

TOWARDS AN INFORMATICS COMPETENT NURSING PROFESSION:  
VALIDATION OF THE  
SELF-ASSESSMENT OF NURSING INFORMATICS COMPETENCY SCALE (SANICS)  
BEFORE AND AFTER ONLINE INFORMATICS TRAINING

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## **Abstract**

Nurses should be involved in healthcare initiatives that incorporate informatics as an essential tool for improving health outcomes (IOM, 2010). However, nurses frequently report lack of competency to perform the most basic computer functions, outside of those required within their work environment (Hwang, 2011). Without educational or training interventions, nurses are limited in their ability to effectively use information technology in practice (Greiner, 2003). This study explored the psychometric performance of the Self-Assessment of Nursing Informatics Competencies Scale (SANICS) when used to measure informatics competency in a population of entry-level nursing students. Data collected before and after an online informatics training intervention (SOLO-IT) confirmed the factor structure and internal consistency reliability of the SANICS. Statistically significant increases ( $p < 0.001$ ) were reported by participants ( $n = 496$ ) on 27 of 30 items measuring self-perceptions of informatics competencies. Significant differences ( $p < 0.001$ ) in each sub-scale mean score before and after completion of SOLO-IT confirmed the construct validity of the SANICS. Results of this study support the SANICS as a psychometrically sound instrument for measuring perceived informatics competencies in entry level nursing students. Diffusion of informatics competency throughout the nursing workforce could depend upon the availability of on-demand training resources and valid instruments which support nurses as competent users of informatics in an era of ubiquitous health information technology. Findings from this study provide preliminary evidence that SOLO-IT may be an effective tool for improving perceptions of informatics competencies among entry level nursing students. Future studies are recommended using paired samples of nurses and nursing students from diverse populations, as well as studies which correlate perceived competencies with actual demonstrated skills.

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## **Chapter I**

### **Introduction**

Numbering more than three million, licensed Registered Nurses (RNs) make up the largest group of healthcare professionals in the United States (Health Resources Services Administration, 2010). Advances in healthcare have created a nursing workforce increasingly dependent upon technology to deliver innovative therapies at the bedside, and to interpret massive amounts of quality-related outcomes data in the executive boardroom. The information age is producing data at rates that exceed the ability to use it. The Economist estimates medical centers are home to almost one billion terabytes of data, “equivalent to almost two trillion file cabinets worth of information” (2010, pg. 3).

Nursing informatics is “a specialty that integrates nursing science, computer science, and information science to manage and communicate data, information, and knowledge in nursing practice” (American Nurses Association [ANA], 2001, p.17). Nurses capable of integrating informatics solutions into an automated healthcare environment will be essential to the future of nursing and the promotion of health that spans “time and place” and “wellness and health maintenance activities” (Health Information and Management System Society [HIMSS], 2012, p. 3). For more than a decade, nursing researchers have recognized that evidence based practice (EBP) would be dependent upon nursing’s ability to demonstrate expert knowledge in patients’ individual and collective decision making processes (McCormack, Kitson, Harvey, Rycraft-Malone, Titchen & Seers, 2002). Such expert knowledge in practice is based on a foundational ability to use information technology effectively and manage electronic sources of information, which assumes at least a basic education in informatics (Courey, Benson-Soros, Deemer, & Zeller, 2006; IOM, 2003).

## **Background**

As the largest group of clinical health information technology users, nurses must possess a minimum set of technical competencies needed for the electronic medical record (EMR), including basic computer skills and information literacy (Ball, Douglas & Hinton-Walker, 2011). Basic computer literacy (competency) is defined as “the use of personal computers, including the use of software tools such as word processing, spreadsheets, databases, presentation graphics, and e-mail” (Hebda & Czar 2013, p. 8). Information literacy is the ability to access, process, and use information and is an essential component of nursing informatics competency (IOM, 2011). The IOM has identified information literacy as the recommended standard for nursing and nursing students (2011).

Significant contributions concerning the role of nursing informatics have been made during the past decade. Stagers and colleagues defined and described informatics competencies, skills, knowledge, and abilities based on educational preparation and expertise: beginning nurse, experienced nurse, informatics nurse specialist, and informatics innovator (Stagers, Gassert, & Curran, 2001, 2002). Their seminal research has informed the development of informatics competency measurements for the nursing profession and has influenced many of the standards commonly used by leading professional nursing organizations. These organizations include the American Association of Colleges of Nursing (AACN, 2008), the TIGER Initiative (2010) and the National League of Nursing (2008).

### **American Association of Colleges of Nursing (AACN)**

The AACN’s “Essentials of a Baccalaureate Education for Professional Practice,” provides guidelines for nursing practice (2008). In 2008, the AACN included the mandate that informatics be included as an “essential element” of a baccalaureate nursing degree, since

“computer and information literacy are crucial to the future of nursing” and provide a bridge between the “preparation-practice” gap (p. 17).

The 2008 guidelines include “Information Management and Application of Patient Care Technology” as one of the nine “Essentials” for a professional nursing education (p. 17).

Standards outlined under the technology “Essential” include:

1. Demonstrate skills in using patient care technologies, information systems, and communication devices that support safe nursing practice.
2. Use telecommunication technologies to assist in effective communication in a variety of healthcare settings.
3. Apply safeguards and decision making support tools embedded in patient care technologies and information systems to support a safe practice environment for both patients and healthcare workers.
4. Understand the use of computerized information systems to document interventions related to achieving nurse sensitive outcomes.
5. Use standardized terminology in a care environment that reflects nursing’s unique contribution to patient outcomes.
6. Evaluate data from all relevant sources, including technology, to inform the delivery of care.
7. Recognize the role of information technology in improving patient care outcomes and creating a safe care environment.
8. Uphold ethical standards related to data security, regulatory requirements, confidentiality, and clients’ right to privacy.

9. Apply patient-care technologies as appropriate to address the needs of a diverse patient population.
10. Advocate for the use of new patient care technologies for safe, quality care.
11. Recognize that redesign of workflow and care processes should precede implementation of care technology to facilitate nursing practice.
12. Participate in evaluation of information systems in practice settings through policy and procedure development (p. 17).

The implementation of informatics as an essential component of accreditation standards is an important step in the process of transforming nursing education in a manner that prepares graduates to practice competently. Such skills are critical in a technology driven healthcare environment (Ball, Douglas & Hinton-Walker, 2011).

### **Technology and informatics Guiding Educational Reform (TIGER)**

Technology and Informatics Guiding Educational Reform (the TIGER Initiative) is an independent, grassroots nursing initiative whose primary focus is educational reform in nursing informatics (Ball, et. al, 2011). The TIGER Initiative began in 2006 in response to the growing need for an informatics competent nursing workforce. The TIGER Initiative catalyzed the formation of the Alliance for Nursing Informatics (ANI), a coalition of 20 nursing informatics professional societies, and major nursing organizations such as the ANA, Association of Nurse Executives (AONE), the American Association of Colleges of Nursing (AACN) (TIGER, 2008). The ANI also includes an additional 170 diverse organizations which seek to make informatics “nursing’s stethoscope by the 21st century” (Ball, et al, 2011, p. 19; TIGER, 2008, 2010). The TIGER Initiative focuses on “the need to engage nurses in all settings in the national effort to

prepare the healthcare workforce toward effective adoption of electronic health records” (p. 10).

The following recommendations emerged from the TIGER Summit (2010):

- Institute a national marketing campaign to promote the value of technology in a multi-disciplinary way that supports an accepting culture.
- Include Health Information Technology (HIT) in every strategic plan, mission, and vision statement; use of HIT is embraced by executives, deans, all point of care clinicians and students with goal of high quality care and safety.
- Establish multidisciplinary teams that embrace a shared vision and operate cohesively to push for broad technology integration within/across entire organizations.
- Develop mutual respect between/among clinicians who may bring different skills and knowledge (p.14).

The TIGER Initiative developed a TIGER Informatics Competencies Collaborative (TICC). This group of informatics and nursing experts was charged with the establishment of a minimum set of informatics competencies (Ball, et al, 2011). The TICC also outlined basic computer and information literacy skills for nurses and nursing students. Recommended information literacy and computer skills are described below (Gugerty & Delaney, 2009):

**Information literacy skills identified by TIGER.**

1. Determine the nature and extent of the information needed
2. Access needed information effectively and efficiently
3. Evaluate information and its sources critically and incorporates selected information into his or her knowledge base and value system
4. Individually or as a member of a group, use information effectively to accomplish a specific purpose

5. Evaluate outcomes of the use of information (p.5).

**Computer skills identified by TIGER.**

1. Concepts of Information and Communication Technology (ICT)

2. Using the Computer and Managing Files

3. Word Processing

4. Spreadsheets

5. Using Databases

6. Presentation

7. Web Browsing and Communication (p. 3).

**The National League of Nursing**

The National League of Nursing (NLN) has called for the development of innovative educational programs which improve informatics competencies and enable competent use of information technologies (2008). For more than a decade, the nursing literature has reported that nursing schools lack standardization as to the type and complexity of computer skills required for nursing students (Sinclair & Gardner, 1999) The ability for nursing education to integrate computer competency and information literacy “will require nursing curriculum reform and an infusion of technologies for learning” (p. 40).

**Nursing Informatics and the Affordable and Accountable Care Act**

Nurses should be involved in healthcare initiatives that incorporate informatics as an essential tool for improving health outcomes (IOM, 2010). As a result of the Affordable Care Act (ACA) of 2010, healthcare delivery is transitioning to electronic health records for meaningful use and exchange of information (Department of Health and Human Resources [HHS], 2010). The ACA includes broad application of informatics competencies to support the

meaningful use of information supporting quality patient outcomes. However, a chasm between knowledge and practice prevails due to incomplete adoption of healthcare innovations (IOM, 2001; Glanz, Rimer & Viswanath, 2008). Nurses deficient in basic informatics competencies have limited ability to use and apply communication and information technology in their practice (IOM, 2003, p. 85). Nurses are the largest group of clinical users of health information technologies and must master a minimum set of competencies needed for the electronic medical record (EMR), including basic computer skills and information literacy (Ball, et al, 2011). Employing agencies may understandably assume that requisite computer skills are being taught during a student's undergraduate college education. However, nurses frequently lack the minimum level of competency to work efficiently or effectively with computerized information systems (Thede & Sewell, 2004; Wilbright, et. al, 2006). Inexperience with technology is one of the most common factors impeding the adoption of Electronic Medical Records (EMR) (McGinn, et al. 2012). Effective use of electronic health systems depend on competence with the complete system, including advanced tools for charting and data management (Saba & McCormick, 2011).

### **Institute of Medicine (IOM)**

Ongoing advances in health informatics require the preparation of a nursing workforce competent in computer based applications. In a groundbreaking report, *The Future of Nursing: Leading Change, Advancing Health*, the Institute of Medicine (IOM) called for nurses to be involved in healthcare initiatives that incorporate informatics as an essential tool for improving health outcomes (2010). The Institute of Medicine defines information literacy as the ability to access, process, and use information (2011). A key component of informatics competency is information literacy, which is the ability to find, retrieve, and analyze information

(American Library Association, 2012). Information literacy is considered an essential competency and is the recommended standard for all nurses and nursing students (IOM, 2011).

### **Significance**

Informatics competency is readily accepted as basic technology skills that nurses must have to perform their duties (McNeil, Elfrink, Pierce, Beyea, Bickford, & Averill 2005; Staggers, Gassert & Curran, 2001; Yoon, Yen, & Bakken, 2009). Effective and efficient use of electronic health systems rely on competence with the complete system, including the ability to use advanced tools designed for charting and data management (Saba & McCormick, 1996). Expert testimony provided to the Office of the National Coordinator (ONC) revealed significant challenges for nurses when locating pertinent data “in the sea of available electronic information in the EMR” (Staggers, 2011, p. 542). Inexperience with technology has been identified as one of the most common factors impeding the adoption of the EMR (McGinn, et al. 2012).

For the past 30 years, nurses have been encouraged to acquire and build upon informatics competencies to perform their role optimally (Ball & Hannah, 1984; Graves & Chocoran, 1989; Herbert, 1999; Saba & McCormick, 1996; Scholes & Barber, 1980; Staggers, Thompson, Happ & Bartz, 1998; Turley, 1996). Still, nurses consistently self-report a lack of competency to perform even the most basic computer functions, outside of those required within their work environment (Ball, Douglas, Hinton-Walker, 2011; Hwang & Park, 2011; Thede & Sewell, 2009).

A gap exists in the literature regarding informatics competency training resources for nurses and the availability of valid, reliable tools to measure their effectiveness. These findings are surprising given persistent recommendations from professional nursing organizations calling for a deliberate, systematic approach to improving the basic computer skills and information



literacy of the nursing profession (ANA, 2001; IOM, 2011; TIGER, 2008). Despite this call, the integration of informatics into the nursing curriculum and development of informatics competencies among nurses is still lacking (Hunter, McGonigle, Dee, Hebda, 2013; Virgona, 2013).

The TIGER Initiative focuses on “helping the nursing profession to adopt informatics tools, principles, theories, and practices that make healthcare safer and more effective, efficient, patient-centered, and equitable for all stakeholders” (p. 3). The TIGER Initiative’s Executive Summary (2010) identified the concern of “informatics illiteracy in nursing education” and included the imperative for nurses to become competent in the use of technology tools to support decision making in clinical practice (p. 2). In a recent study (2013), students enrolled in the first semester of a Doctor of Nursing Practice (DNP) Program were not competent in any of three categories of computer skills, informatics knowledge, and informatics skills. Despite ubiquitous use of technology in daily life, the incorporation of basic computer skills and informatics into nursing curricula is still considered an “essential” need (Virgona, 2013, p. 61). A common misperception is that younger students enter traditional BSN programs with requisite computer and information literacy skills. However, recent research suggests that RN to BSN and Accelerated BSN students may be more competent in informatics than younger Pre-Licensure students (Choi, 2012). Even though use of technology has been expanded in K-12 education, “findings indicate that (nursing) students’ computer competencies may be lower than anticipated” (Elder & Koehn, 2009).

