: 10.1016/j.ijmedinf.2010.10.021.

McNeil, B. J., Elfrink, V., Beyea, S. C., Pierce, S. T., & Bickford, C. J. (2006). Computer literacy study: Report of qualitative findings. *Journal of Professional Nursing, 22*(1), 52-59.

McNeil, B. J., Elfrink, V. L., Pierce, S. T., Beyea, S. C., Bickford, C. J., & Averill, C. (2005). Nursing informatics knowledge and competencies: A national survey of nursing education programs in the United States. *International Journal of Medical Informatics, 74*(11-12), 1021-1030.

McNeil, B. J., & Odom, S. K. (2000). Nursing informatics education in the United States: Proposed undergraduate curriculum. *Health Informatics Journal, 6*(1), 32-38. Retrieved from http://login.ezproxy.library.ualberta.ca/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=rzh&AN=2000049318&site=ehost-live&scope=site.

Melo, D., & Carlton, K. H. (2008). A collaborative model to ensure graduating nurses are ready to use electronic health records. *CIN: Computers Informatics Nursing, 26*(1), 8-12.

Milne, A. J. (2007). Entering the INTERACTION AGE today. *Educause Review, 42*(1), 13-31.

Mitchell, B. (Spring, 2006). Identifying requisite informatics competencies for entry-level practice. *Canadian Journal of Nursing Informatics*, 1 (1). Retrieved from http://cjni.net/Journal_original/volume1_no1_5-5.htm.

Moody, L. E., Slocumb, E., Berg, B., & Jackson, D. (2004). Electronic health records documentation in nursing: Nurses' perceptions, attitudes, and preferences. CIN: *Computers, informatics, nursing*, 22, 337-344.

Moore, A. H., Fowler, S. B., & Watson, C. E. (2007). Designing change. *Educause Review, 42*(5), 42-60. Retrieved from http://login.ezproxy.library.ualberta.ca/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=a9h&AN=26755075&loginpage=Login.asp&site=ehost-live&scope=site.

Munro, B. H. (2005). *Statistical Methods for Health Care Research.* (5th Ed.) Philadelphia: PA: Lippincott Williams & Wilkins.

Myrick, F. (2005). Educating nurses for the knowledge economy. *International Journal of Nursing Education Scholarship, 2*(1), 7p.

Nagle, L. M., & Clarke, H. F. (2004). Assessing informatics in Canadian schools of nursing. *Studies in Health Technology and Informatics, 107*, 912-915. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=cmedm&AN=15360945&loginpage=Login.asp&site=ehost-live&scope=site.

Nayda, R., & Rankin, E. (2008). Information literacy skill development and life long learning: Exploring nursing students' and academics' understandings. *Australian Journal of Advanced Nursing, 26*(2), 27-33.

Ndiwane, A. (2005). Teaching with the nightingale tracker technology in community-based nursing education: A pilot study. *The Journal of Nursing Education, 44*(1), 40-42.

Oblinger, D. G., & Hawkins, B. L. (2006). The myth about student competency. *EDUCAUSE Review, 41*(2), 12-13.

O'Neil, C.A., Fischer, C.A., & Newbold, S.K. (2009). *Developing online learning environments in nursing education* (2nd ed.). New York, NW: Springer Publishing Company, LLC.

Orchard, C., Reid-Haughian, C., & Vanderlee, R. (2006). Health outcomes for better information and care (HOBIC): Integrating patient outcome information into nursing undergraduate curricula. *Canadian Journal of Nursing Leadership, 19*(3), 28-33.

Ornes, L. L., & Gassert, C. (2007). Computer competencies in a BSN program. *Journal of Nursing Education, 46*(2), 75-78.

Pallant, J. (2007). *SPSS Survival Manual (3rd Ed.)*. England, UK: Open University Press McGraw-Hill Education.

Parker, B. C., & Myrick, F. (2009). A critical examination of high-fidelity human patient simulation within the context of nursing pedagogy. *Nurse Education Today, 29*(3), 322-329. DOI: 10.1016/j.nedt.2008.10.012.

Pierce, C. A., Block, R. A., Aguinis, H. (2004). Cautionary note on reporting eta-squared values from multi-factor ANOVA designs. *Educational and Psychological Measurement*, 64 (6), 916-924. DOI: 10.1177/0013164404264848.

Perry, P. E., & King, M. (2009). Course development: Nursing informatics. *Online Journal of Nursing Informatics, 13*(2), 20p-20p. Retrieved from http://login.ezproxy.library.ualberta.ca/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=rzh&AN=2010504657&loginpage=Login.asp&site=ehost-live&scope=site.

Richardson, J.T. (2011). Eta squared and partial eta squared as measures of effect size in educational research. *Educational Research Review*, 6 (1), 135-147. DOI: 10.1016/j.edurev.2010.12.001.

Romyn, D. M., Linton, N., Giblin, C., Hendrickson, B., Limacher, L. H., Murray, C., . . . Zimmel, C. M. (2009). Successful transition of the new graduate nurse. *International Journal of Nursing Education Scholarship, 6*(1), 17p-17p. DOI: 10.2202/1548-923X.1802.

Romanow, R. (2002). Building on Values*: The Future of Health Care in Canada*. Health Canada.

Rose, M. A., Frisby, A. J., Hamlin, M. D., & Jones, S. S. (2000). Evaluation of the effectiveness of a web-based graduate epidemiology course. *Computers in Nursing, 18*(4), 162-167. Retrieved from http://login.ezproxy.library.ualberta.ca/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=rzh&AN=2000061550&site=ehost-live&scope=site.

Rudner, L. M., Schafer, W. D. (2001). Reliability. ERIC Clearinghouse on Assessment, and Evaluation. *ERIC Digest.*

Sackett, K. M., & Scott-Erdley, W. (2002). The history of health care informatics. In S. P. Englebardt, & R. Nelson (Eds). *Health care informatics: An interdisciplinary approach* (pp. 453-477). St. Louis, MO: Mosby.

Skiba, D. J. (2011). Informatics and the learning healthcare system. *Nursing Education Perspectives, 32*(5), 334-336. DOI: 10.5480/1536-5026-32.5.334.

Stamler, L. L., Thomas, B., & McMahon, S. (1999). Nursing students respond to a computer assignment. *Journal of Professional Nursing: Official Journal of the American Association of Colleges of Nursing, 15*(1), 52-58.

Schlairet, M. C. (2010). Efficacy of podcasting: Use in undergraduate and graduate programs in a college of nursing. *Journal of Nursing Education, 49*(9), 529-533. DOI: 10.3928/01484834-20100524-08.

Schmidt, S. M., Arndt, M. J., Gaston, S., & Miller, B. (1991). The effectiveness of computer-managed instruction versus traditional classroom lecture on achievement outcomes. *Computers in Nursing, 9*(4), 159-163.

Shadish, W. R., Cook, T. D., & Campbell, D.T. (2002). *Experimental and Quasi-Experimental Designs for Generalized Causal Inference.* NY: Houghton Mifflin Company.

Staggers, N., Gassert, C. A., & Curran, C. (2001). Informatics competencies for nurses at four levels of practice. *J Nurs Educ*, 40, 303-16.

Staggers, N., Gassert, C., & Curran, C. (2002). A Delphi study to determine informatics competencies for nurses at four levels of practice. *Nursing Research, 51*(6), 383-390.

Thabane, L., Ma, J., Chu, R., Cheng, J., Ismaila, A., Rios, L. P., . . . Goldsmith, C. H. (2010). A tutorial on pilot studies: The what, why and how. *BMC Medical Research Methodology, 10*, 1-10. DOI: 10.1186/1471-2288-10-1.

The voice of nursing informatics and the future of nursing technology informatics guiding education reform (TIGER). (2010). *ANIA-CARING Newsletter, 25*(4), 11-12.

Thompson, C., & Crutchlow, E. (1993). Learning style research: A critical review of the literature and implications for nursing education. *Journal of Professional Nursing, 9*(1), 34-40. DOI: 10.1016/8755-7223(93) 90084-P.

Thompson, B.W. & Skiba, D.J. (2008). Headlines from the NLN. Informatics in the nursing curriculum: A national survey of nursing informatics requirements in nursing curricula. *Nursing Education Perspectives, 29*(5), 312-317. Retrieved from http://login.ezproxy.library.ualberta.ca/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=rzh&AN=2010041332&site=ehost-live&scope=site.

Tsai, C., Chuang, S., Liang, J., & Tsai, M. (2011). Self-efficacy in Internet-based learning environments: A literature review. *Journal of Educational Technology & Society, 14*(4), 222-240.

Travis, L. L., Hudak, C. A., & Brennan, P. F. (1995). Summative evaluation of a baccalaureate nursing informatics curriculum. *Proceedings / the ...Annual Symposium on Computer Application [Sic] in Medical Care. Symposium on Computer Applications in Medical Care,* 484-487.

Vanderbeek, J., & Beery, T. A. (1998). A blueprint for an undergraduate healthcare informatics course. *Nurse Educator, 23*(1), 15-19.

Verhey, M. P. (1999). Information literacy in an undergraduate-nursing curriculum: Development, implementation, and evaluation. *Journal of Nursing Education, 38*(6), 252-259.

Vogt, M., Schaffner, B., Ribar, A., & Chavez, R. (2010). The impact of podcasting on the learning and satisfaction of undergraduate nursing students. *Nurse Education in Practice, 10*(1), 38-42. DOI: 10.1016/j.nepr.2009.03.006.

Wallace, M. C., Shorten, A., & Crookes, P. A. (2000). Teaching information literacy skills: An evaluation. *Nurse Education Today, 20*(6), 485-489.

Yavuz, M. (2006). Computer courses in the undergraduate-nursing curriculum in turkey. *Computers, Informatics, Nursing: CIN, 24*(3), 159-166.

Appendix A

Tutorial 1—Introduction to Health Informatics

Slides: 4 &5

Objective: Describe driving forces behind health informatics development in general and in relation to the Canadian context.

Which of the following factors has been a key driving force for the development of health informatics in Canada?

a. Aging of population.
b. Shortage of nurses.
c. **Lack of quality information.**
d. Confidentiality of data.

Slide 11-14

Objective: Define health informatics

A colleague asks you about the meaning of the term health informatics. Which of the following responses would best describes this term?

a. Health informatics is the use of informatics in the provision of medical care.
b. Health informatics is the use of technology to generate evidence.
c. Health informatics is the use of computers in the delivery of health care.
d. **Health Informatics is the use of informatics to improve patient outcomes**

Slide 15-17

Objective: Describe relevance of informatics to nurses' work.

Which of the following informatics tools is relevant to the practice of nurse administrators?

Tutorial 2—Informatics Tools in Health Care

Slide 4, 9

Objective: Identify informatics applications that nurses can use to support clinical decision-making.

Which of the following is an example of an informatics application that supports nurses' clinical decision making at the point of care:

a. Risk management systems
b. Personal Digital Assistants
c. Tele-health.
d. Quality assurance systems

Slide 5

Objective: Define electronic health records, electronic medical records and personal health records.

Which of the following statements presents an accurate description of an Electronic health record?

a. A health care record that is created by a health care agency and replaces the patient paper record.
b. An institutionally based health care record used to document the patient's encounters with the health care system.
c. **A longitudinal record of patients' health care information that can be accessed by many health care providers.**
d. A record that provides clients with access to their health care information.

Slide 17-22

Objective: Describe ways in which informatics improves nursing documentation

Which of the following facilitates the capture of nursing data in electronic

a. Outcome analysis tools.
b. Reminders and Prompts.
c. Monitoring devices
d. Computerized documentation

Slide 18-19
Objective: Identify key facilitating factors associated with the use of informatics in health care
Which of the following factors has a positive impact on the use of informatics in health care?
a. Cost of technology.
b. Competencies of users.
c. Emergence of new platforms
d. Development of new data bases

Slide 20-24
Objective: Identify informatics competencies at different levels of practice.

Researching the impact of computer technology in nursing is an example of a competency at the:
a. Beginner level.
b. Experienced level.
c. Specialist level.
d. I**nnovator level.**

records?
a. Scheduling systems.
b. Standardized languages.
c. SNOMED CT.
d. None of the above.

Slide 20
Objective: Recognize benefits of computerized data in enhancing nursing visibility.

Computerized data enhances nursing visibility by:
a. Enhancing the efficient delivery of standardized care.
b. Decreasing medication errors.
c. Linking nurses' work to patient outcomes.
d. Minimizing time required for documentation.

Appendix B
Pre-Survey Questionnaire
Effectiveness of Online and Lecture Methods for Teaching Informatics among Undergraduate Nursing Students

Dear participant,
My name is Manal Kleib, a PhD student in the Faculty of Nursing at the University of Alberta working under the supervision of Dr. Karin Olson. My research project aims at comparing the effectiveness of online and lecture formats for teaching health informatics. Findings from this study will help guide decisions related to integration of health informatics in baccalaureate nursing education.

Guidelines for completing the survey:

- By choosing to complete the study surveys, you are indicating your **consent** to participate in this study. There are two surveys in this study: (1) A pre-survey completed before the lecture, and (2) A post survey completed at the end of the lecture. Each survey takes approximately 10 minutes to complete.
- Please **DO NOT use your name, ID, or any other personal identifying information when completing this survey**.
- Your responses will be handled confidentially.

In what year were you born? _____

How do you learn best? ☐ Auditory (By hearing) ☐ Visual (By seeing) ☐ Kinesthetic (By doing)

On a scale of 1 to 5, where 1 = None, and 5 = A lot, how would you rate your previous education in informatics?

1 2 3 4 5

Section B: Self-Efficacy in Relation to Electronic Health Records

Often in our jobs we are told about software packages that are available to make-work easier. For the following questions, imagine that you were given **a new software package such as an electronic health record** for some aspect of your work. It doesn't matter specifically what this software package does, only that it is intended to make your job easier and that you have never used it before. The following questions ask you to indicate whether you could use this unfamiliar software package under a variety of conditions. For each of the conditions, please indicate whether you think you would be able to complete the job using the software package. Then, for each condition that you answered **"yes,"** please rate your confidence about your first judgment, by circling a number from 1 to 10, where **1** indicates "Not at all confident," **5** indicates "Moderately confident," and **10** indicates "Totally confident." ***For example, consider the following sample item:***

		NOT AT ALL CONFIDENT				MODERATELY CONFIDENT					TOTALLY CONFIDENT
If there was someone giving	**Yes** NO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**

me step by step instructions

The sample response that the individual felt he or she could complete the job using the software with step by step instructions (**Yes** is bolded in this example—*please circle when you provide your response)*, and was ***moderately confident*** that he or she could do so (**5** is highlighted/*Please circle when you provide your response).*

			NOT AT ALL CONFIDENT					**MODERATELY CONFIDENT**				**TOTALLY CONFIDENT**
1	…if there was no one around to tell me what to do as I go.	Yes NO	1	2	3	4	5	6	7	8	9	10
2	…if I had never used a package like it before.	Yes NO	1	2	3	4	5	6	7	8	9	10
3	…if I had the software manuals for reference.	Yes NO	1	2	3	4	5	6	7	8	9	10
4	…if I had seen someone else using it before trying it myself.	Yes NO	1	2	3	4	5	6	7	8	9	10
5	…if I could call someone for help if I got stuck.	Yes NO	1	2	3	4	5	6	7	8	9	10
6	…if someone else had helped me get started.	Yes NO	1	2	3	4	5	6	7	8	9	10
7	…if I had a lot of time to complete the job for which the software was provided.	Yes NO	1	2	3	4	5	6	7	8	9	10
8	…if I had just the built-in help facility for assistance.	Yes NO	1	2	3	4	5	6	7	8	9	10
9	…if someone showed me how to do it first.	Yes NO	1	2	3	4	5	6	7	8	9	10
10	…if I had used similar packages before this one to do the same job.	Yes NO	1	2	3	4	5	6	7	8	9	10

Section C: Attitudes towards Electronic Health Records

In this section, ***where 1= Strongly Disagree (SD) and 5 = Strongly Agree*** **(SA)** please indicate whether you agree or disagree with the following statements by circling the appropriate number:

		SD				***SA***
11	Use of electronic health records is more of help than a hindrance to patient care.	1	2	3	4	5

12	Use of computerized charting has helped to improve documentation of the clinical record.	1	2	3	4	5
13	Electronic health records pose less threat to the patient's privacy than do paper records.	1	2	3	4	5
14	Computerized charting has decreased the workload of nurses and other personnel.	1	2	3	4	5
15	In time, the use of electronic health records will lead to improved patient care.	1	2	3	4	5

Section D: Perceived Knowledge in Relation to Informatics Competence

This set of questions describes ways that nurses relate to information technology at work. On a scale of **1 to 5** where **1 = none, 5 = very much**, please rate your **KNOWLEDGE** (theory and concepts) of the following informatics competencies.

		None				**Very much**
		1	**2**	**3**	**4**	**5**
16	Knowledge of computer applications for administration Example: Patient acuity classification systems					
17	Knowledge of computer applications for communication Examples: Email, Internet					
18	Knowledge of computer applications for data access Example: Local clinical information systems (Intranet systems)					
19	Knowledge of computer applications for documentation Example: Hospital system for documenting patient data, assessments, interventions, plan of care and discharge planning Examples: (NetCare, Health Link)					
20	Knowledge of computer applications for education Examples: On-line literature searches; PDA resources; patient education					
21	Knowledge of computer applications for patient monitoring Examples: Automated BP, pulse oximetry, telemetry					
22	Knowledge of computer applications for basic desktop software Examples: Keyboarding, word processing, printing, Power point presentation skills					
23	Knowledge of current peripheral devices used in patient care Examples: Hand-held i.e. PDA (med administration; blood glucose meters); bedside computer terminals					
24	Informatics knowledge: Data Examples: Recognizes ways that nursing data can be used to improve practice					
25	Informatics knowledge: Impact Example: Recognizes benefits and limitations of computer use in health care					

26	Informatics knowledge: Privacy/security Examples: Recognizes patients' rights related to computerized health information					
27	Informatics knowledge: Systems Examples: Recognizes value of clinician involvement in design, selection, implementation and evaluation of computer applications					

Section E: Knowledge in Relation to Content Delivered in this Intervention Study

28. Which of the following factors has been a key driving force for the development of health informatics in Canada?
    a. Aging of population.
    b. Shortage of nurses.
    c. Lack of quality information.
    d. Confidentiality of data.
29. A colleague asks you about the meaning of the term health informatics. Which of the following responses would best describes this term?
    a. Health informatics is the use of informatics in the provision of medical care.
    b. Health informatics is the use of technology to generate evidence.
    c. Health informatics is the use of computers in the delivery of health care.
    d. Health Informatics is the use of informatics to improve patient outcomes.
30. Which of the following informatics tools is relevant to the practice of nurse administrators?
    a. Outcome analysis tools.
    b. Reminders and Prompts.
    c. Monitoring devices.
    d. Computerized documentation.
31. Which of the following factors has a positive impact on the use of informatics in health care?
    a. Cost of technology.
    b. Competencies of users.
    c. Emergence of new platforms.
    d. Development of new databases.
32. Researching the impact of computer technology in nursing is an example of a competency at the:
    a. Beginner level.
    b. Experienced level.
    c. Specialist level.
    d. Innovator level.

End of Survey

Appendix C
Post-Survey Questionnaire

Effectiveness of Online and Lecture Methods for Teaching Informatics among Undergraduate Nursing Students

Section B: Self-Efficacy in Relation to Electronic Health Records

Often in our jobs we are told about software packages that are available to make-work easier. For the following questions, imagine that you were given **a new software package such as an electronic health record** for some aspect of your work. It doesn't matter specifically what this software package does, only that it is intended to make your job easier and that you have never used it before. The following questions ask you to indicate whether you could use this unfamiliar software package under a variety of conditions. For each of the conditions, please indicate whether you think you would be able to complete the job using the software package. Then, for each condition that you answered **"yes,"** please rate your confidence about your first judgment, by circling a number from 1 to 10, where **1** indicates "Not at all confident," **5** indicates "Moderately confident," and **10** indicates "Totally confident." ***For example, consider the following sample item:***

		NOT AT ALL CONFIDENT				MODERATELY CONFIDENT					TOTALLY CONFIDENT
If there was someone giving me step by step instructions	**Yes** NO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**

The sample response that the individual felt he or she could complete the job using the software with step by step instructions (**Yes** is bolded in this example—*please circle when you provide your response)*, and was ***moderately confident*** that he or she could do so (**5** is highlighted/*Please circle when you provide your response)*.