Broad adoption of essential nursing informatics competencies would be advantageous for the nursing profession (Ball, et al., 2011). The TIGER Initiative calls for competency based training resources which can help prepare the nursing workforce to improve healthcare delivery

using informatics (Ball, et al, 2011). However, informatics competency training resources for nurses remain insufficient and frequently do not provide validity and reliability data for the instrument, or lack formalized assessments altogether (2011).

Evidence exists that “without a basic education in informatics, nurses and other healthcare professionals are limited in their ability to make effective use of communication and information technology in their practice” (IOM, 2003, p. 85). Educational interventions aimed directly at informatics competencies of nursing students have proven effective (Choi, 2012; Flood, Gasiewicz & Delpier, 2010; Tarrant, Dodgson, & Law, 2008, Yoon, et al., 2009). However, nursing education programs have been slow to support the development of informatics competencies or to provide the training and resources necessary for nurses to enter the professional world with adequate technology or information literacy skills (Westra & Delaney, 2008).

### **Purpose**

The TIGER Collaborative issued a Call to Action identifying the need for educational interventions which foster information technology innovation and adoption by nurses (2008). In 2011, the TIGER Initiative called for competency based training resources which improve basic informatics competencies (computer skill and information literacy) and prepare the nursing workforce to improve healthcare delivery using informatics (Ball, et al). While numerous instruments have been utilized to measure the informatics competencies of nurses, relatively few research reports provide psychometric data to support the reliability and validity of the instruments (Lin, 2011). Issues related to computer competency and information literacy have long been described by researchers, yet few training resources exist and “little attention has been paid to the validity of scales used” (Lin, 2011, p. 306).

This purpose of this study is to evaluate the psychometric performance of the Self-Assessment of Nursing Informatics Competency Scale (SANICS) before and after completion of informatics training. Principal component analysis will be used to examine the factor structure of the SANICS. Internal consistency reliability will be used to examine the psychometric properties of the SANICS among a sample of BSN entry-level nursing students. Responsiveness of the SANICS over time will be examined following completion of Successful Online Learning and Orientation Informatics Training (SOLO-IT) modules. Construct validity of the SANICS will be assessed using a known group approach to compare differences in means for each SANICS subscale (construct) before and after completion of Successful Online Learning and Orientation Informatics Training (SOLO-IT) modules.

### **Research Questions**

The literature supports an ongoing lack of informatics competencies among the nursing profession, as well as a lack of valid tools in which to measure them. Additionally, the literature acknowledges a lack of empirically sound informatics training resources. Research questions to be answered by this study are as follows:

- 1) What are the psychometric properties of the SANICS among a population of BSN entry-level students?
- 2) Is the SANICS responsive over time when used to measure informatics competencies following completion of Successful Online Learning and Orientation (SOLO) Informatics Training (IT) modules?
  - Hypothesis: There will be a significant difference in SANICS scores between pre-SOLO and post-SOLO.

## **Methods**

Essential informatics concepts will provide the foundational underpinnings for this research. Authoritative definitions derived from research studies, professional nursing organizations and national health collaboratives were used to inform the study's design. A thorough review of current and historical literature supported the lack of requisite computer competency and information literacy skills essential for an informatics competent nursing workforce. The literature also described a persistent lack of reliable and valid tools to measure those competencies.

National professional nursing organizations recommend web based informatics training for nurses, as well as rigorous assessment tools and strategies to validate their effectiveness (Ball, et al., 2011). However, a comprehensive literature search identified a lack of web based training resources and accompanying instruments used to measure the outcomes of informatics training. Due to the small number of empirical studies available, the search for training resources was expanded to include both nursing and educational tools which measure competencies before and/or after informatics training. Review of curriculum based informatics instruction and/or health record simulation training sites was excluded from this search.

## **Summary**

Researchers have developed measurement scales which define and quantify the informatics competency (IC) levels needed for nurses and nursing students (Staggers, Gassert, & Curran, 2002; Yoon, et al., 2009). Competency levels outlined by these instruments are comprehensive and span from the "beginning nurse" to "informatics innovator" (Staggers, et al., 2002). While nursing informatics competencies have been described for more than a decade, a comprehensive review of the literature revealed a surprising lack of research studies describing

training interventions to address the problem of insufficient informatics competencies among nursing professionals. Additionally, published literature describing valid, reliable assessment tools to measure the effect of informatics competency training among nurses or nursing students was relatively sparse.

## **Chapter II**

### **Review of the Literature**

#### **Theoretical Framework**

This quantitative study will use a post-positivist theoretical perspective grounded in objectivist epistemology. In post-positivism, objectivity is the “regulatory ideal” but may not be achievable due to the research process which allows claims to be refined or abandoned altogether (Guba & Lincoln, 1994, p. 205). The post-positivist approach does not seek to prove a hypothesis (as with positivism), but rather to indicate a failure to reject the hypothesis (Phillips & Burbules, 2000). Human knowledge can be challenged and assumptions withdrawn, when warranted, for further investigation (2000). Quantitative research is defined as “a means for testing objective theories by examining the relationship among variables” (Creswell, 2009, p. 4). Quantitative inquiry allows theories to be tested deductively, “building in protections against bias, controlling for alternative explanations, and being able to generalize and replicate findings” (Creswell, 2009, p. 4).

#### **Theoretical Model: Principal Components of Scale Theory**

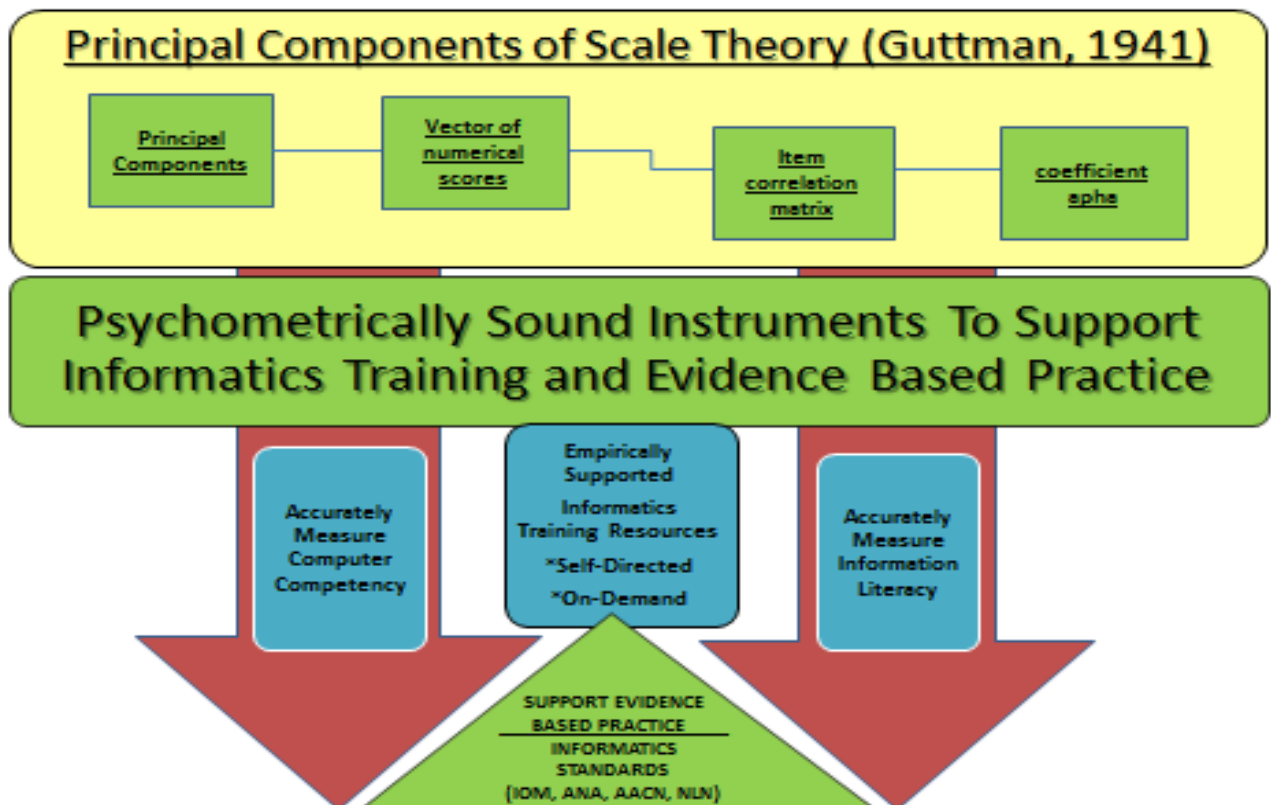
Scientific inquiry is dependent upon the adequacy of its measures (Foster and Cone, 1995). Figure 1 illustrates the importance of using psychometrically sound instruments to accurately measure the informatics competencies necessary for nursing practice in a technology-driven healthcare environment. This model is built upon the Principal Components of Scale Theory (Guttman, 1941), which involves a vector of numerical weights or scores with corresponding principal components. In this system “each numerical score...is proportional to the sum of the weights for the item response” in such a manner that maximizes the “correlation ratio” (p. 327). The resulting scoring weights support item reliability by factoring a matrix of

inter-item correlations. Principal components are considered correlated with the scores when the weighted items maximize the coefficient alpha (Lord, 1958).

Validated measurement tools support the development of on-demand training resources for self-directed learners who work in fast paced healthcare environments. The need for an informatics competent workforce is mandated by professional nursing standards (AACN), scope of nursing practice (ANA), and recommendations of authoritative bodies (IOM, NLN). The model shows the relationship between easily accessed tools for self-directed learning and the achievement of information technology skills consistent with a technologically competent nursing workforce prepared for evidence based practice.

Figure 1: Theoretical Model

*Principal Components of Scale Theory: Developing Instruments to Support Informatics Training and Evidence Based Practice*



## **Psychometrics**

This study will measure the items contained within the Self-Assessment of Nursing Informatics Competencies Scale (SANICS) and will analyze their psychometric properties. Psychometric evaluation is concerned with an instrument's reliability and validity (Carmines & Zeller, 1979). An instrument is a device used by researchers to measure variables (Neale & Liebert, 1986). Commonly, research instruments include questionnaires, rating scales, and physiological or observational measurements (1986). Reliability is established when a measure, repeated on a different population, remains consistent (Cortina, 1993). The degree to which evidence supports the interpretation of a test is referred to as validity (Guilford, 1946).

This study will evaluate the psychometric properties of the SANICS instrument using: 1) principal component analysis, 2) internal consistency reliability, and 3) responsiveness.

### **Principal Component Analysis**

Principal component analysis with oblique (promax) rotation will be used to determine the factor structure of the SANICS instrument. Principal component analysis is the preferred method for factor extraction since, unlike factor analysis, it allows for all sources of variability (unique, shared, or error) to be analyzed (Mertler & Vannatta, 2010). The goal in principal component analysis is to “extract the maximum variance from the data set, resulting in a few orthogonal (uncorrelated) components” (2010, p. 234). Parallel analysis will be used to determine which factors should be retained. In parallel analysis, “eigenvalues from research data prior to rotation are compared with those from a random matrix of identical dimensionality to the research data set. Component PCA eigenvalues which are greater than their respective component parallel analysis eigenvalues from the random data would be retained” (Franklin, Gibson, Robertson, Pohlmann & Fralish, 1995, p. 100). An eigenvalue is “the amount of total



variance explained by each factor, with the total amount of variability in the analysis equal to the number of original variables in the analysis (i.e. each variable contributes one unit of variability to the total amount)” (Mertler & Vannatta, 2010, p. 234). Parallel analysis is “considered more replicable than using eigenvalues or Scree plot to determine the cut-off for retention” (Yoon, et al, 2009, pg. 548). Factor loadings and promax rotation with Kaiser normalization will be used to examine and confirm correlations among factors (Tabachnick & Fidell, 2007). Factorial validity involves the measurement of reference factors to determine if a test theoretically measures what it was intended to measure (Guilford, 1946). Rotation is “a process by which a factor solution is made more interpretable without altering the underlying mathematical structure” (Mertler & Vannatta, 2010, p. 238). Promax rotation is an oblique rotation of factors to determine their relationship with one another (2010).

### **Internal Consistency Reliability**

Internal consistency reliability of the SANICS instrument will be determined using Cronbach’s alpha to assess the total scale and each subscale. Cronbach’s alpha (Cronbach, 1951) is one of the most popular reliability statistics and is used to determine “the internal consistency or average correlation of items in a survey instrument to gauge its reliability” (Reynaldo & Santos, 1999, p.2). An acceptable reliability coefficient of 0.7 has been identified as reliable, though lower thresholds have been used (Nunnally & Bernstein, 1994). A scale which fails to show variables with high correlation would be considered to have poor reliability (1994).

### **Construct Validity**

Construct validity refers to an instrument’s ability to measure constructs adequately (Shuttleworth, 2014). Construct validity is frequently measured using intervention studies, where groups with low scores on the construct being measured are taught the construct, then re-

measured. The presence of statistically significant differences between pre and post-test scores establishes good construct validity (Shuttleworth, 2014).

Construct validity of the SANICS will be assessed using a known group approach to compare differences in means (averages) for each SANICS subscale (construct) before and after completion of Successful Online Learning and Orientation: Informatics Training (SOLO-IT) modules. In a known group approach, “the instrument is administered to two groups known to be high and low on the measured concept (Burns & Grove, 2010). This study will also determine if self-perceptions of informatics competencies increased following completion of SOLO-IT’s online training modules. Competency is indicated by a minimum SANICS score of 3 (Yoon et al., 2009). If the SANICS is sensitive to individual differences in means (averages) before and after completion of SOLO-IT, then the mean performance between each group should be significantly different (Waltz, et al. 2005).

### **Responsiveness**

Responsiveness is an index used to measure an instrument’s ability to detect change over time between baseline and post-test (Middel & Van Sonderen, 2002). Responsiveness, or effect size (ES), of the SANICS will be determined using a standardized response mean (SRM) which is commonly used to measure responsiveness (2002). The SRM will be calculated as the difference between scores before and after completing SOLO-IT, divided by the standard deviation of the difference. Effects sizes of  $< 0.20$  are commonly accepted as trivial responsiveness;  $ES \geq 0.20 < 0.50$  small;  $ES \geq 0.50 < 0.80$  moderate; and  $ES \geq 0.80$  large (Cohen, 1977). Responsiveness of the scale over time will be assessed using independent sample t-tests.