			NOT AT ALL CONFIDENT			MODERATELY CONFIDENT					TOTALLY CONFIDENT
1	…if there was no one around to tell me what to do as I go.	Yes NO	1	2	3	4	5	6	7	8	9	10
2	…if I had never used a package like it before.	Yes NO	1	2	3	4	5	6	7	8	9	10
3	…if I had the software manuals for reference.	Yes NO	1	2	3	4	5	6	7	8	9	10
4	…if I had seen someone else using it before trying it myself.	Yes NO	1	2	3	4	5	6	7	8	9	10

5	…if I could call someone for help if I got stuck.	Yes NO	1	2	3	4	5	6	7	8	9	10
6	…if someone else had helped me get started.	Yes NO	1	2	3	4	5	6	7	8	9	10
7	…if I had a lot of time to complete the job for which the software was provided.	Yes NO	1	2	3	4	5	6	7	8	9	10
8	…if I had just the built-in help facility for assistance.	Yes NO	1	2	3	4	5	6	7	8	9	10
9	…if someone showed me how to do it first.	Yes NO	1	2	3	4	5	6	7	8	9	10
10	…if I had used similar packages before this one to do the same job.	Yes NO	1	2	3	4	5	6	7	8	9	10

Section C: Attitudes towards Electronic Health Records

In this section, ***where 1= Strongly Disagree (SD) and 5 = Strongly Agree*** **(SA)** please indicate whether you agree or disagree with the following statements by circling the appropriate number:

		SD				***SA***
11	Use of electronic health records is more of help than a hindrance to patient care.	1	2	3	4	5
12	Use of computerized charting has helped to improve documentation of the clinical record.	1	2	3	4	5
13	Electronic health records pose less threat to the patient's privacy than do paper records.	1	2	3	4	5
14	Computerized charting has decreased the workload of nurses and other personnel.	1	2	3	4	5
15	In time, the use of electronic health records will lead to improved patient care.	1	2	3	4	5

Section D: Perceived Knowledge in Relation to Informatics Competence

This set of questions describes ways that nurses relate to information technology at work. On a scale of **1 to 5** where **1 = none, 5 = very much**, please rate your **KNOWLEDGE** (theory and concepts) of the following informatics competencies.

		None				**Very much**
		1	**2**	**3**	**4**	**5**
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21	Knowledge of computer applications for patient monitoring Examples: Automated BP, pulse oximetry, telemetry					
22	Knowledge of computer applications for basic desktop software Examples: Keyboarding, word processing, printing, Power point presentation skills					
23	Knowledge of current peripheral devices used in patient care Examples: Hand-held i.e. PDA (med administration; blood glucose meters); bedside computer terminals					
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Section E: Knowledge in Relation to Content Delivered in this Intervention Study

33. Which of the following factors has been a key driving force for the development of health informatics in Canada?
    a. Aging of population.
    b. Shortage of nurses.
    c. Lack of quality information.

d. Confidentiality of data.

34. A colleague asks you about the meaning of the term health informatics. Which of the following responses would best describes this term?
    a. Health informatics is the use of informatics in the provision of medical care.
    b. Health informatics is the use of technology to generate evidence.
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    a. Cost of technology.
    b. Competencies of users.
    c. Emergence of new platforms.
    d. Development of new databases.
37. Researching the impact of computer technology in nursing is an example of a competency at the:
    a. Beginner level.
    b. Experienced level.
    c. Specialist level.
    d. Innovator level

We would like you to share your thoughts with us…

Given that you have completed this learning unit, we would like to know your thoughts about whether you found the information presented useful and whether it increased your knowledge in this area.

Thank you for participating in this study.

Study Instrument (Pre Survey—Module 2) Pilot Phase
Effectiveness of Online and Lecture Methods for Teaching Informatics among Undergraduate Nursing Students

Dear participant,
My name is Manal Kleib, a PhD student in the Faculty of Nursing at the University of Alberta working under the supervision of Dr. Karin Olson. My research project aims at comparing the effectiveness of online and lecture formats for teaching health informatics. Findings from this study will help guide decisions related to integration of health informatics in baccalaureate nursing education.

Guidelines for completing the survey:

- By choosing to complete the study surveys, you are indicating your **consent** to participate in this study. There are two surveys in this study: (1) A pre-survey completed before the lecture, and (2) A post survey completed at the end of the lecture. Each survey takes approximately 10 minutes to complete.
- Please **DO NOT use your name, ID, or any other personal identifying information when completing this survey**.
- Your responses will be handled confidentially.

Section A: Demographic Information

In what year were you born? _____

How do you learn best? ☐ Auditory (By hearing) ☐ Visual (By seeing) ☐ Kinesthetic (By doing)

On a scale of 1 to 5, where 1 = None, and 5 = A lot, how would you rate your previous education in informatics?

1 2 3 4 5

Section B: Self-Efficacy in Relation to Electronic Health Records

Often in our jobs we are told about software packages that are available to make-work easier. For the following questions, imagine that you were given **a new software package such as an electronic health record** for some aspect of your work. It doesn't matter specifically what this software package does, only that it is intended to make your job easier and that you have never used it before. The following questions ask you to indicate whether you could use this unfamiliar software package under a variety of conditions. For each of the conditions, please indicate whether you think you would be able to complete the job using the software package. Then, for each condition that you answered **"yes,"** please rate your confidence about your first judgment, by circling a number from 1 to 10, where **1** indicates "Not at all confident," **5** indicates "Moderately confident," and **10** indicates "Totally confident."

Example:

		NOT AT ALL CONFIDENT			MODERATELY CONFIDENT				TOTALLY CONFIDENT		
If there was	**Yes**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**

someone giving me step by step instructions	NO	

In the above example, the sample response that <u>the individual felt he or she could complete the job using the software with step by step instructions (Yes is bolded in this example—*please circle when you provide your response)*</u>, and was <u>*moderately confident*</u> that he or she could do so (5 is highlighted/*Please circle when you provide your response).*

			NOT AT ALL CONFIDENT					MODERATELY CONFIDENT				TOTALLY CONFIDENT
1	…if there was no one around to tell me what to do as I go.	Yes NO	1	2	3	4	5	6	7	8	9	10
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3	…if I had the software manuals for reference.	Yes NO	1	2	3	4	5	6	7	8	9	10
4	…if I had seen someone else using it before trying it myself.	Yes NO	1	2	3	4	5	6	7	8	9	10
5	…if I could call someone for help if I got stuck.	Yes NO	1	2	3	4	5	6	7	8	9	10
6	…if someone else had helped me get started.	Yes NO	1	2	3	4	5	6	7	8	9	10
7	…if I had a lot of time to complete the job for which the software was provided.	Yes NO	1	2	3	4	5	6	7	8	9	10
8	…if I had just the built-in help facility for assistance.	Yes NO	1	2	3	4	5	6	7	8	9	10
9	…if someone showed me how to do it first.	Yes NO	1	2	3	4	5	6	7	8	9	10
10	…if I had used similar packages before this one to do the same job.	Yes NO	1	2	3	4	5	6	7	8	9	10

Section C: Attitudes towards Electronic Health Records

In this section, ***where 1= Strongly Disagree (SD) and 5 = Strongly Agree*** **(SA)** please indicate

whether you agree or disagree with the following statements by circling the appropriate number:

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14	Computerized charting has decreased the workload of nurses and other personnel.	1	2	3	4	5
15	In time, the use of electronic health records will lead to improved patient care.	1	2	3	4	5

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This set of questions describes ways that nurses relate to information technology at work. On a scale of **1 to 5** where **1 = none, 5 = very much**, please rate your **KNOWLEDGE** (theory and concepts) of the following informatics competencies.

		None				**Very much**
		1	**2**	**3**	**4**	**5**
16	Knowledge of computer applications for administration Example: Patient acuity classification systems					
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21	Knowledge of computer applications for patient monitoring Examples: Automated BP, pulse oximetry, telemetry					
22	Knowledge of computer applications for basic desktop software Examples: Keyboarding, word processing, printing, Power point presentation skills					
23	Knowledge of current peripheral devices used in patient care					

	Examples: Hand-held i.e. PDA (med administration; blood glucose meters); bedside computer terminals					
24	Informatics knowledge: Data Examples: Recognizes ways that nursing data can be used to improve practice					
25	Informatics knowledge: Impact Example: Recognizes benefits and limitations of computer use in health care					
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27	Informatics knowledge: Systems Examples: Recognizes value of clinician involvement in design, selection, implementation and evaluation of computer applications					

Section E: Knowledge in Relation to Content Delivered in this Intervention Study

28. Which of the following is an example of an informatics application that supports nurses' clinical decision making at the point of care:
    a. Risk management systems.
    b. Personal Digital Assistants.
    c. Tele-health.
    d. Quality assurance systems.

29. Which of the following statements presents an accurate description of an Electronic health record?
    a. A health care record that is created by a health care agency and replaces the patient paper record.
    b. An institutionally based health care record used to document the patient's encounters with the health care system.
    c. A longitudinal record of patients' health care information that can be accessed by many health care providers.
    d. A record that provides clients with access to their health care information.

30. Which of the following facilitates the capture of nursing data in electronic records?
    a. Scheduling systems.
    b. Standardized languages.
    c. SNOMED CT.
    d. Hand-held devices.

31. Computerized data enhances nursing visibility by:

a. Enhancing the efficient delivery of standardized care.
b. Decreasing medication errors.
c. Linking nurses' work to patient outcomes.
d. Minimizing time required for documentation.

End of Survey

Study Instrument (Post Survey—Module 2) Pilot Phase
Effectiveness of Online and Lecture Methods for Teaching Informatics among Undergraduate Nursing Students

Section B: Self-Efficacy in Relation to Electronic Health Records

Often in our jobs we are told about software packages that are available to make-work easier. For the following questions, imagine that you were given **a new software package such as an electronic health record** for some aspect of your work. It doesn't matter specifically what this software package does, only that it is intended to make your job easier and that you have never used it before. The following questions ask you to indicate whether you could use this unfamiliar software package under a variety of conditions. For each of the conditions, please indicate whether you think you would be able to complete the job using the software package. Then, for each condition that you answered **"yes,"** please rate your confidence about your first judgment, by circling a number from 1 to 10, where **1** indicates "Not at all confident," **5** indicates "Moderately confident," and **10** indicates "Totally confident."

Example:

		NOT AT ALL CONFIDENT				MODERATELY CONFIDENT					TOTALLY CONFIDENT
If there was someone giving me step by step instructions	**Yes** NO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**

In the above example, the sample response that the individual felt he or she could complete the job using the software with step by step instructions (Yes is bolded in this example—*please circle when you provide your response)*, and was *moderately confident* that he or she could do so (5 is highlighted/*Please circle when you provide your response).*

			NOT AT ALL CONFIDENT				MODERATELY CONFIDENT				TOTALLY CONFIDENT
1	…if there was no one around to tell me what to do as I go.	Yes NO	1	2	3	4	5	6	7	8	9	10
2	…if I had never used a package like it before.	Yes NO	1	2	3	4	5	6	7	8	9	10
3	…if I had the software manuals for reference.	Yes NO	1	2	3	4	5	6	7	8	9	10
4	…if I had seen someone else using it before trying it myself.	Yes NO	1	2	3	4	5	6	7	8	9	10

5	…if I could call someone for help if I got stuck.	Yes NO	1	2	3	4	5	6	7	8	9	10
6	…if someone else had helped me get started.	Yes NO	1	2	3	4	5	6	7	8	9	10
7	…if I had a lot of time to complete the job for which the software was provided.	Yes NO	1	2	3	4	5	6	7	8	9	10
8	…if I had just the built-in help facility for assistance.	Yes NO	1	2	3	4	5	6	7	8	9	10
9	…if someone showed me how to do it first.	Yes NO	1	2	3	4	5	6	7	8	9	10
10	…if I had used similar packages before this one to do the same job.	Yes NO	1	2	3	4	5	6	7	8	9	10

Section C: Attitudes towards Electronic Health Records

In this section, ***where 1= Strongly Disagree (SD) and 5 = Strongly Agree*** **(SA)** please indicate whether you agree or disagree with the following statements by circling the appropriate number:

		SD				***SA***
11	Use of electronic health records is more of help than a hindrance to patient care.	1	2	3	4	5
12	Use of computerized charting has helped to improve documentation of the clinical record.	1	2	3	4	5
13	Electronic health records pose less threat to the patient's privacy than do paper records.	1	2	3	4	5
14	Computerized charting has decreased the workload of nurses and other personnel.	1	2	3	4	5
15	In time, the use of electronic health records will lead to improved patient care.	1	2	3	4	5

Section D: Perceived Knowledge in Relation to Informatics Competence

This set of questions describes ways that nurses relate to information technology at work. On a scale of **1 to 5** where **1 = none, 5 = very much**, please rate your **KNOWLEDGE** (theory and concepts) of the following informatics competencies.

		None				**Very much**
		1	**2**	**3**	**4**	**5**
16	Knowledge of computer applications for administration Example: Patient acuity classification systems					

17	Knowledge of computer applications for communication Examples: Email, Internet					
18	Knowledge of computer applications for data access Example: Local clinical information systems (Intranet systems)					
19	Knowledge of computer applications for documentation Example: Hospital system for documenting patient data, assessments, interventions, plan of care and discharge planning Examples: (NetCare, Health Link)					
20	Knowledge of computer applications for education Examples: On-line literature searches; PDA resources; patient education					
21	Knowledge of computer applications for patient monitoring Examples: Automated BP, pulse oximetry, telemetry					
22	Knowledge of computer applications for basic desktop software Examples: Keyboarding, word processing, printing, Power point presentation skills					
23	Knowledge of current peripheral devices used in patient care Examples: Hand-held i.e. PDA (med administration; blood glucose meters); bedside computer terminals					
24	Informatics knowledge: Data Examples: Recognizes ways that nursing data can be used to improve practice					
25	Informatics knowledge: Impact Example: Recognizes benefits and limitations of computer use in health care					
26	Informatics knowledge: Privacy/security Examples: Recognizes patients' rights related to computerized health information					
27	Informatics knowledge: Systems Examples: Recognizes value of clinician involvement in design, selection, implementation and evaluation of computer applications					

Section E: Knowledge in Relation to Content Delivered in this Intervention Study

32. Which of the following is an example of an informatics application that supports nurses' clinical decision making at the point of care:
    a. Risk management systems.
    b. Personal Digital Assistants.

c. Tele-health.
d. Quality assurance systems.

33. Which of the following statements presents an accurate description of an Electronic health record?
    a. A health care record that is created by a health care agency and replaces the patient paper record.
    b. An institutionally based health care record used to document the patient's encounters with the health care system.
    c. A longitudinal record of patients' health care information that can be accessed by many health care providers.
    d. A record that provides clients with access to their health care information.

34. Which of the following facilitates the capture of nursing data in electronic records?
    a. Scheduling systems.
    b. Standardized languages.
    c. SNOMED CT.
    d. Hand-held devices.

35. Computerized data enhances nursing visibility by:
    a. Enhancing the efficient delivery of standardized care.
    b. Decreasing medication errors.
    c. Linking nurses' work to patient outcomes.
    d. Minimizing time required for documentation.

Given that you have completed this learning unit, we would like to know your thoughts about whether you found the information presented useful and whether it increased your knowledge in this area.

What areas can you suggest for improvement in this learning unit?

Thank you for participating in this study.

Appendix D

Post Data Collection Feedback Survey

Dear Student,

Recently, a research group has piloted two modules about Health Informatics among 4th year students in the Collaborative program at the Faculty of Nursing. For those who have had the chance to participate in the study, we hope that you have found the educational opportunity useful to your learning and for those who have not participated yet, we hope that you consider taking few minutes to view the modules and resource list before the modules close on Dec. 19th.

As we are moving ahead with our planning for the full study, we would like to seek your input on some aspects related to this experience. Your feedback is invaluable to us and would help us improve our plans for the actual study design and recruitment.

We have provided a set of questions in the attached word document. If you would like to respond to these questions, please download the file, complete the questions, and send back to Mr. Adam Henley, the research assistant for this study, at adhenley@gmail.com. Mr. Henley will remove all identifying information and send your comments for the research team.

1. Did you participate in the pilot study?
   _____ Yes, both modules
   _____ No, one module
   _____ No

   If yes, please indicate whether you were in N490 or N491 by putting an x on the appropriate line below:
   _____ N490 (face-to-face format)
   _____ N491 (online format)

2. Please put an x in front of any items below that you think may have limited the number of students who participated in the study. Any additional comments you would like to make are most welcome.

   _____ Timing of the pilot (during N490 and N491
   _____ Content of the questionnaires
   _____ Length of the questionnaires
   _____ Content of the module
   _____ Pre-post design
   _____ Skills and knowledge of the guest speaker
   _____ Relevance of the modules to learning needs and professional practice
   _____ Technical issues that you experienced in the online learning module
   Other factors, please specify: _____

3. How do you think we could enhance the participation rate of students when we conduct the full study?

4. Do you think the participation rate would have been higher if we conducted the study with students in second or third year instead of fourth year?
   _____Yes
   _____ No
   _____Not sure

Appendix E

Administrative Approvals

Permission to Access Study Participants: Administrative Approval

August 30, 2010
Vice Dean
Dr. Joanne Profetto-McGrath
Faculty of Nursing
University of Alberta

Dear Dr. Profetto-McGrath,

I am requesting approval to conduct a research study as part of my PhD degree in the Faculty of at the University of Alberta, under the supervision of Dr. Anne Sales. The title of my research project is "**Health Informatics in Baccalaureate Nursing Education: Effectiveness of Lecture vs. Online Learning."** The purpose of my study is to compare the effectiveness of online and lecture methods in achieving learning outcomes related to health informatics education. Outcomes measured in this study include: Actual knowledge gained, perceived level of informatics competence at a beginner level, attitudes towards electronic health record (EHR), and perceived level of self-efficacy in using the EHR.

The proposed educational intervention is a learning unit about clinical information management systems that was originally developed and piloted in the Faculty of Medicine and Dentistry at the University of Alberta in 2007 and has been adapted to address learning needs of nursing students. Because the use of clinical information management systems is very relevant to nurses' work, I would like to test the effectiveness of this learning unit among nursing students in the undergraduate nursing programs.

There are two arms in this intervention, a face-to-face lecture and an online self-learning tutorial. An introductory content is provided in both arms; then the content is divided into two learning units, where each covers a specialized content. The online arm covers content related to informatics applications used in health care, whereas the lecture arm covers content related to documentation. Effectiveness of either modality of education (lecture vs. online) is not clearly demonstrated; therefore equipoise is assumed between groups. Both groups of students will receive education in both modalities through a crossover design assuring that there will be no adverse effect on any student's ability to learn the material.

This research would benefit nursing graduates because it will help them incrementally build an integrated user experience about multidisciplinary point of care technology and its role in supporting patient care as well as prepare them to use it competently and safely. Indeed, this intervention is timely as it coincides with Alberta's vision to institute EHRs in the province.

The research would require a sample of about128 nursing students. In order to benefit the largest number of students and to enhance generalizability of findings, the sample recruitment will target 4th year level students from the Collaborative, ADP, and Bilingual programs. Students at this level of study would have accumulated necessary

theoretical and clinical nursing knowledge that would enable them to integrate concepts related to informatics knowledge and its applications in health care. In the delivery of intervention, students registering in NURS 490 & NURS 491 courses in the Collaborative program will be able to receive the lecture & online tutorial because both arms of the intervention can be offered within regular course teaching time with minimal disruption to students' learning. However, students in the ADP and Bilingual programs will be able to receive the online arm of the intervention only due to lack of availability of FRS in courses offered during the fall term in these two programs. Consent to participate in the study is implied by completion of pre and post survey assessments. Students who agree to participate in the study will be asked to complete a pre and post intervention survey.