## **Studies Describing Informatics Competencies**

Staggers and colleagues established the standards for measuring informatics competencies largely in use today (2001, 2002). This seminal work has served as the foundation for studies which have followed, resulting in expanded competency descriptions for specific populations. Despite the significant contributions by Staggers and colleagues which have resulted in comprehensive competency descriptions, most nursing informatics research reports still fail to define this concept (Hunter, McGonigle, & Hebda, 2013).

In a recent study (2011) of 350 nurses, more than two-thirds (69.2%) reported below average informatics competency and over half (58.9%) rated computer skills as below average (Hwang & Park). The ability to search databases and use nursing-specific software, both critical information technology skills, were also reported as lacking by survey participants (2011). This study positively correlated the presence of basic computer skills and formal informatics education with informatics competency. Hwang and Park concluded accessibility to informatics education, as well as training opportunities to improve basic computer skills, are needed in nursing practice to improve the competencies necessary for managing and using healthcare information, and improving patient safety (2011). Furthermore, the researchers recommended that priority be given to groups possessing low computer proficiency (2011).

Another study exploring common practices employed by RNs when accessing data to support evidence based practice (EBP) indicated a preference for information obtained from colleagues rather than a review of scholarly literature (Dee & Stanley, 2005). The reason cited for this preference was unfamiliarity with navigational skills necessary to access electronic databases (2005). Opportunities to infuse technology into nursing education include access of real-time linkages to expansive and widely available global information networks. Nursing

programs frequently focus on the use of technology as a means to support educational programming rather than an essential tool to prepare students for technology enhanced nursing practice (McNeil, Elfrink, Pierce, Beyea, Bickford, & Averill, 2005).

In further research conducted by McNeil and colleagues, college deans and directors from 266 baccalaureate and higher nursing programs ranked their faculty's ability to teach and use nursing informatics as "novice" or "advanced beginner" (McNeil, et al., 2005). The study revealed that United States (U.S.) nursing programs inconsistently taught information literacy skills, standardized nursing language, and technology supported evidence based practice. Their research examined informatics knowledge and skills taught in baccalaureate and master's level nursing education programs in the U.S.. Findings from this study showed that only about half of U.S. baccalaureate nursing programs (n=135) taught information literacy skills or required basic word processing and e-mail skills for entering students. Only 25% (n=67) expected students to enter their nursing program with information literacy skills and only 9% (n=24) expected students to have the ability to use presentation software. The informatics content taught most frequently included "accessing electronic resources" (50%), followed by "computer based patient record" (46%), "ethical use of information systems" (45%), "informatics nurse competencies" (40%), and "informatics definitions" (39%). Only 37% of respondents reported teaching informatics content which supported evidence-based practice. Graduate programs were found to have even less informatics related content areas than undergraduate programs. The researchers also examined the perceptions of faculty members' informatics competency and their use of informatics tools. Almost half of respondents ranked nursing faculty abilities as "novice" or "advanced beginners" with using nursing informatics applications. This study determined that a critical need exists to "include informatics concepts, informatics skills, and the use of

informatics tools in professional nursing practice within nursing curricula across the US” and to prepare faculty who are qualified to teach these skills (p. 1029). These findings have implications for nursing education since the ability to access and translate informatics knowledge is essential for evidence based nursing practice (IOM, 2011). Much work is needed to prepare current and future generations of nurses to function as competent users of the information technologies that support evidence based practice (Desjardins, Cook, Jenkins, Bakken, 2005; Waters, Rochester, McMillan, 2012).

Frequently, a substantial amount of time passes between an initial nursing degree and a return to higher education. This delay between nursing programs of study exacerbates the problem of informatics deficiencies for nurses since technological changes in the educational setting further illuminate a lack of understanding of informatics (Spratley, et al., 2000).

Many high functioning students (top 10% of incoming college freshman) capable of performing internet based literature searches lack the ability to 1) access scholarly sources, 2) think critically about the information attained, and 3) lack awareness of legal and ethical issues relating to information technology (Gross & Latham, 2009). Consensus exists among deans and directors of nursing programs across the nation that nursing students should graduate with basic information literacy skills, though such skills are frequently not taught in undergraduate programs (McDowell & Ma, 2007). Additionally, nurse educators frequently possess only basic skills in the area of applied informatics (Skiba, Connors, Jeffries, 2008). Informatics training, therefore, shifts to the employing institution and to nursing administrators who are left to manage the lack of informatics training and the inadequate technological preparation of nurses (Westra & Delaney, 2008). Because graduating nurses are prepared insufficiently with technology skills,

formalized informatics training which should have been provided during the post-secondary educational process, is necessarily absorbed by the workplace, or is entirely absent (2008).

Information literacy (the ability to access, process, and use information) is the recommended standard for nursing and nursing students (IOM, 2011). Nurse information literacy skills must be highly efficacious to manage vast amounts of new information (Majid, Foo, Luyt, Zhang, Theng, Chang, and Mokhtar, 2011). However, despite groundbreaking technological advances in healthcare, nurses frequently lack basic informatics competencies outside of their own work environment (Thede & Sewell, 2009). A survey of nurse executives revealed the existence of a “preparation-practice” gap regarding technical readiness among nursing graduates (Nurse Executive Center Nursing School Curriculum Survey [NECNCS], 2008). Only 10.4% of respondents felt that nursing graduates are being sufficiently prepared for practice in the area of technical skills. This finding was followed with agreement by almost 90% of the 362 nursing school leaders surveyed (2007).

### **Instruments Measuring Informatics Competencies**

Since the arrival of computer systems to the healthcare setting, nurses have been urged to obtain competency with using technology in all practice settings (Ball, Douglas, Hinton Walker, 2011). Experts and leading professional nursing organization have provided perspectives regarding the need for all nurses to use and apply information technology in their practice (ANA, 2001; IOM, 2011; TIGER, 2008).

Nursing experts and professional organizations have called for a nursing workforce capable of demonstrating informatics competencies. However, integration of informatics into the nursing curriculum and development of informatics competencies among nurses is still lacking (Hunter, McGonigle, Dee, Hebda, 2013; Virgona, 2013). While numerous informatics

competency instruments have been utilized, relatively few research reports provide psychometric data to support the reliability and validity of the instruments (Lin, 2011). Issues related to computer competency and information literacy have long been described by researchers, yet “little attention has been paid to the validity of scales used” (Lin, 2011, p. 306).

The following discussion summarizes research reports describing informatics competencies using a variety of instruments over the past decade. An outline of what is currently known about instruments measuring nursing informatics competencies follows (including their psychometric properties, when available). This information is also summarized chronologically in Table 2, with studies using the SANICS instrument highlighted separately toward the end of the table.

### **Graduating Nurses’ Self-Evaluation of Information Technology Competencies**

The 43 informatics novice nurse competency items developed as part of the seminal work by Staggers, Gassert, and Curran (2001) served as the foundation for the Graduating Nurses’ Self-Evaluation of Information Technology Competencies survey instrument (Fetter, 2009). In a pilot study, informatics competencies were ranked by 42 graduating seniors. The majority of the program’s graduating students rated themselves as having moderate ability on novice nurse standardized competencies. Students self-reported strongest skills in computer based communication and desktop software, and lowest competencies in the use of documentation systems and valuing informatics knowledge (2009). Recommendations included integrating information technology into all courses and establishing minimum performance standards for each course. The project “lacked the rigor of formal research” since reliability data on how it performed were not collected (2009).

## **Computer Literacy Scale for Newly Enrolled Nursing College Students**

Lin (2011) described the reliability and validity of computer competency and computer literacy scales used in nursing. Of the five survey tools included in the background evaluation, only three included any basic reliability/validity data, and this information was limited (Bataineh & Baniabdelrahman, 2006; Cole & Kelsey, 2004; Elder & Koehn, 2009; Lupo & Erlich, 2001; McNeil, Elfrink, Beyea, Pierce, & Bickford, 2006). The researcher described the computer literacy of Taiwanese nursing students using the Computer Literacy Scale for Newly Enrolled Nursing College Students (2011). This assessment scale was developed based on the Ministry of Education (MOE) guidelines. The resource was designed for technical schools and included computer hardware, software, networks, computer problem solving and IT society (Hinkin, 1998). The content validity index (CVI) was tested using eleven experts who rated content relevance (2011). Principal component analysis with varimax rotation was used to estimate total variance, and Eigenvalues greater than one guided the total number of factors used. Exploratory factor analysis confirmed the content validity and internal consistency of the instrument. The researcher concluded the instrument had good content validity, reliability, convergent validity, and discriminant validity, and was an “excellent computer literacy assessment for newly enrolled nursing students” (p. 315).

## **Assessment Tool for Nursing Student Computer Competencies**

The Assessment Tool for Nursing Student Computer Competencies is comprised of 40 self-ranking statements, designed by the researchers, to measure perceptions of computer competency (Elder & Koehn, 2009). Students were offered a voluntary tutoring session on computer skills as an incentive to participate in this study. The researchers compared computer competency self-ratings of 79 first and second semester nursing students and 8 RN-BSN



completion students. Ratings were then compared with the actual performance of those skills on a computer graded assessment. Reliability was computed using Kuder-Richardson 20 coefficient of reliability, resulting in an alpha of 0.65. Content validity, questions, and skills were derived from concepts taught in a basic computer course. Correlation coefficients were computed for survey and actual assessment scores which showed a low but significant correlation ( $r=0.282$ ,  $p<0.05$ ). Results suggested that students self-rated computer skills higher than actual ability to perform them (2009).

### **The eNNI Project**

The Electronic National Nursing Informatics (eNNI) Project measured the electronic documentation competencies of nurses and nurse educators before and after an educational intervention designed to improve information and communication technology (ICT) skills (Rajalahti & Saranto, 2012). A total of 158 Finnish nurse educators and novice-to-experienced RNs took part in this study. An e-questionnaire was developed and used based on the foundational work of Staggers, et al. (2002) and Saranto (1997) which itemized requisite computer competency and information literacy skills. The psychometric properties of the e-questionnaire instrument were not evaluated during this project. The researcher concluded that informatics competencies of the nurse participants and educators did not improve as a result of this project (2012).

### **Computer Competencies in the Curriculum**

Ornes and Gassert (2007) used the beginning nurse competency items from Staggers' (2001) earlier work to develop an informatics competency tool for beginning nurses. This tool was used to evaluate baccalaureate nursing students' information technology skills by determining how informatics content was represented in the curriculum. Researchers determined

students were not routinely exposed to computerized systems in the class room and may not be prepared to use IT. No syllabi addressed informatics knowledge competencies. Researchers concluded that students received insufficient exposure to informatics and were at risk for being insufficiently prepared to use information technology. Recommendations included increasing exposure to nursing informatics within the BSN curriculum. No reliability/validity data was provided for the instrument used in this study (Ornes & Gassert, 2007).

### **Survey of Beginning Nurse Competencies**

Desjardins, Cook, Jenkins & Bakken (2005) evaluated the effect of an informatics curriculum on nursing informatics competencies among undergraduate students using a modified version of the tool developed by Staggers, et al (2001, 2002). The researchers used a repeated-measures, non-equivalent comparison group design to measure differences in self-rated informatics competencies before and after a curriculum on Informatics for Evidence Based Practice (IEBP). Students were not competent in information literacy at the beginning of the BS/MS Program, despite having a bachelor's degree in another field. Significant increases were reported from admission to graduation in most or all of the cohorts studied. Findings suggested incorporating informatics into the curriculum was successful. However, all data was self-reported, and information concerning the validity or reliability of the survey tool was not provided (Desjardins, et al., 2005).

### **Computer Competencies Survey and Assessment Tool**

Elder and Koehn (2009) observed undergraduate nursing students may perceive computer skills to be higher than ability to perform them, suggesting that actual competencies may be even lower than reported. The researchers compared the self-rated computer competencies among incoming nursing students' (n=87) with their ability to perform those skills on assessment. The

Computer Competencies Survey tool was developed by the researchers and included Likert-type scale items asking students to rate themselves from expert to no experience. The survey was followed by completion of the Computer Competencies Assessment, a 40 question computer-graded assessment also created by the researchers. Correlation coefficients showed a low, but significant correlation for the survey and assessment ( $r=0.282$ ;  $p<0.05$ ). No psychometric data describing the reliability and validity of either tool was provided. Findings from this study suggested that students frequently “did not have an adequate grasp of basic computer knowledge”, as demonstrated by high self-ratings and low performance scores (Elder & Koehn, 2009).

### **Gassert/McDowell Computer Literacy Survey**

McDowell and Ma (2007) surveyed 411 students on admission and 429 upon graduation from a baccalaureate nursing program to compare differences in computer experience between program entrance and exit. Significant increases in experience were noted with word processing, e-mail, and Internet experience, but little improvement was noted in information literacy, or advanced skills, such as spreadsheets and use of data bases. Results suggested that “nursing education programs currently may not be providing beginning nurses with the tools needed to effectively and efficiently work in the technology-rich healthcare arena” (2007, pg. 30). No reliability or validity data was provided for the research instrument.

### **TIGER Initiative Informatics Competencies**

The TIGER Initiative Informatics Competencies instrument was developed to measure self-perceptions of nursing informatics competency (Hunter, McGonigle & Hebda, 2013). The 231 items on the instrument were selected from three other instruments already in existence following three rounds of reviews by content experts. The basic-computer-skills items (108)

came from European Computer Driver License computer literacy course ( 2012). The information literacy items (47) were adapted from the American Library Association's Information-Literacy Standards (2012). The source of items for clinical information management (76) came from the Health Level Seven electronic health-record-system functional model (2004). Content Validity Index (CVI) was calculated on each subset of NI competencies and demonstrated moderate validity: Information Literacy=1.0; Clinical information Management=1.0; Basic Computer Skills=1.0. The instrument was piloted with 184 participants ranging in age from 26-70 years (161 of the respondents were RNs). The majority of participants ranked themselves as expert on most of items on the survey, with lesser confidence on information literacy related items. Limited reliability/validity data was provided, as this report focused on instrument development. The researchers stated an analysis of each item will be forthcoming and reported in a future article (Hunter, McGonigle & Hebda, 2013).