I am seeking permission to contact 4th year nursing students in the Collaborative, ADP, and Bilingual programs to invite them to participate in the study. The recruitment will take place through appropriate channels and as per the directions of the Faculty of Nursing. Confidentiality will be strictly maintained. No name or identifying information will be written on any of the data collection forms. All data will be kept in a secured location, the FON data repository with researcher access only.

Being a faculty member at the research site and a lead investigator in this project, I would like to assure you that this potential conflict of interest would be addressed through minimizing researcher's contact with participants. This includes measures such as inviting a guest speaker to deliver the lecture portion of the study, and the use of support staff in the collection and coding of research data. Hence, I would like to request assistance from the Faculty of Nursing in releasing two support staff for a total of 8 hours each to assist in the delivery of this intervention—Two hours are used for data collection/one hour for each teaching block, four hours for coding of online surveys, and 2 hours for orientation.

The study findings will provide the Faculty with evidence on the effectiveness of these two approaches in achieving learning outcomes about informatics. This information may help in guiding the planning and possible integration of informatics education in future baccalaureate-nursing education. Results of the study will be presented at research conferences and in nursing journals.

If it is possible, I would like to schedule an appointment with you so that we can discuss the possibility of conducting this research in the Faculty of Nursing. *However, in the meantime* and *while awaiting the approval of the Faculty of Nursing, I would like to request permission to proceed with contacting the administrative team at the Camrose/Augustana site for the purpose of conducting the pilot phase of the study. The pilot should be completed by the third week of September so that its findings can be used to refine the intervention before fully rolling it out, once approved, in the 5th week of September as per the proposed study timelines. The study protocol has been submitted for an expedited review on August 27th 2010.*

Sincerely,

Administrative Approval Letter for Phase 1—Pilot Study

September 21, 2010
Ms. Manal Kleib
PhD Student
Faculty of Nursing, UofA

Re: Health Informatics in Baccalaureate Nursing Education: Effectiveness of Lecture vs. Online Learning
Approaches

Dear Manal:
Thank you for submitting your proposal for review and for your interest in conducting your doctoral research with Year 4 students at the Faculty of Nursing, University of Alberta. I also thank you and your supervisor, Dr. Karin Olson, for meeting with me this morning to discuss your proposal and to answer my questions. I am pleased to inform you that you have approval to carry out Phase One (Pilot) of your study with N490 students (2 Fixed Resource Sessions) and N491 students (Online module) re informatics during 6W2.
This approval is subject to the following conditions:
You receive ethical approval for your study by the Ethics Review Board and provide my office with a copy of the approval. You apprise Sue Gauthier, Year 4 coordinator, and course leads re the nature of the study and the process to access students for the purpose of your study.
I look forward to meeting with you and Dr. Karin Olson early in 2011 to discuss plans for Phase two of the study which is anticipated to take place with N490 and N491 students in Spring or Fall term 2011.
If you have any questions please feel free to call me at (780) 492-1597 or email me at joanne.profettomcgrath@ualberta.ca. Best wishes with your research study.

Sincerely,
Joanne Profetto-McGrath PhD, RN
Vice Dean & Professor

cc.: Karin Olson, PhD, RN – Doctoral Supervisor
Sue Gauthier, MN, RN – Year 4 Collaborative BScN Program Coordinator
Barb Steeves, MN, RN – N491 Course Lead
Joanne Olson, PhD, RN – Associate Dean Undergraduate Programs
Kaysi Kushner, PhD, RN – Assistant Dean Undergraduate Programs

Administrative Approval Letter—Main Study

June 20, 2011

Ms. Manal Kleib
PhD Student
Faculty of Nursing, UofA
Re: Health Informatics in Baccalaureate Nursing Education: Effectiveness of Face to Face vs. Online Learning Approaches

Dear Manal:
Thank you for submitting the information and Student Information Sheet relevant to Phase 2 of your doctoral research with Year 3 an 4th year students in the Collaborative, AD, and Bilingual programs at the Faculty of Nursing, University of Alberta during September – October 2011. This approval is subject to the following conditions:
You have ongoing ethical approval for your study provided by the Ethics Review Board.
You keep relevant coordinators and course leads appraised of the study as you proceed.
Your study activities take place outside program schedules and do not interfere with student participants' course schedules.

If you have any questions please feel free to call me at (780) 492-1597 or email me at joanne.profetto-mcgrath@ualberta.ca. Best wishes with your research study.

Sincerely,
Joanne Profetto-McGrath PhD, RN
Vice Dean & Professor

cc.: Karin Olson, PhD, RN – Doctoral Supervisor
Deidre Jackman, PhD Candidate, RN – Year 2 AD BScN Program Coordinator
Phyllis Castelein, MN, RN – Bilingual BScN Program Coordinator
Deanna McFayden, MEd, RN – Year 3 Collaborative BScN Program Coordinator
Sue Gauthier, MN, RN – Year 4 Collaborative BScN Program Coordinator
Kaysi Kushner, PhD, RN – Associate Dean Undergraduate Programs
Carolyn Ross, PhD, RN – Assistant Dean Undergraduate Programs

FACULTY OF
NURSING
UNIVERSITY OF ALBERTA

Certificate of Completion

Health Informatics in Nursing Practice

Beginner Level

Two Contact Hours

Type In Student's Name Here, Save, And Send As Pdf Via E-Mail

January/February, 2012

Manal Kleib, MSN, MBA, PhD (c), RN

Karin Olson, PhD, RN

Appendix G
Confidentiality Agreement

FACULTY OF NURSING
UNIVERSITY OF ALBERTA

Confidentiality Agreement

Date: 09/01/2010

Research Project: Health Informatics in Baccalaureate Nursing Education: Effectiveness of Face-to-Face vs. Online Learning Approaches

I understand that as a research assistant involved in this study conducted by Manal Kleib, a PhD student at the Faculty of Nursing, University of Alberta under the supervision of Dr. Karin Olson, I am privy to confidential information. I agree to keep all data collected during this study confidential and will not reveal it to anyone outside the research team.

Research Assistant:
Adam Henley, BSN
Faculty of Nursing, University of Alberta, Canada
Signature:

Research Assistant:
Brettany Johnson, MLIS
Faculty of Medicine & Dentistry, University of Alberta, Canada
Signature:

Appendix J—Learning Activities

Learning Activities—Face-to-Face Session & Online Module

Activity	**Self-Assessment Informatics Competence for a Beginning Nurse**
Learning Outcome	Reflect on personal level of competence using a self-assessment scale.
Activity Time	**10 minutes**

This set of questions describes ways that nurses relate to information technology at work. On a scale of **1 to 5** where **1 = none, 5 = very much**, rate your level of competence by placing the mark (√) in the box that best reflects your level of knowledge about each aspect of competence.

		None				**Very much**
		1	**2**	**3**	**4**	**5**
Computer Skills—Knowledge of Computer Applications for:						
1	**Administration** Example: Patient acuity classification systems					
2	**Communication** Examples: Email, Internet					
3	**Data access** Example: Local clinical information systems (Intranet systems)					
4	**Documentation** Example: Hospital system for documenting patient data, assessments, interventions, plan of care and discharge planning Examples: (NetCare, Health Link)					
5	**Education** Examples: On-line literature searches; PDA resources; patient education					
6	**Patient monitoring** Examples: Automated BP, pulse oximetry, telemetry					
7	**Basic desktop software** Examples: Keyboarding, word processing, printing, Power point presentation skills					
8	**Current peripheral devices used in patient care** Examples: Hand-held i.e. PDA (med administration; blood glucose meters); bedside computer terminals					
Informatics Knowledge:						
9	**Data** Example: Recognizes ways that nursing data can be used to improve practice					
10	**Impact** Example: Recognizes benefits and limitations of computer use in health care					
11	**Privacy/security**					

	Example: Recognizes patients' rights related to computerized health information					
12	**Systems** Example: Recognizes value of clinician involvement in design, selection, implementation and evaluation of computer applications					

Activity	Providing health education using best practice guidelines
Learning Outcomes	1. Value the role of information literacy in advancing clinical practice of the Registered Nurse. 2. Select credible sources for retrieving evidence-based information and best-practice guidelines.
	**30 minutes (**20 minutes to work on the topic and 10 minutes for presentation of the findings).

One of your clients has been diagnosed with **Asthma**. The client is requesting additional information about this condition, but reference books on the unit describe this condition very briefly. You decide to prepare a health education plan for your client about **the symptoms of asthma, causes and triggers, & things he/she could do to control the disease** based on the best available evidence, but you are not sure where to start!

Check this reading first!

1. **Making Best Practice Guidelines a Reality available at: http://www.cna-aiic.ca/CNA/issues/now/default_e.aspx?y=2004**
2. **http://www.cna-aiic.ca/CNA/practice/standards/bestpractice/default_e.aspx**

Take a peek!
http://www.cna-aiic.ca/CNA/practice/family/evidence/default_e.aspx

Hint!
The resource page has additional sources on evidence-based practice & best practice guidelines.

Response:

Activity	**Electronic health records**
Learning Outcome	Understand nurses' role in relation to electronic health records.
	**25 minutes** (15 minutes to do the activity and 10 minutes for presentation of findings).

1. Access the website: http://www.cche.net/f2fworkshop
2. Click on the resource link to access the following resource:
   Demystifying the Electronic Health Record available at:
http://www.cna-aiic.ca/CNA/issues/now/default_e.aspx?y=2002

Learning Tasks:

Q.1 Identify three benefits for using electronic health records

Q.2 Identify three challenges/concerns associated with the use of electronic records.

Activity	**Reflection on Personal Experiences with Technology**
Learning Outcome	Reflect on personal experiences with using technology applications in the clinical setting.
	**20 minutes** (10 minutes to work on the activity and 10 minutes to present the findings).