### **Informatics Competency Questionnaire**

Hwang & Park (2011) conducted a cross-sectional study among nurses in Seoul, Korea. The 292 item questionnaire measured self-perceptions of informatics competency, basic computer skills, attitudes toward computers and population. Informatics competency positively correlated with basic computer skills and formal informatics education. The majority of nurses (69.2%) rated informatics competencies below average and more than half (58.9%) rated computer skills as below average. Content validity was examined by three informatics experts. Principal component factor analysis with varimax rotation revealed factor loadings ranging from .41 to .81. Based on principal component analysis, factors were considered to be in the developmental stage. Study recommendations included enhancement of nursing curriculum with informatics content which includes basic computer skills (Hwang & Park, 2011).

## **Technology Skills Assessment Survey**

The Technology Skills Assessment Survey is an instrument developed by the researcher to assess the self-perceptions of technology skills among graduate Registered Nursing students (n=19) enrolled in their first semester of course work (Virgona, 2012). The survey tool included two qualitative and ten quantitative items measuring nurses' perceptions of current technology skills and the barriers to using and learning new technologies. Students generally rated themselves as novices with technologies (Word, Excel, HTML, Javascript, and online bill payment) other than social media and smart phones. Technology skills were not seen as critical when entering nursing, but critical for promotion. The major theme emerging from the qualitative data was the lack of in-house technology training resources, and the perception that certain technology skills were not valued by organizations (Virgona, 2012). Reliability and validity data were not included in this research report.

## **Competency Assessment Tool**

Choi and Zucker (2013) compared the informatics competencies of Doctor of Nursing Practice (DNP) students enrolled in the post-BS track (n=68) with students enrolled in the post-MS (n=64) using the Competency Assessment Tool. This 86 item instrument assessed 18 areas of informatics competency in the categories of computer skills, informatics knowledge, and informatics skills. The instrument was based on Stagers and colleagues competency statements for the beginning and experienced nurse (2001, 2002) with additional items added on information literacy (Bakken, et al, 2004 and Curran, 2003). The internal consistency reliabilities of the instrument were high, with a Cronbach's alpha for all items of .98. The Cronbach's alpha for the three competency categories was: computer skills .97, informatics knowledge .95, and informatics skills .93. Overall, students in the post-BS and post-MS tracks

were not competent in any of the three categories of informatics competency at the beginning of their first semester in the DNP Program. However, statistically significant improvement was observed in perceived informatics competencies in all three categories following a 14 week online informatics course ( $p < .05$ ). Recommendations included offering an informatics curriculum to improve the informatics knowledge and competency skills of DNP students, particularly computer skills for decision support (Choi & Zucker, 2013).

### **The SANICS**

The Self-Assessment of Nursing Informatics Competencies Scale (SANICS) is the instrument chosen for this study. The internal consistency reliabilities of the instrument are high. The SANICS was developed to assess the informatics competencies of nursing students and practicing nurses using a valid, reliable means of measurement. This instrument is primarily based on the informatics competencies developed by Stagers and colleagues, for beginning and novice level informatics users (Stagers, Gassert, & Curran, 2002). Additional items were added to the SANICS to include standardized terminologies, evidence-based practice, and wireless communications. The SANICS contains 30 items designed to measure informatics competencies with descriptors ranging from 1 (not competent) to 5 (expert) (2009). The instrument was initially tested on a sample of 336 students completing the baccalaureate portion of a combined BS to MS Nursing program following an informatics curriculum. Exploratory principal components analysis with oblique promax rotation extracted a five-factor structure which explained 63.7% of the variance. Those factors were as follows: Basic Computer Knowledge and Skills (Cronbach's alpha = 0.94), Applied Computer Skills: Clinical Informatics (Cronbach's alpha = 0.89), Clinical Informatics Role (Cronbach's alpha = 0.91), Clinical Informatics Attitudes (Cronbach's alpha = 0.94), and Wireless Device Skills (Cronbach's alpha = 0.90).

Responsiveness of the SANICS was supported by significantly improved scores following completion of an informatics course.

The studies summarized below describe how the SANICS was used to measure informatics competencies in nursing student populations. Data describing the psychometric performance of the SANICS is included, where available.

### **Choi**

The SANICS was the chosen instrument in a study to compare informatics competencies of 131 nursing students in three undergraduate tracks: Traditional Pre-Licensure, RN to BSN, and Accelerated BSN (Choi, 2012). Students from each group were found to differ significantly in overall informatics competency ( $F(2, 92)=4.31, p=.02$ ). The RN to BSN students were significantly more competent (mean=3.21) than Traditional Pre-Licensure students (mean=2.82) ( $p=.02$ ). The SANICS showed high internal consistency reliabilities. Cronbach's alpha for the total scale was .95. Subscale alphas ranged from .93 for "Basic computer knowledge and skills" to .89 for "Clinical informatics role" and "Wireless Device Skills". The researcher recommends future research to identify factors affecting informatics competency, such as age, gender, basic computer skills, level of nursing experience, or formal informatics education (Choi, 2012).

### **Choi & De Martinas**

The informatics competencies of 289 undergraduate and graduate students were examined using the SANICS (Choi & De Martinas, 2013). The internal consistency reliabilities of the instrument were high. The Cronbach's alpha for each subscale was calculated for each of the five factors, as follows: Basic Computer Knowledge and Skills (0.94); Applied Computer Skills (0.90) Clinical Informatics Role (0.89); Clinical Informatics Attitudes (0.90); and Wireless Device Skills (0.87). Overall, students were found to be competent in informatics: Graduate

students reported a higher informatics competency mean (3.23, SD = 0.70) than undergraduate students (3.01, SD = 0.72) ( $t = 2.35, p = 0.02$ ). Study findings indicate that students in both programs were most confident in their basic computer skills and informatics attitudes. However, students from both programs perceived themselves to be less competent in the areas of applied computer skills and clinical informatics role.

### **Choi & Bakken**

The psychometric properties of the SANICS were examined in nursing students attending an undergraduate (n=131) and graduate (n=171) program. The five-factor structure of the instrument was valid, and accounted for 69.38% of the variance. The Cronbach's alpha was 0.96 for the total scale with subscales ranging from 0.94 for basic computer knowledge and skills to 0.84 for data/information management skills. The SANICS showed good responsiveness (standardized response mean =0.99). Significant improvement in competency scores among students with diverse demographic and educational backgrounds was demonstrated following completion of an informatics course. Construct validity using a known group approach was supported by significantly higher mean scores for graduate compared to undergraduate students. Researchers concluded the SANICS is a psychometrically sound for nursing students with diverse demographic and educational backgrounds.



Table 1

*Informatics Competency Instruments*

Name and Source of Items	Researcher and Year	# of Items	Population	Psychometric Characteristics	Education or Training Intervention	Findings
<p><b>Survey of Beginning Nurse Competencies</b></p> <p>Based on 43 beginning nurse informatics competencies Stagers, et al (2001, 2002).</p> <p>Additional EBP items added based on a survey of directors at Columbia University Bakken, et al. (2004)</p>	Desjardins, Cook, Jenkins & Bakken (2005)	39-44 items, varied by survey version	274 nursing students completing year one of a BS/MS Program	No validity/reliability data	No Intervention	Students were not competent in information literacy at the beginning of the BS/MS Program, despite having a bachelor's degree in another field. Significant increases reported from admission to graduation in most or all of cohorts studied
<p><b>Gassert/McDowell Computer Literacy Survey</b></p> <p>McDowell &amp; Ma (2007)</p>	McDowell & Ma (2007)	11	840 admitted and graduated nursing students over an eight year period	No validity/reliability data	Matriculating or completion of nursing program curriculum	Statistically significant increases were reported in experience and computer ownership during the eight year study period

<p><b>Computer Competencies in the Curriculum Matrix</b></p>	<p>Ornes &amp; Gassert (2007)</p>	<p>Not Provided</p>	<p>Tool developed to evaluate informatics competencies within syllabi of 18 courses.</p>	<p>No validity/reliability data</p>	<p>Not Applicable</p>	<p>Students were not routinely exposed to computerized systems and may not be prepared to use IT. No syllabi addressed informatics knowledge competencies</p>
<p><b>Graduating Nurses' Self-Evaluation of Computer Competencies Survey</b></p>	<p>Fetter (2009)</p>	<p>43</p>	<p>42 graduating seniors</p>	<p>“Lacked the rigor of formal research since reliability data were not collected”</p>	<p>No Intervention</p>	<p>Majority of graduating students self-rated as having moderate ability on novice nurse standardized competencies</p>
<p>Based on Staggers, et al. (2001) novice nurse competencies</p>				<p>No validity/reliability data</p>		

<p><b>Computer Competencies Survey and Computer Competency Assessment Tool</b></p>	<p>Elder &amp; Koehn (2009)</p>	<p>40</p>	<p>61 first and second semester nursing students and RN-BSN completion students</p>	<p>Content validity, questions, and skills tested were derived from textual concepts used in a basic computer course.</p> <p>Correlation coefficients were computed for survey and assessment scores and showed a low but significant correlation (<math>r = 0.282, p &lt; 0.05</math>).</p>	<p>Pre-test to self-assess current computer competency followed by computer assessment of ability to perform skills</p>	<p>Results suggested that students rated their skills higher than their actual performance of computer skills.</p> <p>Limited reliability/validity studies</p>
<p>Both tools developed by the researchers Elder &amp; Koehn (2009)</p>						
<p><b>Computer Literacy Scale for Newly Enrolled Nursing Students</b></p>	<p>Lin (2011)</p>	<p>24</p>	<p>270 first year undergrads</p>	<p>Used context validity index (CVI) to test the content validity of computer literacy measurement items. Confirmatory factor analysis showed the scale possessed good content validity, reliability, convergent validity, and discriminant validity.</p>	<p>No Intervention</p>	<p>Participants earned the highest scores for the network domain and the lowest score for the hardware domain</p> <p>Appears to be an excellent computer literacy assessment for newly enrolled nursing students</p>
<p>Based on Ministry of Education (MOE) course guidelines and relevant literature on computer literacy and competency (2008)</p>						

<b>Informatics Competency Questionnaire</b>	Hwang & Park (2011)	40	292 hospital nurses	Cronbach alpha coefficient = .79; Principal component factor analysis with varimax rotation revealed factor loadings ranging from .41 to .81. Content Validity was examined by three informatics experts.	No intervention	More than two-thirds felt they had insufficient informatics competency and more than half rated computer skills below average.  Based on principal component analysis, factors were considered to be in the developmental stage.
<b>The eNNI Project</b>	Rajalahti, Saranto (2012)	158	136 nurse educators, novice and experienced RNs, other nurse professionals in Finland	No validity/ reliability data	Education provided on electronic nursing documentation and information communication technology (ICT)	The NI skills of the participants and educators did not improve during the project  No reliability/ validity studies

<p><b>Technology Skills Assessment Survey</b></p>	<p>Virgona (2012)</p>	<p>12</p>	<p>19 graduate Registered Nursing students enrolled in first semester of course work</p>	<p>No validity/ reliability data</p>	<p>No intervention</p>	<p>Students perceived technology skills as not critical when entering nursing but critical for promotion. Lack of training resources were identified as a barrier</p>
<p><b>Competency Assessment Tool</b></p>	<p>Choi, Zucker 2013</p>	<p>86</p>	<p>68 post-BS compared to 64 post-MS</p>	<p>Cronbach's alpha for all items was .98. The Cronbach's alpha for the three competency categories was: computer skills .97, informatics knowledge .95, and informatics skills .93.</p>	<p>14 week online informatics course</p>	<p>Students were not informatics competent at the beginning of their first semester. Statistically significant improvement in all categories reported after completion of informatics course.  The internal consistency reliabilities of the instrument were high.</p>

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**TIGER Initiative  
Competencies**

<p>Basic computer skills (108) came from European Computer Driver License (ECDL, 2012). Information literacy items (47) were adapted from the American Library Association's Information Literacy Standards (2012). Source for clinical information management (76) came from Health Level Seven electronic health record system functional model (2004).</p>	<p>Hunter, McGonigle &amp; Hebda (2013)</p>	<p>231</p>	<p>184 ranging in age from 26-70 years</p>	<p>Limited reliability/ validity studies</p> <p>Content Validity Index (CVI) was calculated on each subset of NI competencies: Information Literacy = 1.0; Clinical information Management = 1.0; Basic Computer Skills = 1.0.</p>	<p>No Intervention</p>	<p>Focused on instrument development.</p> <p>Analysis of each item to be reported in future article.</p>
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**Self-Assessment of Nursing Informatics Competency Scale (SANICS)**

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<p><b>Self- Assessment of Nursing Informatics Competencies Scale (SANICS)</b></p> <p>Yoon, Yen &amp; Bakken (2009)</p> <p>Primary source was Staggers, et al., (2001, 2002) beginning and experienced nurse informatics competencies</p>	<p>Yoon, Yen &amp; Bakken (2009)</p>	<p>93</p>	<p>Combined BS/MS nursing students in 2006-07 (N=336)</p>	<p>Principal component analysis with oblique promax rotation extracted five factors: clinical informatics role (<math>\alpha = .91</math>), basic computer knowledge and skills (<math>\alpha = .94</math>), applied computer skills: clinical informatics (<math>\alpha = .89</math>), nursing informatics attitudes (<math>\alpha = .94</math>), and wireless device skills (<math>\alpha = .90</math>).</p>	<p>Informatics curriculum which emphasized informatics tools to support patient safety mindfulness modeling and monitoring</p>	<p>Preliminary evidence exists for the reliability and validity of the SANICS</p> <p>Sample dependent-young with a high level of basic computer knowledge and skills</p>
<p><b>SANICS</b></p> <p>Yoon, Yen &amp; Bakken (2009)</p>	<p>Choi (2012)</p>	<p>30</p>	<p>131 nursing students from three tracks: Traditional Pre-Licensure, RN to BSN, and Accelerated BSN</p>	<p>Cronbach's alpha for the total scale was .95. Subscale alphas ranged from .93 for "Basic computer knowledge and skills" to .89 for "Clinical informatics role" and "Wireless device skills"</p>	<p>No intervention</p>	<p>RN to BSN students were significantly more competent (mean=3.21) than Traditional Pre-Licensure students (mean=2.82) (p=.02).</p> <p>The SANICS had high internal consistency reliabilities</p>