1. **What have been your observations about the use of technology in the clinical setting?**

2. **How do you feel about your readiness and preparedness to work with these technologies competently upon graduation?**

3. **If you were to improve overall learning experiences with technology, what would you recommend?**

Activity	**Adoption of health care technology & change management strategies**
Learning Outcomes	**1.** Examine significant issues affecting the adoption of health care technology. **2.** Identify strategies that can facilitate adoption of health care technology.
Activity Time	**10 minutes**

A health care organization is planning to implement the **Bar Code Medication Administration System (BCMA)** on all surgical units. The BCMA is a scanning technology that allows comparison of the medication being administered with what was ordered for the patient. Use of this technology enhances patient safety by improving communication regarding medication administration processes, allowing multiple users to access medication administration information, and improving documentation of all aspects of the process. The technology will become available on the unit at the end of the year but the staff including physicians and nurses are quite restless about this change and feel it would disrupt patient care.

Q. 1. Based on the above scenario, which of the following responses would suggest a potential barrier to the adoption of this technology that you may encounter during the implementation of this technology. ***(Select all that apply)***

- *I'd rather spend my time with patients rather than this machine!*
- I am not worried about using this technology; I have attended two hours of training about it.
- I don't see a problem in using it. I can always ask for help or read the user's manual.
- *I have never learnt about this technology in school. How do they expect me to be confident using it!*
- *Shouldn't they bring all components of the BCMA first before they expect us to use it!*
- *If it is not broken, why fix it! We have always administered medications manually and it worked perfectly. I just don't get it.*
- *Nobody told me about this project!*
- *One day these devil machines will take over our jobs!*

Q. 2. Which of the following might be an effective strategy to gain the support of physicians and nurses for the implementation of this project? ***(Select all that apply)***

- *Provide training, support, and education*
- *Discuss the design of the BCMA with the health care team prior to implementing the project.*
- *Allow time for users to adjust to the change*
- Assign supervisors to monitor users

- *Issue a memo detailing the role of each one involved in the use of this application.*

N.B. Correct answers are shown in Italics

Sample Guidelines to Facilitators

Title of Activity: Self-assessment of informatics knowledge competencies.
Duration: 5-10 minutes prior to presenting the session.

Description: Students will work individually to rate their level of competence using a Likert Scale.

Procedure:

1. Welcome students to the session and ask them to open their workshop folder and look up the Self-assessment Tool.
2. State the learning outcomes for the activity.
3. Ask students to take 5-10 minutes to rate their level of competence. Advise students that they can use the same tool at the end of the session to assess improvement.
4. Respond to students' questions, if any.
5. Wrap up the activity and begin session presentation.

Title of Activity: Providing health education to a client using best practice guidelines
Time: 09:00 – 09:30.
Duration: 30 minutes

Description: Students will work in **pairs**. Each pair will receive the same activity.

1. **Making Best Practice Guidelines a Reality available at: http://www.cna-aiic.ca/CNA/issues/now/default_e.aspx?y=2004**
2. **http://www.cna-aiic.ca/CNA/practice/family/evidence/default_e.aspx**

*(Readings are available in your folder)—Please note that students are expected to access these readings online therefore they **will not** be provided with a hard copy).*

Procedure:

1. Ask students to select a peer to work with. Each pair of students can use a computer station.
2. Ask students to open their workshop folder and look up Session 1 activity 1.
3. State the learning outcomes for the activity and read the scenario.
4. Direct students to the required learning tasks as stated in the activity.
5. Provide guidance to students, if needed, about accessing learning resources available at the Homer Gateway website. To access these, students are required to log on the Homer Gateway website using the link **in the card that they have received during randomization.** Because two students are using the station, one student can log on to the site using their website user ID and password.
6. Remind students that the activity will require 30 minutes to complete (20 minutes in searching and writing notes about the task, and 10 minutes for reporting findings to the group and wrap up of the activity).
7. Respond to students' questions, if any.
8. Wrap up the activity.

Title of Activity: Electronic Health Records
Time: 10:15 – 10:40
Duration: 25 minutes

Description: Students will work in **two small groups** on the same activity, but **each** group will address one question of the activity, then the two groups will present their findings in a debate like format.

- **Resources and answer key to activity:** Please refer to the following reading: CNA—Demystifying the electronic health record http://www.cna-nurses.ca/CNA/documents/pdf/publications/Demystifyinghealthrecord_April2002_e.pdf

(Reading is available to you in your folder)

Procedure:

1. Ask students to open their folders and look up Session 2 activity 1.
2. State the learning outcomes for the activity
3. **Show** the following videos accessible at http://www.cche.net/f2fworkshop. **The electronic health record video (5-7 minutes).** [12]
4. EHR Demonstration

5. Form two small groups: Count 1 and 2 as you go around the students in the room, those who have the number 1 form group 1, and those who get number 2 form group 2. Both groups stay in the room, but work at different sides of the room. If the number of students is too large, you can form 3-4 groups. Two groups can tackle one question.
6. Advise students that they can access **a reading material about the activity** on the Homer Gateway website. To access these, students are required to log on the Homer Gateway website using the link **in the card that they have received during randomization.**
7. Remind students that the activity takes 25 minutes to complete (10 minutes on working on the task and writing notes, and 10 minutes to present the findings to the class. Presentation will be in a debate format, the group (s) tackling question one will argue/defend the benefits of EHR, and the other group (s) will argue/defend concerns/challenges with EHR.
8. Respond to students' questions, if any.
9. Wrap up the activity.

[12] **Disclaimer** "Capital Health is now known as "Alberta Health Services". Net Care is the property of Alberta Health and Wellness, and now is known as Alberta Net Care"

Title of Activity: Reflection on Personal Experiences with Technology
Time: 10:40 – 11:00
Duration: 20 minutes (10 minutes for addressing the questions, and 10 minutes for reporting back to the group).

Description: Depending on number of students in class, students will work in **3-4 small groups** on the same activity, and **each** group will address **all questions** listed in the activity separately. After 10 minutes, all groups report back and are seated as a large group, and then each group share/present their findings.

Procedure:

1. Ask students to open their folders and look up Session 2 activity 2.
2. State the learning outcomes for the activity.
3. Form 3-4 small groups depending on number of students available. Ask students for their preference to formulate the small groups. Students can either self-select in groups or groups can be formulated according to a numerical designation. Each group should have 4-5 students.
4. Remind students that the activity takes 10 minutes to complete (10 minutes to respond the questions and 10 minutes present the findings to the class—it is helpful to remind each group to nominate a presenter and a time keeper).
5. Respond to students' questions, if any.
6. Wrap up the activity.

Online Module Activities

Activity	**General Informatics Knowledge**
Learning Outcome	Review general concepts about nursing and health informatics.
Activity Time	**10 minutes**

Select one best response from the options listed below:

1. A colleague seeks your advice about professional associations supporting nursing informatics in Canada. Which of the following organizations would you recommend to her to find this information?
    a. Canadian Health Informatics Association (COACH)
    b. Canadian Nurses Informatics Association (CNIA)
    c. Canada Health Infoway.

2. An individual's capacity to obtain, process, and understand basic health information needed to make appropriate health decision refers to:
    a. Information literacy.
    b. Computer literacy.
    c. Health literacy.

3. Which of the following terms are central themes in the definition of health informatics?
    a. Data, information, knowledge, & wisdom.
    b. Information, computers & communication.
    c. Informatics, health data, knowledge, & technology.

4. Nursing informatics defined as a combination of "computer science, information science, and nursing science…" reflects a _____ definition.
    a. Role-oriented
    b. Conceptually-oriented
    c. Technology-oriented

5. Many formal and Informal educational opportunities are available for nurses to help them develop their competence in health/nursing informatics. An example of an Informal educational opportunity would be:
    a. Attend the annual CNIA conference
    b. Apply for a graduate degree at the University of Alberta
    c. Complete a computer course at the University.

Key

1. A colleague seeks your advice about professional associations supporting nursing informatics in Canada. Which of the following organizations would you recommend to her to find this information?
    a. Canadian Health Informatics Association (COACH)
    b. Canadian Nurses Informatics Association (CNIA)
    c. Canada Health Infoway.

2. An individual's capacity to obtain, process, and understand basic health information needed to make appropriate health decision refers to:
    a. Information literacy.
    b. Computer literacy.
    c. Health literacy.

3. Which of the following terms are central themes in the definition of health informatics?
    a. Data, information, knowledge, & wisdom.
    b. Information, computers & communication.
    c. Informatics, health data, knowledge, & technology.

4. Nursing informatics defined as a combination of "computer science, information science, and nursing science…" reflects a _____ definition.
    a. Role-oriented
    b. Conceptually-oriented
    c. Technology-oriented

5. Many formal and Informal educational opportunities are available for nurses to help them develop their competence in health/nursing informatics. An example of an Informal educational opportunity would be:
    a. Attend the annual CNIA conference
    b. Apply for a graduate degree at the University of Alberta
    c. Complete a computer course at the University.

Activity	Providing health education using best practice guidelines
Learning Outcomes	1. Value the role of information literacy in advancing clinical practice of the Registered Nurse. 2. Select credible sources for retrieving evidence-based information and best-practice guidelines.
Activity Time	30 minutes

One of your clients has been diagnosed with **Asthma**. The client is requesting additional information about this condition, but reference books on the unit describe this condition very briefly. You decide to prepare a health education plan for your client about **the symptoms of asthma, causes and triggers, & things he/she could do to control the disease** based on the best available evidence, but you are not sure where to start!

Check this reading first!

1. **Making Best Practice Guidelines a Reality available at: http://www.cna-aiic.ca/CNA/issues/now/default_e.aspx?y=2004**
2. **http://www.cna-aiic.ca/CNA/practice/standards/bestpractice/default_e.aspx**

Take a peek!
http://www.cna-aiic.ca/CNA/practice/family/evidence/default_e.aspx

Hint!
The resource page has additional sources on evidence-based practice & best practice guidelines.

Response:

Activity 2	**Adoption of health care technology & change management strategies**
Learning Outcomes	**1.** Examine significant issues affecting the adoption of health care technology. **2.** Identify strategies that can facilitate adoption of health care technology.
Activity Time	**10 minutes**

A health care organization is planning to implement the **Bar Code Medication Administration System (BCMA)** on all surgical units. The BCMA is a scanning technology that allows comparison of the medication being administered with what was ordered for the patient. Use of this technology enhances patient safety by improving communication regarding medication administration processes, allowing multiple users to access medication administration information, and improving documentation of all aspects of the process. The technology will become available on the unit at the end of the year but the staff including physicians and nurses are quite restless about this change and feel it would disrupt patient care.