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<b>SANICS</b>	Choi & Bakken (2013)	30	131 undergrads 171 post-graduates	Cronbach's alpha of 0.96 for the total scale with subscales ranging from 0.94 for basic computer knowledge/skills to 0.84 for data/information management skills.	14-week online informatics course	Construct validity using a known group approach was supported by significantly higher mean scores for graduate students compared to undergraduate students.
Yoon, Yen & Bakken (2009)				The SRM was large (0.99) indicating the SANICS was responsive		The SANICS is psychometrically sound for nursing students with diverse demographic and educational backgrounds

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<p><b>SANICS</b> Yoon, Yen &amp; Bakken (2009)</p>	<p>Choi &amp; De Martinas (2013)</p>	<p>30</p>	<p>289 undergrad and graduate students</p>	<p>Cronbach's alpha for each subscale is below: Total (= 0.96) Basic computer knowledge and skills (0.94); Applied computer skills (0.90) Clinical informatics role (0.89); Clinical informatics attitude (0.90); Wireless device skills (0.87)</p>	<p>No intervention</p>	<p>Students were competent in informatics. Graduate students reported a higher informatics competency mean (3.23, SD = 0.70) than undergraduate students (3.01, SD = 0.72) (<math>t = 2.35</math>, <math>p</math> = 0.02).  The internal consistency reliabilities of the instrument were high</p>
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## **Informatics Training and Assessment**

The Technology Informatics Guiding Educational Reform (TIGER) Collaborative issued a Call to Action requesting education and training interventions which foster information technology innovation and adoption by nurses (2008). Essential skills for clinicians were identified as basic computer competencies and information literacy (2008). While the need for improved informatics competencies has been well established for more than 25 years (Ball, 1984; Graves, 1989; Herbert, 1999; Saba & McCormick, 1996; Scholes & Barber, 1980; Staggers, Thompson, Happ & Bartz, 1998; Turley, 1996), there remains a lack of training resources for nurses (Ball, et. al, 2011). Informatics competency is also essential for students enrolled in web based and web enhanced coursework commonly used to deliver nursing education (Virgona, 2013). Education and training interventions described in the literature are typically limited to informatics content modification for a single course (Bakken, Sheets, Cook, Curtis, Soupios, Curran, 2003), or curricular revisions which measure informatics competency from program entry to program exit (McDowell & Ma, 2007). Research has consistently supported the effectiveness of courses which address the lack of informatics competencies of nursing students (Choi & Bakken, 2013; Desjardins, Cook, Jenkins & Bakken, 2005; Shorten, Wallace & Crookes, 2001; Tarrant, et al, 2008; and Wallace, Shorten, Crookes, McGurk, & Brewer, 1999). Unfortunately, only half of nursing programs teach information literacy skills (McNeil, et al., 2005; Pilarski, 2011).

Nurses work in complex, fast paced environments where they must quickly process data and form clinical judgments which ultimately guide patient care (Kossman, Bonney & Kim, 2014). Universal adoption of informatics competencies will require access to on-demand training resources available “at any time and from any site” (Ball, et al., 2011, p. 445).

Educational strategies limited to the occasional informatics course, or initiative which require matriculation through an entire nursing program are insufficient and inadequate to meet the growing informatics competency needs of busy nurses in practice, or a technologically dependent nursing profession as a whole (Ball, et al., 2011).

A comprehensive review of the literature was conducted for training interventions which used instruments to measure informatics competencies (computer skills and/or information literacy) following a training intervention. This review identified a lack of web based training resources and accompanying instruments to measure outcomes resulting from the delivery of informatics training. Due to the paucity of empirical studies, the search for informatics training resources for nurses with valid/reliable instruments was expanded to include 1) works published since 1995, and 2) published resources/tools used in general education to measure computer competency or information literacy before and/or after informatics training. These results yielded only eight such informatics training resources in the scholarly literature or via public access. Of these resources, only two included measurement tools. Review of curriculum-based informatics instruction and/or health record simulation training sites was excluded from this search. Training resources identified by this review are described in the following discussion, and summarized in Table 2.

### **European Computer Driver's License (ECDL) Certification**

The Task Force of the Council of European Professional Informatics Societies (1997-2014) developed the European Computer Driver's License (ECDL) Certification Program as a way to promote standardization of information technology skills within the IT industry and for the general population. The subscription based ECDL online modules include computer essentials, online essentials, word processing and spreadsheets. Additional training options (fee

based) include presentations, using databases, web editing, image editing, project planning, IT security, online collaboration, and health information storage. The TIGER Informatics Competencies Team offered their endorsement of the ECDL and recommends training for nurses using the Basic Computer Competencies Modules. The ECDL is the world's largest end-user computer skills certification program, has been used by more than 7 million users, and has "a very well developed and mature training program, work book, and testing process" (TIGER, 2008). The ECDL's Basic Computer Competency training is comprised of the seven modules outlined below:

- Module 1 – Concepts of Information Technology (IT)
- Module 2 – Using the Computer and Managing Files
- Module 3 – Word Processing
- Module 4 – Spreadsheets
- Module 5 – Database
- Module 6 – Presentation
- Module 7 – Information and Communication

While ECDL training is endorsed by the TIGER Collaborative, its modules are generalized for use in a wide range of industries and do not address essential computer skills required in healthcare, or the unique challenges of the healthcare setting (eg. HIPAA, meaningful use, interoperability, etc.). Validity and reliability measurements for the tools used for ECDL assessments are not available online, and were refused upon request of this researcher.

### **TIGER Virtual Demonstration Center**

As mentioned above, the TIGER Collaborative has recommended the ECDL program as a computer competency training option for nurses (2008). However, a new subscription based,

Virtual Demonstration Center (2013) sponsored by the TIGER Collaborative, was recently launched as a virtual conference, simulation and training site for nurses. The Demonstration Center contains web based informatics resources, including links to clinical simulations, as well as observable and interactive demonstrations. Links are embedded within the Center's web pages allowing users to navigate to other sites which support the development of informatics competencies. Access to the Center also includes webinars and educational sessions covering electronic health records, usability, clinical decision support, meaningful use, health information exchange, and interoperability. The vision of the TIGER Virtual Demonstration Center is to provide "highly effective and efficient, technology-enabled, solutions of exemplary healthcare delivery systems of the next three to ten years" (2013). An online instrument, (The TIGER Online Self-Assessment Tool) has been designed and piloted which measures self-perceptions of informatics competencies. This instrument has demonstrated moderate content validity (Hunter, McGonigle & Hebda, 2013).

### **Nursing Resources: A Self-Paced Tutorial and Refresher**

An online training resource entitled "Nursing Resources: A Self-Paced Tutorial and Refresher" is available via open source through New York University's (NYU's) Library (Jacobs, 2014). The site includes four self-paced online modules covering the following topics:

- Beginner's Research Guide – Literature search, locating articles, background questions, Search strategies, citing, and locating full text articles.
- Evidence Based Nursing- Locating the best evidence, developing the research question, expanding the search for evidence, specialized databases, and clinical guidelines.
- Web Resources – Searching the web, search engines, web directories, consumer health information, and evaluating the web.

- Tools – Saving search histories

Learners move through the site using navigational arrows at the bottom of each page.

The site is not interactive and skill demonstrations, or the use of assessments or evaluation tools, are not options on this site.

### **IC<sup>3</sup> Training and Certification Program**

The IC<sup>3</sup> Training and Certification Program is available online through Pearson Vue Business (2000). The site targets incoming college students who may need computer remediation or employers who may wish to use its assessment capabilities as a screening tool for new job candidates. Certification comprises individual examinations for computing fundamentals, key applications (word processing, spreadsheet and presentation software), and living online (internet and networking). A convenience feature found on this site is the “IC<sup>3</sup> Fast Track” which allows literacy skills to be quickly assessed. This resource is only available commercially, with an option to purchase bulk user licenses. Certification is achieved through successful completion of a “one time test. Approximately 175,000 examinations are administered monthly in 148 countries and in 27 languages. Benefits of IC<sup>3</sup> certification are described as a means to “validate digital literacy skills”, although no published data regarding the site’s effectiveness, or the psychometric properties of instrument could be located. Pearson Vue denied requests by this researcher to provide data describing the performance of the training site or assessment tool.

### **The Passport Project for Nursing Success**

The purpose of the Passport Project for Nursing Success was to “assess the skills, knowledge, and informatics comfort level of students, while providing computer training and teaching for beginning nursing students in an undergraduate nursing program” (Edwards &

O'Connor, 2011). A survey was created by the researchers since “no tools with measured reliability and validity were available upon a review of the literature” (p. 5). The survey was administered to incoming students’ (n=90) to measure self-perceived informatics competencies and learning needs. Following this initial assessment, students completed seven self-paced online learning modules housed in the Blackboard LMS. On-line tutorials with questionnaires and demonstration assignments were incorporated into the modules to facilitate learning needs of the students. These modules included:

- Module 1: Basic Computing
- Module 2: Nursing Program Handbook
- Module 3: College Orientation & Resources
- Module 4: Netiquette
- Module 5: Managing Documents
- Module 6: Research & APA
- Module 7: On-line Testing

Evaluation of learning was based on the ability to perform various functions, including complete an interactive evaluation, construct and download a document, and using the quiz function within Blackboard. Five qualitative program evaluation questions yielded themes of appreciation for the training, and improved understanding of informatics and Blackboard. No reliability/validity data was available for any of the quantitative assessments used by the researchers. While the Passport Project was described in the literature by the authors, the actual site was not available for review.

## **Computer Competencies Tutorial**

St. Edward University's Computer Competencies Tutorial (1995-2007) is a web based, computer skills remediation tool for all incoming freshmen. Completion of this training was required during the years 1995-2007, but became optional during the years 2008-2011.

Descriptions of this online computer training resource are provided here for completeness only, as the Tutorial was removed as an active training site in 2013. No assessment instrument was used to measure the effect of training. The Computer Competency Tutorial consisted of five modules covering the following content:

- 1.) Introduction to Computers
- 2.) World Wide Web
- 3.) Introduction to Word Processing
- 4.) Introduction to Spreadsheets
- 5.) Multimedia

## **Information Literacy Tutorial**

The open source Information Literacy Tutorial, sponsored by Rutgers University, is a web based training site for nursing students (2008). This tutorial consists of three sections covering animated and/or video recorded content intended to improve information literacy. The Tutorial's content includes: formulate a research question, navigate CINAHL and Medline, find full-text articles, and employ RefWorks to store reference sources and produce bibliographies in proper APA format. The site is not interactive, requires no assignments, and uses no instrument to measure outcomes.



### **Pre-test for Attitudes Toward Computers in Healthcare (PATCH)**

The Pre-test for Attitudes Toward Computers in Healthcare (PATCH) is an open source, online tool for self-assessment of general nursing informatics competencies (Kaminski, 2011). Modules on the site provide information, links, and self-assessment checklists for a variety of computer based tasks. Attitudes regarding various computer skills are measured via an online survey, covering the following competency items: Word processing, keyboarding, spreadsheets, presentations, databases, desktop publishing, internet, e-mail, expert and decision support systems, multimedia, web development, telecommunications, nursing information systems, hospital information systems, peripherals, PDAs, nursing data and information, current computer literacy, life-long learning, computer-human interface dynamics, networking, basic computer configurations, protection for client data & information, and evidence based practice. A study of Turkish nurses (n=200) was conducted to assess the validity and reliability of the PATCH Scale (Kaya & Turkinaz, 2008). Test-retest reliability was 0.20-0.77 and 0.85 for the total scale. Item total correlation was 0.06-0.68 and Cronbach's Alpha was 0.92 (2008).

Table 2

*Non-Curricular Informatics Training Resources*

<b>Training Site/ Resources</b>	<b>Author(s)</b>	<b>Delivery Method</b>	<b>Population</b>	<b>Description of Training</b>	<b>Pre/Post Tests</b>	<b>Site</b>
European Computer Driver License (ECDL) Certification	Council of European Prof. Informatics Societies (1997-2014)	Developed the certification program as an online way of to promote information technology skills	General population and skill standardization within the IT industry.	ECDL base modules include computer essentials, online essentials, word processing and spreadsheets. ECDL Standard add on options include presentations, using databases, web editing, image editing, project planning, IT security, online collaboration, 2D CAD and Health Information Storage.	Not available	<a href="http://www.ecdl.org/programmes/index.jsp?pn=2931&amp;n=2954">http://www.ecdl.org/programmes/index.jsp?pn=2931&amp;n=2954</a>
Passport Project for Nursing Success	Edwards, J. & O'Connor, P. (2011)	7 self-paced online learning modules housed in Blackboard	Incoming nursing students n=90	On-line tutorials with questionnaires and demonstration assignments to facilitate learning needs of the students. 1: Basic Computing 2: Nursing Program Handbook 3: College Orientation & Resources	“No tools with measured reliability and validity were available upon a review of the literature”  Five program evaluation questions	<a href="http://www.thejeo.com/Archives/Volume8Number2/EdwardsandOConnorPaper.pdf">http://www.thejeo.com/Archives/Volume8Number2/EdwardsandOConnorPaper.pdf</a>

				4: Netiquette 5: Managing Documents 6: Research & APA 7: On-line Testing	only.	
Pretest for Attitudes Toward Computers in Healthcare (PATCH) Self-Assessment Tool	Kaminski (2011)	An online tool for self-assessment in general nursing Informatics competencies . Various competency taxonomies have been reviewed and integrated in the process.	Registered Nurses N=200 Turkish nurses	Modules Include: Word Processing, Keyboarding, Spreadsheets, Presentations, Databases, Desktop Publishing, Internet, Email, Decision Support Systems, Multimedia, Web Development, Telecommunications, Nursing Information Systems, Hospital Information Systems, Peripherals, PDAs, Data and Information, Computer Literacy, Life Long Learning, Computer-Human Interface and EBP	Test-retest reliability was 0.20-0.77, for the total scale was 0.85. Item total correlation was 0.06-0.68 and Cronbach's Alpha was 0.92.	<a href="http://nursing-informatics.com/niasse/plan.html">http://nursing-informatics.com/niasse/plan.html</a>
Nursing Resources: Self-Paced Tutorial and Refresher	Kaplan (2014). New York University	Online instructional tool consisting of 4 modules	Nursing Students	This tutorial encompasses a beginner's research guide, web resources, tools, and evidence based practice only.	No instrument	<a href="http://nyu.libguides.com/nursingtutorial">http://nyu.libguides.com/nursingtutorial</a>
Certiport IC <sup>3</sup> Internet and	Pearson Vue Business	One hour online competency	Incoming college students or	IC <sup>3</sup> Fast Track can be used to gauge digital literacy	One-time fee based test	

Computing Certification	(2000)	test	screening tool for new job candidates.	skills. Certification comprises individual examinations for computing fundamentals, key applications (word processing, spreadsheet and presentation software), and living online (internet and networking )	No published data	<a href="https://www.certiport.com/portal/common/documentlibrary/IC3_GS4_Program_Overview.pdf">https://www.certiport.com/portal/common/documentlibrary/IC3_GS4_Program_Overview.pdf</a>
Information Literacy Tutorial	Rutgers University Library (2008)	3 online sections	Nursing Students	Tutorial: Used to formulate a research question, navigate CINAHL and Medline, find full-text articles, and employ RefWorks to store reference sources and produce bibliographies in proper APA format	No instrument	<a href="http://www.libraries.rutgers.edu/rul/rr_gateway/research_guides/nursing/tutorial/">http://www.libraries.rutgers.edu/rul/rr_gateway/research_guides/nursing/tutorial/</a>
Computer Competency Tutorial	St. Edward's University (1995-2011)	5 self-paced online modules	Incoming freshmen requirement until 2009. Currently optional	Five Modules: 1.) Introduction to Computers 2.) World Wide Web 3.) Introduction to Word Processing 4.) Introduction to Spreadsheets 5.) Multimedia	Inactive Test Link  No instrument	<a href="http://academic.stedwards.edu/competency/module2/Lesson1/wwwandintegrated.htm">http://academic.stedwards.edu/competency/module2/Lesson1/wwwandintegrated.htm</a>
					The TIGER Online Self-Assessment	

The TIGER Virtual Demonstration Center	TIGER and Hunter, McGonigle & Hebda, (2013)	Web based conference and simulation center	Nurses and nursing students	Web based informatics resources, including links to simulations, as well as observable and interactive demonstrations	Tool-designed and piloted; measures self-perceptions of informatics competency; moderate content validity	<a href="http://www.thetigerinitiative.org/virtuallearning.aspx">http://www.thetigerinitiative.org/virtuallearning.aspx</a>
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### Summary

For more than 30 years, authoritative nursing bodies have urged the nursing profession to strategically address informatics competency for all nurses. Despite persistent recommendations from the ANA, AACN, NLN, TIGER and IOM regarding the critical need for an informatics competent nursing workforce, nurses still frequently lack essential informatics competencies, including basic computer skills. Evidence based practice depends upon ability to use and apply information technology skills, such as searching data bases and using nursing-specific software. Studies of nurse executives and academicians describe a nursing profession which remains insufficiently prepared with basic informatics skills upon entry to practice. Research supports the effectiveness of courses which address the lack of informatics competencies of nursing students, with recommendations that priority be given to groups possessing low computer proficiency. Unfortunately, nursing programs have been slow to incorporate information literacy skills into the curricula. Informatics training programs which could support nurses in practice are sparse in the literature. Curriculum based instruction alone is no longer sufficient for nurses attempting to keep pace in a fast paced technology-rich healthcare environment. Finally, this review identified few or insufficiently validated instruments which could be used to measure

empirical outcomes resulting from delivery of nursing informatics training. The sparse number of empirically supported informatics training resources and evaluative tools is inconsistent with recommendations from official nursing and health organizations calling for a deliberate, systematic approach to improve the basic computer skills and information literacy of the nursing profession.

The SANICS has become a nationally recognized instrument with numerous empirical studies attesting to its internal consistency reliability, responsiveness, and factorial validity (Choi, 2012; Choi & Bakken, 2013; Choi & De Martinas, 2013). Studies of the SANICS to date have focused on a variety of nursing student populations engaged in curriculum based instruction. However, no studies to date have examined the effectiveness of the SANICS instrument when used in a population of undergraduate nursing students before and after a self-directed, web-based, informatics training program, such as SOLO-IT.

Curriculum-based instruction alone is no longer sufficient for nurses attempting to keep pace in a fast paced technology-rich healthcare environment. Diffusion of informatics competencies throughout the nursing workforce could depend upon the availability and usability of on-demand training resources focused on the needs of the self-directed learner. Further testing is necessary to examine the psychometric properties of the SANICS in a sample of BSN entry-level nursing students. Principal component analysis will be used to examine the factor structure of the SANICS. Internal consistency reliability will be used to determine if the SANICS is responsive over time when used to measure informatics competencies.

## **Chapter III**

### **Research Methodology**

#### **Introduction**

A comprehensive search of informatics training resources revealed a significant gap in the literature regarding the availability of these resources, and a lack of valid, reliable tools to measure informatics competencies. This study will use psychometric analyses as a means to quantify the precision of the Self-Assessment of Nursing Informatics Competency Scale (SANICS). The psychometric performance of the SANICS will be evaluated before and after completion of Successful Online Learning and Orientation: Informatics Training (SOLO-IT) for nursing students. Principal component analysis will be used to examine the factor structure of the SANICS. Internal consistency reliability will be used to determine if the psychometric properties of the SANICS remain consistent in a sample of BSN entry-level nursing students and if the SANICS is responsive over time when used to measure informatics competencies. This study will also evaluate the mean rating differences of the SANICS instrument before and after completion of SOLO-IT. Construct validity of the SANICS will be assessed using a known group approach to compare differences in means for each SANICS subscale (construct) before and after completion of SOLO-IT modules.

#### **Research Questions**

- 1) What are the psychometric properties of the SANICS among a population of BSN entry-level students?
- 2) Is the SANICS responsive over time when used to measure informatics competencies following completion of Successful Online Learning and Orientation (SOLO) Informatics Training (IT) modules?

- Hypothesis: There will be a significant difference in SANICS scores between pre-SOLO and post-SOLO.

### **Research Design**

Successful Online Learning and Orientation: Informatics Training (SOLO-IT) is a web based remediation tool designed and created by the researcher to enhance the informatics competencies (computer skills and information literacy) of nursing students (Godsey, 2011). Online modules were designed to be self-guided and self-paced to allow nursing students to learn, practice and demonstrate informatics competencies using common technological tools embedded into the Blackboard™ learning management system (Godsey, 2011). This study will explore the psychometric performance of the SANICS instrument using archived survey data collected before and after completion of SOLO-IT. A one-group pre/post-test design using the 30-item SANICS was utilized in a sample of undergraduate nursing students. The survey design provides a “quantitative or numeric description of trends, attitudes, or opinions of a population by studying a sample of that population” (Creswell, 2009, p. 145). Surveys comprised of competency items contained within the SANICS instrument were administered via Survey Monkey to student volunteers prior to and at the completion of SOLO-IT. Permission to use the SANICS (2009; Appendix A) was requested and granted by Dr. Yoon and colleagues.

### **Conceptual Definitions**

#### **Informatics**

The ANA defines nursing informatics as “a specialty that integrates nursing science, computer science, and information science to manage and communicate data, information, and



knowledge in nursing practice” (2008, p. 177). The ANA’s (2001) position statement also describes the relevance of informatics to nursing practice:

Nursing informatics facilitates the integration of data, information, and knowledge to support patients, nurses and other providers in their decision-making in all roles and settings. This support is accomplished through the use of information, information processing, and information technology (p.17).

### **Informatics Competency**

Staggers and colleagues made a significant contribution in the area of nursing informatics when they defined the competencies, skills, knowledge, and abilities necessary for nurses based on educational preparation and expertise: beginning nurse, experienced nurse, informatics nurse specialist, and informatics innovator (Staggers, Gassert, & Curran, 2002). Since the present study concerns measurement of nursing informatics competencies among undergraduate nursing students, the following discussion of informatics competency (informatics knowledge and computer skills) is limited to the beginning nurse only.

**Informatics Knowledge.** Informatics knowledge needed for nurses at the beginner level has been categorized into data, impact, privacy/security, and systems information and is described below (Staggers, Gassert, & Curran, 2002).

#### 1. Data

- Recognizes the use and/or importance of nursing data for improving practice

#### 2. Impact

- Recognizes that a computer program has limitations due to its design and capacity of the computer

- Recognizes that it takes time, persistent effort, and skill for computers to become an effective tool
- Recognizes that health computing will become more common
- Recognizes that the computer is only a tool to provide better nursing care and that there are human functions that cannot be performed by computer
- Recognizes that one does not have to be a computer programmer to make effective use of the computer in nursing

### 3. Privacy/security

- Seeks available resources to help formulate ethical decisions in computing
- Describes patients' rights as they pertain to computerized information management

### 4. Systems

- Recognizes the value of clinicians' involvement in the design, selection, implementation, and evaluation of applications, systems in health care
- Describes the computerized or manual paper system that is present
- Explains the use of networks for electronic communication (e.g., Internet)
- Identifies the basic components of the current computer system (e.g., features of a PC, workstation. (p.3)

**Computer Skills.** Stagers and colleagues outlined beginner level computer skills in the competency categories of administration, communication, data access, documentation, education, monitoring, basic desktop software and systems skills (2002). A beginner level computer competent nurse possesses the following skills:

#### 1. Administration

- Uses administrative applications for practice management (e.g., searches for patient demographics, billing data)
- Uses applications for structured data entry (e.g., patient acuity or classification applications)
- Communication (email, internet, telecommunications)
- Uses telecommunication devices (e.g., modems or other devices) to communicate with other systems (e.g., access data, upload, download)
- Use e-mail (e.g., create, send, respond, use attachments)
- Uses the Internet to locate, download items of interest (e.g., patient, nursing resources)
- Data access
- Uses sources of data that relate to practice and care
- Accesses, enters, and retrieves data used locally for patient care (e.g., uses HIS, CIS for plans of care, assessments, interventions, notes, discharge planning)
- Uses database applications to enter and retrieve information
- Conducts on-line literature searches
- Documentation
- Uses an application to document patient care
- Uses an application to plan care for patients to include discharge planning
- Uses an application to enter patient data (e.g., vital signs)
- Education
- Uses information management technologies for patient education (e.g., identifies areas for instruction, conducts education, evaluates outcomes, resources)

- Monitoring
- Uses computerized patient monitoring systems
- Basic Desktop Software
- Uses multimedia presentations
- Uses word processing
- Demonstrates keyboarding (typing) skills
- Systems
- Uses networks to navigate systems (e.g., file servers, www)
- Operates peripheral devices (e.g., bedside terminals, hand-helds)
- Uses operating systems (e.g., copy, delete, change directories)
- Uses existing external peripheral devices (e.g., CD-ROMs, zip drives)
- Uses computer technology safely
- Is able to navigate Windows (e.g., manipulate files using file manager, determine active printer, access installed applications, create & delete directories)
- Identifies the appropriate technology to capture the required patient data (e.g., fetal monitoring device)
- Demonstrates basic technology skills (e.g., turn computer off & on, load paper, change toner, remove paper jams, print documents)

(pp. 1-2).

## Operational Definitions

### Entry Level Nursing Student

For the purpose of this study, an entry level nursing student is defined as any student enrolled in the first year (first or second semester) of a traditional Baccalaureate of Science in Nursing (BSN) program. Students enrolled in the Registered Nurse to Masters of Science in Nursing (RN to MSN) Program were excluded from data collection procedures.

**Blackboard™.** The Learning Management System (LMS) used to house SOLO-IT is called Blackboard. A LMS uses web-based technologies to plan, organize and deliver on-demand course content and also assess student performance and learner outcomes (Blackboard, 2004). Blackboard is one of the most popular LMSs nationally (Bradford, Porciello, Balkon, & Backus, 2007; Ferrin, 2013), and was the system of choice for the mid-western university which approved the conduct of this research and the completion of SOLO-IT by their BSN student population.

**Curricular Instruction.** Informatics specific content provided as part of a nursing school's curriculum. This type of instruction typically occurs as part of a didactic course and lasts for the duration of an academic semester or quarter. Curricular instruction may also refer to informatics content delivered during the time of the student's matriculation through the nursing program, not limited to a single course.

**Informatics Training.** Informatics training refers to delivery of informatics content and instruction as part of a brief, intensive, episodic program designed to increase the informatics competencies of participants. Informatics training typically involves self-directed learning and interactive teaching strategies which engage the learner to demonstrate competencies.

**Competency on the SANICS.** The SANICS instrument uses a Likert Scale ranging from 1 (not competent) to 5 (expert). Self-perceived competence is indicated by a minimum SANICS score of 3 (Yoon et al., 2009).

### **Instrumentation**

The SANICS was developed by researchers out of Columbia University School of Nursing (Yoon, et al, 2009; Appendix A). Development of this tool evolved primarily from a Delphi Study conducted by Staggers and colleagues which incorporates competencies for the beginner and experienced nurse (Staggers, Gassert & Curran, 2001). Additional items were added to the SANICS by the researchers in areas relating to standardized nursing terminologies, evidence based practice, and wireless communications (2009). The reliability and validity of the SANICS has been established using a combined sample of 337 BSN/MSN students (Yoon, et.al, 2009). Cronbach's  $\alpha$  measurements confirmed the internal consistency of related items within the scale. None of the inter-item correlations was less than  $\alpha = .89$ . Reliability coefficients of .70 or higher are usually considered acceptable by most researchers (Bruin, 2006). Independent t-tests confirmed the responsiveness of the SANICS over time and also measured the five categorical factors of the scale: 1) Clinical Role, 2) Basic Computer Knowledge, 3) Applied Computer Skills, 4) Clinical Informatics Attitudes, and 5) Wireless Device Skills. The sub-scales and individual items contained within the SANICS instrument are described below:

#### 1. Clinical informatics role

- As a clinician (nurse), participate in the selection process, design, implementation and evaluation of systems
- Market self, system, or application to others

- Promote the integrity of and access to information to include but not limited to confidentiality, legal, ethical, and security issues
- Seek resources to help formulate ethical decisions in computing
- Act as advocate of leaders for incorporating innovations and informatics concepts into their area of specialty

## 2. Basic computer knowledge and skills

- Use telecommunication devices
- Use the Internet to locate, download items of interest
- Use database management program to develop a simple database
- Use database applications to enter and retrieve information
- Conduct on-line literature searches
- Use presentation graphics to create slides, displays
- Use multimedia presentations
- Use word processing
- Use networks to navigate systems
- Use operating systems
- Use existing external peripheral devices
- Use computer technology safely
- Navigate Windows
- Identify the basic components of the computer system
- Perform basic trouble-shooting in applications

## 3. Applied computer skills: Clinical informatics

- Use applications for diagnostic coding

- Use applications to develop testing materials
- Access shared data sets
- Extract data from clinical data sets

#### 4. Clinical informatics attitudes

- Recognize that health computing will become more common
- Recognize human functions that cannot be performed by computer
- Recognize that one does not have to be a computer programmer to make effective use of the computer in nursing
- Recognize the value of clinician involvement in the design, selection, implementation, and evaluation of applications, systems in health care

#### 5. Wireless device skills

- Use wireless devices to download safety and quality care resources
- Use wireless devices to enter data

### **Method to Test the SANICS Instrument**

As described previously, the TIGER Collaborative has issued a call to action urging improved informatics competencies, increased educational resources, and affordable programs which foster information technology innovation and adoption by nurses (2008). In response to this call, TIGER urges the development of competency based training strategies utilizing pre- and post- test data as measure of effectiveness in meeting competencies (Ball, et al, 2008).