Based on the above scenario, which of the following responses would suggest a potential barrier to the adoption of this technology that you may encounter during the implementation of this technology. ***(Select all that apply)***

- I'd rather spend my time with patients rather than this machine!
- I am not worried about using this technology; I have attended two hours of training about it.
- I don't see a problem in using it. I can always ask for help or read the user's manual.
- I have never learnt about this technology in school. How do they expect me to be confident using it!
- Shouldn't they bring all components of the BCMA first before they expect us to use it!
- If it is not broken, why fix it! We have always administered medications manually and it worked perfectly. I just don't get it.
- Nobody told me about this project!
- One day these devil machines will take over our jobs!

Which of the following might be an effective strategy to gain the support of physicians and nurses for the implementation of this project? ***(Select all that apply)***

- Provide training, support, and education
- Discuss the design of the BCMA with the health care team prior to implementing the project.
- Allow time for users to adjust to the change

- Assign supervisors to monitor users
- Issue a memo detailing the role of each one involved in the use of this application.

Activity 1	**Electronic health records**
Learning Outcome	Understand nurses' role in relation to electronic health records.
Activity Time	**30 minutes**

1. **Read: Demystifying the Electronic Health Record available at:** http://www.cna-aiic.ca/CNA/issues/now/default_e.aspx?y=2002

2. **Watch the electronic health record video (5-7 minutes).** EHR Demonstration

3. **Watch Canada Health Infoway Campaign to educate the public** about electronic health records available at: http://www.knowingisbetter.ca/

4. **Respond to the following questions:**

   - **Identify three benefits for using electronic health records**

   - **Identify three challenges/concerns associated with the use of electronic records.**

Activity	**Personal reflection activity.**
Learning Outcome	Reflect on personal experiences with using technology applications in the clinical setting.
Activity Time	**30 minutes**

1. What have been your observations about the use of technology in the clinical setting?

2. How do you feel about your readiness and preparedness to work with these technologies competently upon graduation?

3. If you were to improve overall learning experiences with technology, what would you recommend?

Appendix I
Learning Session Evaluation Forms (Online & F2F)

Face-to-Face Session Evaluation Form

Thank you for attending the Health Informatics Workshop! Please reflect on this workshop and let us know what worked and what needs improvement. Your input is valuable to us as we plan future workshops. Your responses to this form will be kept confidential.

Why did you participate in this workshop? Check all that apply.

- Interest in health informatics
- Relevance to future practice
- To increase my chances of success in job applications

If other, please specify:

_____

Please rate aspects of the workshop on a scale of 1 to 4 where 4 = excellent, 3 = very good, 2 = good, and 1 = needs improvement (NI). Choose N/A if the item is not appropriate or not applicable to this workshop.

Workshop	4	3	2	N.I	N/A
Content:					
- Content was well organized					
- Scope of the content met my expectations					
- Presentation notes covered the subject adequately					
- Technical and equipment facilities					
Design:					
- Workshop objectives were clear to me					
- Workshop activities stimulated my learning					
- Workshop activities gave me sufficient practice and feedback					
- Difficulty level of this workshop was appropriate					
- Pace of the workshop was appropriate					
- Homer web site was easy to use and navigate					
Facilitator/Presenter:					
- Knowledgeable about subject matter					
- Responded to questions effectively					
Results/Value:					
- I accomplished the objectives of this workshop					
- I will be able to use what I learned in this workshop					

How would you improve this workshop? (Check all that apply.)

- Provide better information before the workshop.
- Clarify the workshop objectives.

- Reduce the content covered in the workshop.
- Increase content covered in the workshop.
- Update the content covered in the workshop.
- Improve the instructional methods.
- Make the workshop activities more stimulating.
- Improve workshop organization.
- Allot more time for the workshop.
- Shorten the time of the workshop.
- Improve the test used in the workshop.

Please use the space below for additional comments (or suggestions for improvement) on any aspect of this workshop.

.....

.....

What aspects of the workshop were the most valuable to you? And why?

.....

.....

What aspects of the workshop were least valuable to you? And why?

.....

.....

Would you be interested in learning more about this health informatics in the future? Yes/ No

Your feedback is sincerely appreciated. Thank you

Online Module Evaluation Form

Thank you for completing this Health Informatics Online Module! Please reflect on this learning experience and let us know what worked and what needs improvement. Your input is valuable to us as we plan future learning opportunities about health informatics. Your responses to this form will be kept confidential.

Why did you participate in this module? Check all that apply.

- Interest in health informatics
- Relevance to future practice
- To increase my chances of success in job applications

If other, please specify:

_____

Please rate aspects of the module on a scale of 1 to 4 where 4 = excellent, 3 = very good, 2 = good, and 1 = needs improvement (NI). Choose N/A if the item is not appropriate or not applicable to this module.

Module	4	3	2	N.I	N/A
Content:					
- Content was well organized					
- Scope of the content met my expectations					
- Presentation notes covered the subject adequately					
- Technical and equipment facilities					
Design:					
- Module objectives were clear to me					
- Module activities stimulated my learning					
- Module activities gave me sufficient practice and feedback					
- Difficulty level of this module was appropriate					
- Pace of the module was appropriate					
- Homer web site was easy to use and navigate					
Vodcast PTT Recorded Presentations:					
- Recordings were clear.					
- Length of each recorded learning unit was appropriate.					
Results/Value:					
- I accomplished the objectives of this module					
- I will be able to use what I learned in this module					

How would you improve this module? (Check all that apply.)

- Provide better information before the module.
- Clarify the module objectives.
- Reduce the content covered in the module.
- Increase content covered in the module.
- Update the content covered in the module.

- Improve the instructional methods.
- Make the module activities more stimulating.
- Improve module organization.
- Allot more time for the module.
- Shorten the time of the module.
- Improve the posttest used in the module.

Please use the space below for additional comments (or suggestions for improvement) on any aspect of this module.

.....

.....

What aspects of the module were the most valuable to you? And why?

.....

.....

What aspects of the module were least valuable to you? And why?

.....

.....

Would you be interested in learning more about this health informatics in the future? Yes/ No

Your feedback is sincerely appreciated. Thank you

Appendix J
Objectives and Knowledge Test Items for Main Study

Core Knowledge	Knowledge Test Items
Unit1: - Identify driving forces behind health informatics development in general and in relation to the Canadian context.	**Which of the following factors has been a key driving force for the development of health informatics in Canada?** a. Aging of population. b. Shortage of nurses. c. Lack of quality information. d. Confidentiality of data.
- Define health informatics, medical informatics, and nursing informatics.	**Which of the following health care reports had proposed recommendations for building Canada's health information technology to achieve better health for Canadians?** a. Kirby. b. Romanow. c. Mazankowski. d. E-Nursing Strategy. **Which of the following organizations have been charged with the goal of leading the development of a pan Canadian electronic health record?** a. Canadian Nurses Informatics Association. b. International Medical Informatics Association. c. Canada Health Infoway. d. The C-HOBIC project. **A colleague asks you about the meaning of the term health informatics. Which of the following responses would best describe this term? Health informatics refers to the use of_____** a. databases in the provision of medical care. b. technology to generate evidence. c. computers in the delivery of health care. d. informatics to improve patient outcomes. **The ability to recognize when information is needed, as well as the skills to find, evaluate, and use needed information effectively is known as:** a. Computer literacy. b. Information literacy. c. Evidence-based practice.

	d. Health literacy. **Which of the following represents approaches the Canadian Nurses Association recommends for building capacity in health informatics among Canadian nurses?** a. Competence, participation, and access. b. Reflective practice. c. Evidence-based practice. d. Workforce development
Unit 2: - Understand the relevance of informatics to nurses' work.	**Which of the following factors has a positive impact on the use of informatics in health care?** a. Cost of technology. b. Competencies of users. c. Emergence of new platforms. d. Development of new databases.
- Identify key facilitating factors associated with the use of informatics in health care.	**Which of the following represents a concern for nurses when using a nursing information system?** a. Reduction in time spent with clients. b. Delayed access to information. c. Possible medication errors. d. Privacy of communication.
- Identify informatics competencies required of a Registered Nurse at a beginning level of practice.	**As a student nurse looking forward to graduation, you hope to get involved in the promotion of electronic health records to your patients as many of them have expressed concerns relating to the maintenance of confidentiality of their electronic records. Which of the following would be an appropriate response that you can share with your clients?** a. There is no risk associated with accessing clients' health information using the electronic health record. b. Health care providers have limited access to health information, which minimizes risk of inappropriate use of information. c. I am sorry, I cannot respond to your question because I am not familiar with this matter. d. Health information is protected under the Personal Information Protection and Electronic Documents Act (PIPEDA). **What key informatics knowledge a beginning nurse should possess upon graduation?**

a. Basic computer skills.
b. Ability to access data and perform computer documentation.
c. Ability to use information technology to support clinical practice.
d. Information literacy

Which following category of computer skills is expected of a beginning nurse?
a. Online learning.
b. Quality improvement.
c. Impact of technology.
d. Documentation.

Unit 3:

- Identify some common health care information systems that nurses could use to support clinical decision-making and enhance delivery of nursing care.

- Recognize key differences between electronic health records, electronic medical records and personal health records.

Which of the following is an example of an informatics application that supports nurses' clinical decision making at the point of care:
a. Risk management systems.
b. Personal Digital Assistants.
c. Outcome analysis tools.
d. Quality assurance systems.

A type of information systems that provide managers information about their business operations is known as:
a. Transaction system.
b. Physiologic monitoring system.
c. Administrative information system.
d. Decision support system.

What type of information system supports the nurse by automatically notifying the dietary department to hold a client's breakfast, the pharmacy to send the appropriate medications, and the radiology department to schedule the test for a barium enema?
a. Laboratory systems.
b. Nursing information systems.
c. Administrative information systems.
d. Computerized order entry systems.

Which of the following statements presents an accurate description of an electronic health record?
a. A health care record that is created by a health care agency and replaces the patient paper record.
b. An institutionally based health care record used to

document the patient's encounters with the health care system.
c. A longitudinal record of patient's health care information that can be accessed by many health care providers.
d. A record that provides clients with access to their health care information.