Successful Online Learning and Orientation: Informatics Training (SOLO-IT) is a web based remediation tool designed and created by the researcher to enhance and measure the informatics competencies (computer skills and information literacy) of nursing students (Godsey, 2011). Online modules were designed to be self-guided and self-paced to allow nursing students



to learn, practice and demonstrate informatics competencies using common technological tools embedded into the Blackboard™ LMS (Godsey, 2011).

**Sample.** The sample for this study will be taken from archived data collected from a population of 271 entry level nursing students during the Spring 2014 semester. All students enrolled in the first year of the Baccalaureate of Science in Nursing (BSN) Program were enrolled into SOLO-IT as a required assignment for most sections of an entry-level nursing course. Students were instructed to complete SOLO-IT's six modules during the first two weeks of the semester in order to prepare for web enhanced instruction. The location for this study was a medium sized, private university located in Cincinnati, Ohio with an enrollment of 6700 students, including 637 nursing students. Entry level nursing students were selected as the population for this study since they may be at risk for lacking the informatics competencies necessary to support and enhance their nursing education. Additionally, this population of students will have had minimal exposure to nursing informatics or the Blackboard learning management system (LMS) which houses course content and provides the educational framework for program matriculation.

### **SANICS and SOLO-IT**

Each competency measured by the five sub-scales of the SANICS has been incorporated (either specifically or broadly) into the six educational modules of SOLO-IT. The SANICS was administered as an analytical survey to measure self- perceptions of informatics competency (Yoon, et al., 2009; Appendix A). Analytical surveys “go beyond simple description; their intention is to illuminate a specific problem through focused data analysis, typically by looking at the effect of one set of variables upon another set” (Kelley, et al, 2003). An advantage of survey research is that it allows for the production of empirical data resulting from “real-world”

situations (Kelley, et al., 2003, p. 261). Survey research can also produce a large amount of data within a relatively short amount of time. Data resulting from representative samples can be generalizable to other populations (2003). Certain disadvantages can also be present with survey research. Response rates may be difficult to control, and data may lack detail or sufficient depth (2003).

The SANICS survey was administered before and after completion of SOLO-IT. The post survey also included Likert scale items, developed by the PI, measuring the experiences of learners taking the course, and evaluations of overall course quality. Completion of SOLO-IT also included successful submission of informatics assignments within the Blackboard™ LMS. Each module included quizzes and/or hands-on activities requiring actual demonstrations of computer competency and information literacy skills. To demonstrate competency, students were required to complete SOLO-IT with a minimum score of 92%, with no limit in the number of times students could repeat modules, exercises or assignments.

### **Instructional Design of SOLO-IT**

The structure of SOLO-IT provides an online framework where nursing students can improve competence with commonly used technological tools (Godsey, 2011). Content was designed to be consistent with the “beginner level” ICs identified by Staggers and colleagues (2001).

**Self-directed learning.** The principles of self- directed learning (SDL) were the guiding framework in the development of SOLO-IT. These principles emphasize the inherent responsibility of the student to contribute to his or her own learning (Chang, 2006; Fisher et al., 2001). Self-Directed Learning occurs “proactively, independently, and patiently” (Chang, 2006, p. 269). Students engaged in SDL are charged with a responsibility to learn, schedule time for

learning, and plan for integral learning as a means to meet an objective (Chang, 2006). The concept of individuals who are capable of understanding their own learning needs, goals, and requirements for learning has been widely studied since its introduction (Knowles, 1975). Self-directed learning means “learning something proactively, independently, and patiently; being responsible to learn; learning which is a challenge; a self- training ability and a high curiosity” (Chang, 2006, p. 269 ). Self-directed learning involves a process by which “learners take responsibility for planning, carrying out, and evaluating their own learning experiences” (DeMaris, 2012, p. 42). Self -directed learning requires learners assume an active role as investors in their own learning (Campbell, Campbell & Dickenson, 1996; Gureckis & Markant, 2012). Self- directed learning encourages students to assume some of the responsibility for their own learning and views the instructor as facilitator (Hunt, Sproat, & Kitzmiller, 2004). The flow of information intake is controlled by the learner in a manner that processes information into a usable form which can be understood and retained (Mikulak, 2012).

Self-directed learners historically perform better in online learning environments (Chou, 2012). In the online environment, SDLs can progress through content at their own pace, increasing the likelihood for retention of information which might otherwise be lost (Hunt, Sproat, & Kitzmiller, 2004). Self-directed learning is the most recommended educational model for competency skill development (Wang & Cranton, 2012).

### **SOLO’s Web-Based Modules**

Each of SOLO-IT’s six modules are embedded within the Blackboard Learning System™, the most popular distance learning platform used by institutions of higher learning (Ferriman, 2013). One of the key features of SOLO Informatics Training is the availability of supplemental tutorials which are easy to identify and select for the struggling new learner.

Supplemental links lead students to additional demonstrations, screen shots, narrative descriptions and competency based activities that reinforce content. Hands-on computer activities occur liberally throughout the course and are structured so that competency demonstrations are practiced repeatedly, in the absence of submission or time limits. A non-punitive approach to evaluation is also a feature of SOLO-IT. All quizzes, demonstrations and written assessments permit unlimited submissions and unlimited time for completion (see Appendix B for SOLO-IT Course Overview and Grading Criteria; Godsey, 2011). This ‘safe grading’ environment promotes repeated practice of computer and information literacy skills, in the absence of time constraints. The foundational intent of SOLO-IT is to be a repository of easily accessible, digitally based resources where professional students can learn and develop as competent informatics users. Students remain enrolled in SOLO-IT during the duration of their MSN Program progression, and may access or repeat training modules, as often as desired.

SOLO-IT consists of the following six modules:

- Module I: Introduction to SOLO-IT: Introduces nursing students to the features of SOLO-IT and the Blackboard platform. The objectives for this module include:
  1. Demonstrate the ability to navigate Blackboard
  2. Describe the purpose of the Successful Online Learning Orientation (SOLO-IT) course
  3. Perform a browser and software check to enable the necessary functions for successful course completion
- Module II- Navigating the Computer and Web: Introduces nursing students to the parts and functions of the computer and presents practice exercises for browsing the web. The objectives for this module include:
  1. Describe the parts and functions of a personal computer

2. Explore the use of the internet as a tool to inform nursing practice
  3. Demonstrate the ability to use and manage an email account
  4. Demonstrate understanding of the importance of anti-virus protection
  5. Demonstrate the ability to back up computer files
- Module III- Computer Applications: Presents computer applications commonly used by nurses, including spreadsheets, documents, and presentation software. The objectives for this module include:
    1. Apply the document construction principles of Microsoft Word, Excel, and Power Point
    2. Demonstrate the ability to save and edit documents
    3. Demonstrate the ability to create a folder for document organization
    4. Demonstrate the ability to create and use Excel spreadsheets
    5. Create a PowerPoint slide presentation
  - Module IV- Information Literacy: Presents library and web based research tools that support information literacy and Evidence Based Practice. The objectives for this module include:
    1. Explain the nursing research process
    2. Demonstrate effective use of search engines, such as Google Scholar
    3. Locate scholarly articles and journals that support nursing research and Evidence Based Practice
    4. Demonstrate the process for locating and evaluating scholarly articles and websites
    5. Discuss safeguards that should be applied when using social media
  - Module V- Preparation for Research: Presents an overview of professional writing and publication principles. The objectives for this module include:
    1. Describe plagiarism avoidance and copyright issues

2. Demonstrate the principles of scholarly writing using American Psychological Association (APA) format
- Module VI-Issues for the Professional e-Nurse: Introduces future e-nurses to professional issues encountered in the clinical setting. The objectives for this module include:
    1. Explore the role of nursing informatics in health care
    2. Describe how Information Technology (IT) is transforming healthcare
    3. Describe upcoming changes to healthcare due to the American Recovery and Reinvestment Act (ARRA) and the Accountable Care Act (ACA)
    4. Describe the roles and responsibilities of nursing in the area of health IT and Personal Health Information (PHI).
    5. Explain the difference between the electronic health record (EHR) and the electronic medical record (EMR).
    6. Outline opportunities for nursing in today's technology rich healthcare environment (Godsey, 2011)

Each SOLO-IT module requires various demonstrations of computer competency and information literacy. The following list outlines the competencies which students must demonstrate to successfully complete SOLO-IT:

- Understand the term hardware
- Understand the main components and functions of a personal computer
- Know the main parts of a computer
- Know the main types of storage media
- Identify the main input devices
- Know the main output devices

- Understand the term software
- Understand the principles of an operating system
- Identify and know the uses of common software
- Understand what the internet is and know its main uses
- Understand the concepts of downloading and uploading
- Understand the term electronic mail
- Understand the importance of having backup copy of files
- Know ways to prevent data theft
- Understand the term computer virus
- Know how to protect against viruses
- Understand the term copyright
- Know how to store files
- Identify common file types: word processing, spreadsheet, database
- Name files/folders
- Copy files
- Open, close a word processing application
- Create a new document
- Save a document to a location on a drive
- Created a PowerPoint containing a background and at least one graphic (or whatever the assignment was).
- Saved and attached documents
- Understand what the World Wide Web (www) is
- Explain the function of a web browser

- Understand and use a search engine
- Know how to identify a secure web site
- Open, close a web browsing application
- Enter a URL in the address bar and go to the URL
- Navigate to the home page
- Select a specific search engine
- Copy, text, image URL from a web page to a document
- Preview a web page
- Understand the term email and know its main use
- Understand the make-up and structure of an email address
- Understand the importance of network etiquette
- Understand the difference between To, CC, BCC fields
- Open, close an email application
- Create a new email
- Enter an email address into the To, CC, BCC fields
- Enter a title in the subject field
- Send an email
- Use the reply, reply to all function
- Forward an email
- Delete an email
- Access needed information effectively and efficiently
- Use information effectively to accomplish a specific goal (Godsey, 2011).



## **Plan for Data Collection and Analyses**

### **Process to Determine Study Feasibility**

This study required access to a significant population of nursing students and use of the university's proprietary LMS, Blackboard. As such, a process was initiated during the 2012-13 academic school year to determine the feasibility of conducting dissertation research exploring the role of SOLO-IT as an intervention to improve the informatics competencies of nursing students. The process of determining feasibility is outlined below:

1. Permission was granted by the Director of the School of Nursing and the Nursing Faculty Organization (NFO) to conduct future dissertation research using a population of entry level undergraduate nursing students in the School of Nursing.
2. Permission was requested and obtained from the university's Distance Learning Department to use the Blackboard platform to house and deliver SOLO-IT modules.
3. Curricular policies were developed outlining the process for students to follow to successfully complete SOLO-IT. This policy was collaboratively designed and unanimously approved by the Nursing Faculty Organization. The policy included suggested syllabus wording regarding the completion of SOLO-IT as a required assignment in certain entry level courses.
4. Nursing faculty granted permission for the PI of this study to be enrolled (as a Teaching Assistant) into the Blackboard sections of each designated course.
5. Completion of SOLO-IT will be required as a course assignment and will be worth 10% of the course grade.
6. A Completion Certificate was awarded for all students who successfully completed SOLO-IT with a grade of a 92% or higher. SOLO-IT has a maximum of 100 points possible and is

worth 10% of the total course grade for select courses. The faculty determined that skills obtained (or strengthened) through SOLO-IT are critically important and students would be more likely to take the course seriously if assignment credit was associated with completion of training.

Following more than one year of planning, it was concluded that dissertation research involving a comprehensive educational intervention with a sample of approximately 270 nursing students and the use of proprietary LMS software was feasible at this university. Unanimous approval by faculty of the School of Nursing, permission from the Director of the School of Nursing and the Educational Technology Department, and the preliminary approval of the sponsoring university's IRB have been successfully obtained to conduct dissertation research. Approval from the University of Hawaii's IRB has been obtained to extract and analyze archived survey data as a means of analyzing the psychometric properties and performance of the SANICS instrument.

### **Data Analysis Plan**

This research study will use principal factor analysis to examine the structure and internal consistency reliability of the SANICS to examine the psychometric properties of the SANICS among a sample of BSN entry-level nursing students, and to determine if the SANICS is responsive over time when used to measure informatics competencies before and after implementation of SOLO-IT modules. Construct validity of the SANICS will be assessed using a known group approach to compare differences in means for each SANICS subscale (construct) before and after completion of Successful Online Learning and Orientation Informatics Training (SOLO-IT) modules. Means, standard deviations, and sample sizes will be computed for items within each SANICS sub-scale category to test the hypothesis that differences in scores from

pre- to post- survey (using archived data) will be significant following completion of SOLO-IT training. Significant results, small p-values, and differences from pre-survey to post-survey in amounts greater than zero may indicate that SOLO-IT training had a positive effect on students' self-perceptions of IC. Significant results with a negative difference will indicate that an adverse effect resulted from completion of SOLO-IT training.