A key goal of the Canada-wide electronic health record is to:
a. Ensure appropriate payments from insurance companies.
b. Provide timely, secure, and appropriate health information access across all jurisdictions.
c. Ensure client access to their personal health information.
d. Have additional client identification when receiving services.

Unit 4:
- Describe ways in which informatics improves nursing documentation.
- Recognize benefits of computerized data in enhancing nursing visibility

Which of the following facilitates capturing of nursing data in electronic records?
a. Scheduling systems.
b. Standardized languages.
c. SNOMED CT.
d. Hand-held devices

How does the nursing process approach to computerized documentation differ from the critical pathway/protocols approach?
a. Many types of care-providers use the nursing process approach while primarily nurses use the critical pathway/protocols approach.
b. The nursing process approach is based upon the paper forms traditionally used by nurses while many types of care providers use the critical pathway/protocols approach.
c. Nurses use the nursing process approach while the critical pathway/protocols approach is based on traditional paper forms.
d. The nursing process approach is better because of the prevalence of managed care while many types of care providers use the critical pathway/protocols approach.

Computerized data enhances nursing visibility through:
a. Efficient delivery of standardized care.
b. Decreasing medication errors.

c. Linking nurses' work to patient outcomes.
d. Minimizing time required for documentation.

Which of the following nursing minimum datasets would help capture outcomes data that are sensitive to nursing care or interventions provided by nurses in Canada?
a. ICNP
b. NANDA
c. C-HOBIC
d. SNOMED CT

Appendix K
Posttest—Main Study

Dear participant,

My name is Manal Kleib, a PhD student in the Faculty of Nursing at the University of Alberta working under the supervision of Dr. Karin Olson. My research project aims at comparing the effectiveness of online and face-to-face formats for teaching health informatics. Findings from this study will help guide decisions related to integration of health informatics in baccalaureate nursing education.

Guidelines for completing the posttest:

- This posttest has 35 items divided into four sections:
    - Section A: Demographic Information
    - Section B: Perceived Self-efficacy in relation to electronic health record.
    - Section C: Attitudes toward electronic health record.
    - Section D: Knowledge gain.
- Please follow instructions provided in each section for completing the scales and multiple-choice questions.
- The posttest takes approximately 30 minutes to complete.
- Your responses will be handled confidentially.

Section A: Demographic Information

In what year were you born? _____

How do you learn best? ☐ By hearing ☐ By seeing ☐ By doing

On a scale of 1 to 5, where 1 = None, and 5 = A lot, how would you rate your previous education in informatics?

1 2 3 4 5

Section B: Perceived Self-Efficacy in Relation to Electronic Health Records

Often in our jobs we are told about software packages that are available to make-work easier. For the following questions, imagine that you were given **a new software package such as an electronic health record** for some aspect of your work. It doesn't matter specifically what this software package does, only that it is intended to make your job easier and that you have never used it before. The following questions ask you to indicate whether you could use this unfamiliar software package under a variety of conditions. For each of the conditions, please rate your confidence by circling a number from 1 to 10, where **1** indicates "Not at all confident," **5** indicates "Moderately confident," and **10** indicates "Totally confident."

		NOT AT ALL CONFIDENT					**MODERATELY CONFIDENT**				**TOTALLY CONFIDENT**
1.	…if there was no one around to tell me what to do as I go.	1	2	3	4	5	6	7	8	9	10
2.	…if I had never used a package like it before.	1	2	3	4	5	6	7	8	9	10
3.	…if I had the software manuals for reference.	1	2	3	4	5	6	7	8	9	10
4.	…if I had seen someone else using it before trying it myself.	1	2	3	4	5	6	7	8	9	10
5.	…if I could call someone for help if I got stuck.	1	2	3	4	5	6	7	8	9	10
6.	…if someone else had helped me get started.	1	2	3	4	5	6	7	8	9	10
7.	…if I had a lot of time to complete the job for which the software was provided.	1	2	3	4	5	6	7	8	9	10
8.	…if I had just the built-in help facility for assistance.	1	2	3	4	5	6	7	8	9	10
9.	…if someone showed me how to do it first.	1	2	3	4	5	6	7	8	9	10
10.	…if I had used similar packages before this one to do the same job.	1	2	3	4	5	6	7	8	9	10

Section C: Attitudes toward Electronic Health Records

In this section, ***where 1= Strongly Disagree (SD) and 5 = Strongly Agree*** **(SA)** please indicate whether you agree or disagree with the following statements by circling the appropriate number:

		SD				***SA***
11.	Use of electronic health records is more of help than a hindrance to patient care.	1	2	3	4	5
12.	Use of computerized charting has helped to improve documentation of the clinical record.	1	2	3	4	5
13.	Electronic health records pose less threat to the patient's privacy than do paper records.	1	2	3	4	5
14.	Computerized charting has decreased the workload of nurses and other personnel.	1	2	3	4	5
15.	In time, the use of electronic health records will lead to improved patient care.	1	2	3	4	5

Section D: Knowledge Gain. *Please note that only ONE answer is correct.*

16. Which of the following factors has been a key driving force for the development of health informatics in Canada?
    a. Aging of population.
    b. Shortage of nurses.
    c. Lack of quality information.
    d. Confidentiality of data.

17. Which of the following health care reports had proposed recommendations for building Canada's health information technology to achieve better health for Canadians?
    a. Kirby.
    b. Romanow.
    c. Mazankowski.
    d. E-Nursing Strategy.

18. Which of the following organizations have been charged with the goal of leading the development of a pan Canadian electronic health record?
    a. Canadian Nurses Informatics Association.
    b. International Medical Informatics Association.
    c. Canada Health Infoway.
    d. The C-HOBIC project.

19. A colleague asks you about the meaning of the term health informatics. Which of the following responses would best describe this term? Health informatics refers to the use of_____
    a. databases in the provision of medical care.
    b. technology to generate evidence.
    c. computers in the delivery of health care.
    d. informatics to improve patient outcomes.

20. The ability to recognize when information is needed, as well as the skills to find, evaluate, and use needed information effectively is known as:
    a. Computer literacy.
    b. Information literacy.
    c. Evidence-based practice.
    d. Health literacy.

21. Which of the following represents approaches the Canadian Nurses Association recommends for building capacity in health informatics among Canadian nurses?
    a. Competence, participation, and access.
    b. Reflective practice.
    c. Evidence-based practice.
    d. Workforce development

22. A type of information systems that provide managers information about their business operations is known as:
    a. Transaction system.
    b. Physiologic monitoring system.
    c. Management information system.
    d. Decision support system.

23. Which of the following factors has a positive impact on the use of informatics in health care?
    a. Cost of technology.
    b. Competencies of users.
    c. Emergence of new platforms.
    d. Development of new databases.

24. Which of the following represents a concern for nurses when using a nursing information system?
    a. Reduction in time spent with clients.
    b. Delayed access to information.
    c. Possible medication errors.
    d. Privacy of communication.

25. CARNA expects you to possess what key knowledge pertaining to informatics upon graduation?
    a. Basic computer literacy.
    b. Ability to access data and perform computer documentation.
    c. Ability to use information technology to support clinical practice.
    d. Information literacy

26. In relation to the categories of nursing informatics competencies, which following category of computer skills is expected of the beginning nurse?
    a. Online learning.
    b. Quality improvement.
    c. Impact of technology.
    d. Documentation.

27. Which of the following is an example of an informatics application that supports nurses' clinical decision making at the point of care:
    a. Risk management systems.
    b. Personal Digital Assistants.
    c. Outcome analysis tools.
    d. Quality assurance systems.

28. What type of information system supports the nurse by automatically notifying the dietary department to hold a client's breakfast, the pharmacy to send the appropriate medications, and the radiology department to schedule the test for a barium enema?
    a. Laboratory systems.
    b. Nursing information systems.
    c. Administrative information systems.
    d. **Order entry systems.**

29. Which of the following statements presents an accurate description of an electronic health record?
    a. A health care record that is created by a health care agency and replaces the patient paper record.
    b. An institutionally based health care record used to document the patient's encounters with the health care system.
    c. **A longitudinal record of patients' health care information that can be accessed by many health care providers.**
    d. A record that provides clients with access to their health care information.

30. A key goal of the Canada-wide electronic health record is to:
    a. Ensure appropriate payments from insurance companies.
    b. Provide timely, secure, and appropriate health information access across all jurisdictions.
    c. Ensure client access to their personal health information.

d. Have additional client identification when receiving services.

31. As a student nurse looking forward to graduation, you hope to get involved in the promotion of electronic health records to your patients as many of them have expressed concerns relating to the maintenance of confidentiality of their electronic records. Which of the following would be an appropriate response that you can share with your clients?

    a. There is no risk associated with accessing clients' health information using the electronic health record.
    b. Health care providers have limited access to health information, which minimizes risk of inappropriate use of information.
    c. I am sorry, I cannot respond to your question because I am not familiar with this matter.
    d. **Health information is protected under the Personal Information Protection and Electronic Documents Act (PIPEDA).**

32. Which of the following facilitates the capture of nursing data in electronic records?
    a. Scheduling systems.
    b. **Standardized languages.**
    c. SNOMED CT.
    d. Hand-held devices.

33. How does the nursing process approach to computerized documentation differ from the critical pathway/protocols approach?
    a. Many types of care-providers use the nursing process approach while primarily nurses use the critical pathway/protocols approach.
    b. **The nursing process approach is based upon the paper forms traditionally used by nurses while many types of care providers use the critical pathway/protocols approach.**
    c. Nurses use the nursing process approach while the critical pathway/protocols approach is based on traditional paper forms.
    d. The nursing process approach is better because of the prevalence of managed care while many types of care providers use the critical pathway/protocols approach.

34. Computerized data enhances nursing visibility through:
    a. Efficient delivery of standardized care.
    b. Decreasing medication errors.
    c. **Linking nurses' work to patient outcomes.**
    d. Minimizing time required for documentation.

35. Which of the following nursing minimum datasets would help capture outcomes data that are sensitive to nursing care or interventions provided by nurses in Canada?

a. ICNP
b. NANDA
c. C-HOBIC
d. SNOMED CT

-END-