Acquisition of informatics skills was the primary purpose of SOLO-IT. Repeated attempts on assignments or demonstration exercises were encouraged and resulted in an unusually high overall course average of 94%. Because all students were required to successfully complete SOLO-IT, the resulting final scores were high and did not provide the data spread necessary to correlate demonstrated competency scores within SOLO-IT with self-reported competencies on the SANICS. Plans are underway to re-design the assessment portion of the course so that correlations between perceived versus demonstrated competencies can be made.

**Statistical Power.** This study will use a sample size of almost 500 nursing students (256 pre and 242 post SOLO-IT). Recommendations for sample size in factor analysis vary widely in the literature. Traditional recommendations have included 10 respondents per item (Sapnas & Zeller, 2002). However, "hypothetical and real research examples illustrate the usefulness of sub-sample analysis in determining that a sample size of at least 50 and not more than 100 subjects is adequate to represent and evaluate the psychometric properties of measures of social constructs" (Sapnas & Zeller, 2002, p. 135).

A power analysis using the G power program (Faul & Erdfelder, 2007) was performed to determine the sample size required for a t-test comparison of means at  $\alpha = 0.05$ . The result of this analysis indicated a total sample size of 202 participants (101 for each group) would be

necessary to obtain a medium effect size ( $d=0.5$ ) and 95% power (Faul & Erdfelder, 2007; Appendix C).

**Plan for Statistical Analysis.** Survey Monkey™ was the software program used to administer anonymous surveys using a 1-5 Likert Scale. Course evaluation procedures were also conducted and included user satisfaction items ranked on a 1-5 Likert Scale, and open-ended questions using text boxes to facilitate narrative comments.

A SPSS 21 Grad Pack will be used for all psychometric analyses. Principal component analysis will be used to “extract the maximum variance from the data set, resulting in a few orthogonal (uncorrelated) components” (2010, p. 234). A parallel analysis will be performed using a simulator with the same number of variables and observations. Factor loadings and promax rotation with Kaiser normalization will be used to examine and confirm correlations among factors (Tabachnick & Fidell, 2007). The performance of the SANICS and the five categorical factors of the scale will be assessed using Cronbach’s alpha (Tabachnick & Fidell, 2007). A standardized response mean will be used to evaluate the responsiveness of the SANICS over time (Neale & Liebert, 1986). Differences between pre- and post- survey scores will be analyzed using two sample t-tests at  $p = 0.05$ . The factor structure and internal consistency reliability of the SANICS will be compared with the study conducted by the authors of the SANICS instrument (Yoon, Yen & Bakken, 2009) to determine if the instrument’s psychometric properties remained consistent when used in a sample of BSN entry level students following informatics training.

### **Ethical Considerations**

**University of Hawaii Institutional Review Board (IRB).** Approval has been granted by the University of Hawaii’s IRB to conduct a psychometric analysis of archived SANICS data

(Appendix D). The request was made for exempt review since the study will involve no risk to former study participants who completed SOLO-IT and participated in pre/post SANICS data collection procedures. All data were collected in accordance with study procedures, as approved by the sponsoring agency (Xavier University) at the time the SOLO-IT course was implemented. All SANICS pre- and post-survey data were collected anonymously on an off-site third party secure server. The software (Survey Monkey) has a decoding feature which provides the following security functions: Firewall restricts access; intrusion detection systems and other systems that detect and prevent interference or access from outside intruders; QualysGuard network security audits performed weekly; McAfee SECURE scans performed daily; all data is stored on servers located in the United States; backups occur hourly internally, and daily to a centralized backup system for offsite storage; backups are encrypted (Survey Monkey, 2013). Since the time of data collection, all study results have been stored securely within Survey Monkey as anonymous, aggregate data.

Upon secure log on to SOLO-IT modules, students were routed to an announcements page where they were introduced to the modules and provided a link to the pre-course survey. Students were informed: 1) participation in the pre/post survey portion of the course was completely voluntary, 2) identities would remain anonymous, 3) no effort would be made to match survey responses with identifiers in Blackboard, and 4) survey data would be collected and stored anonymously on Survey Monkey (secure, off-site, encrypted, survey software). Students were also advised that any survey response (or lack of response) would have no impact on assignment or course grade. Students were also informed that aggregate evaluative data would facilitate course evaluation strategies and support quality improvement measures.

**Xavier University IRB.** To ensure compliance with university level policies and procedures and to determine the level of cooperation by the university's Institutional Review Board (IRB), a SOLO-IT research proposal was submitted requesting advanced permission to conduct future PhD student research using a population of nursing students attending the sponsoring university. The preliminary request for IRB approval was made to determine the feasibility of performing future research at the sponsoring institution in partial fulfillment of the dissertation requirements leading to a PhD in Nursing from the University of Hawaii for the study's Principle Investigator (PI). Study approval was granted by the sponsoring university's IRB and included an open ended date for collection and analyses of study data (Appendix E).

Informed consent was obtained from each student participant. Students were advised of study procedures and the voluntary nature of survey completion, as evidenced by: 1) the option to click the link to gain voluntary access to the survey, 2) the option to voluntarily complete pre- and post- surveys, and 3) the anonymous nature of the survey via an off-site secure server.

Nursing faculty of select entry level courses volunteered to include SOLO-IT completion as one of the required assignments leading to partial fulfillment of one or more course objectives (see Appendix C for Course Overview and Grading Criteria; Godsey, 2011). Completion of the SOLO-IT modules was required for select entry level courses. However, completion of all SOLO-IT related pre- and post- competency surveys was strictly voluntary.

During the first week of the semester, students enrolled into the SOLO-IT course received an introductory e-mail message from the PI and SOLO-IT instructional designer describing the training modules and outlining access to SOLO-IT training. To measure perceptions of IC, students were asked to complete voluntary surveys prior to and immediately following completion of SOLO-IT. Student volunteers were informed that data resulting from

completion of surveys would inform this research study and would support quality initiatives within the nursing program. Instructions accompanying pre- and post-surveys restated and emphasized the voluntary and anonymous nature of study participation. Students were also advised that survey responses would be analyzed as aggregate data and no attempt would be made to match enrollment data resulting from SOLO-IT training with anonymous survey data. Additionally, students were informed that, while completion of SOLO-IT training is a course requirement, lack of participation in voluntary survey procedures or quality of survey response would have no impact on assignment or course grades. Finally, students were advised that survey data would be collected via an off-site, secure server with encryption features. Refusal to participate in the data collection procedures associated with SOLO-IT survey completion would not be tracked in any way, further providing assurance that penalties could not be incurred for lack of survey participation.

### **Limitations of the Design**

A sample of undergraduate nursing students were pre-tested on the dependent variable (informatics competencies) then post-tested following completion of SOLO-IT. This design is considered superior to a post-test only design because it allows for the effect of the intervention to be measured as the difference between pre-post scores. However, a one-group pre/post-test design does not control for potentially confounding variables, such as history, maturation or regression artifact (Johnson & Christensen, 2004). This study was taken from one sample of undergraduate nursing students from a single private university in the mid-west, which could limit generalizability of findings to other populations (eg. graduate students) or sites.

Additionally, measurements of computer competency were based on self-perceptions which may not accurately represent ability to demonstrate competency. Finally, the possibility for a conflict

of interest exists given the intervention for this study (SOLO-IT) was also designed and implemented by the researcher. Full disclosure of this association will be made in all forms of reporting and in the dissemination of research findings.

### **Summary**

The components of this study included a thorough literature review describing computer competency, information literacy skills, and the current state of informatics competency among the nursing profession. A comprehensive search of informatics training resources revealed a significant gap in the literature regarding the availability of valid and reliable informatics training resources and valid, reliable tools to measure informatics competencies. The SOLO-IT program is an online educational intervention designed to improve the informatics competencies of nursing students. A one-group pre/post-test design using the SANICS was utilized in a sample of undergraduate nursing students. Surveys comprised of competency items were administered via Survey Monkey to student volunteers prior to and at the completion of SOLO-IT.

This study will explore the psychometric performance of the SANICS. Archived pre/post SOLO-IT data will be used to assess the factor structure and internal consistency reliability of the SANICS, and to examine the psychometric properties of the SANICS among a sample of BSN entry-level nursing students, and to determine if the SANICS is responsive over time when used to measure informatics competencies following completion of SOLO-IT. This study will also evaluate the mean rating differences of SANICS scores before and after completion of SOLO-IT. Construct validity of the SANICS will be assessed using a known group approach to compare differences in means for each SANICS subscale (construct) before and after completion of Successful Online Learning and Orientation Informatics Training (SOLO-IT) modules.



## **Chapter IV**

### **Results**

This chapter provides descriptions of the study sample and presents the factor structure, internal consistency reliability and responsiveness of the SANICS instrument. Findings reported in this chapter will serve to answer the following research questions:

- What are the psychometric properties of the SANICS among a population of BSN entry-level students?
- Is the SANICS responsive over time when used to measure informatics competencies following completion of SOLO-IT?

### **Research Design**

This study explored the psychometric performance of the SANICS instrument using archived survey data collected before and after completion of SOLO-IT. A pre/post-test design using the 30-item SANICS was utilized in a sample of undergraduate nursing students. Surveys comprised of competency items contained within the SANICS instrument were administered via Survey Monkey to student volunteers prior to and at the completion of SOLO-IT.

### **Setting and Sample**

During the period of January-March, 2014, two hundred seventy one (271) entry level BSN students from a medium sized mid-western university were enrolled into SOLO-IT. A total of 229 students (85%) successfully completed all SOLO-IT assignments, requiring an average of two attempts per assignment in order to achieve the minimum passing score of 92% (overall course average was 97%). Forty two students started, but did not complete all assignments in SOLO-IT (although 13 of these students still chose to complete the post-training SANICS survey). Most, but not all, course instructors required SOLO-IT completion. Courses which

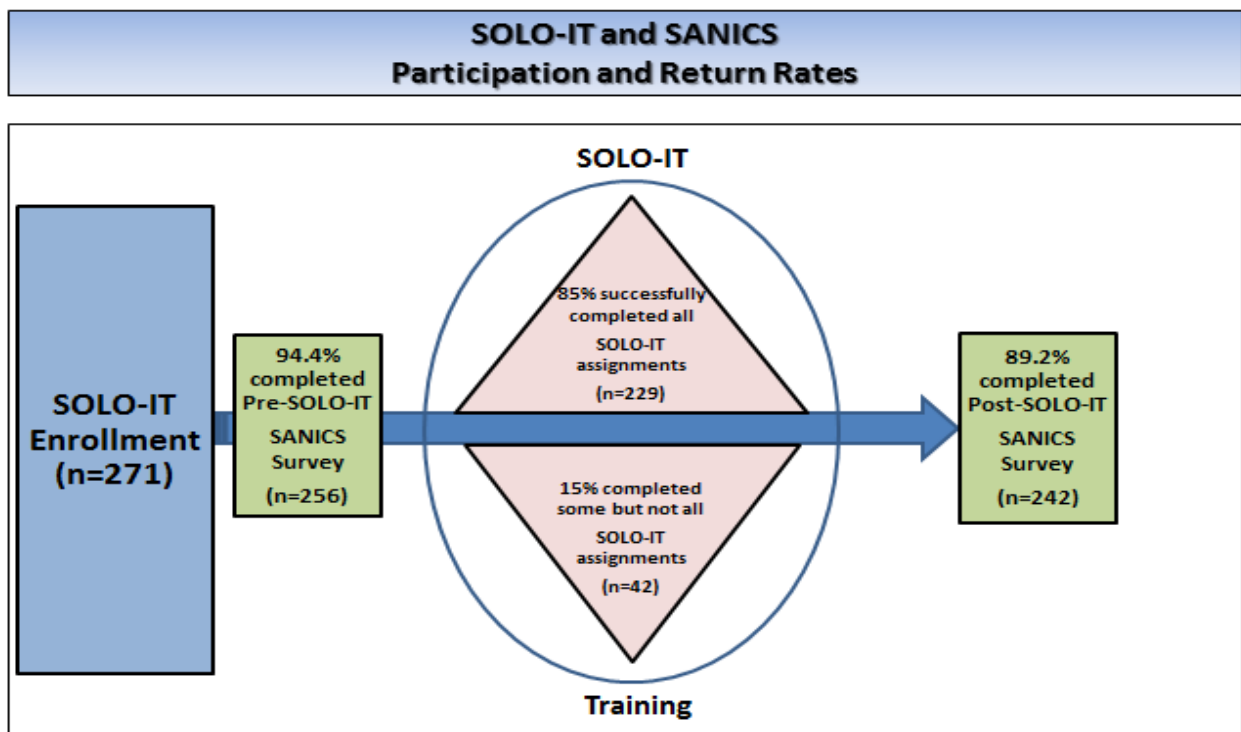
lacked the formal requirement of SOLO-IT completion likely negatively influenced some of the students' decision not to complete the training.

Of the 271 students originally enrolled in SOLO-IT, 256 completed the pre-course SANICS survey data (response rate of 94.4%) and 242 completed the post-training SANICS survey (response rate of 89.2%), for a total sample size of 498 BSN students (see Figure 2).

Both the pre- and post- training surveys were administered using Survey Monkey software. All data were entered and analyzed using Microsoft Excel and SPSS version 18.0 statistical software.

Figure 2

*SOLO-IT and SANICS: Participation and Return Rates*



## Profile of Respondents

The sample for this study was 89.5% female and 10.5% male. Most of the student volunteers were 20-29 (58.4%), followed by 30-39 (25.3%). Students in the combined 40-64 age group made up 16.4% of the study population (12.1% in the 40-49 age group and 4.3% in the 50-64 age group) (see Table 3).

Almost all of the BSN students in this study used computers for more than two years (97.7%). Six students (2.3%) reported using computers for less than six months. The majority of students reported using computers several times a day or daily (94.2%), followed by several times a week (5.1%). Two students (0.8%) reported using computers only several times a month, or never (see Table 3).

Table 3

### *BSN Demographics*

	<b>Variable</b>	<b>Count</b>	<b>Percent</b>
Gender	Female	230	89.5%
	Male	27	10.5%
	Total	257	100.0%
Age	20-29	150	58.4%
	30-39	65	25.3%
	40-49	31	12.1%
	50-64	11	4.3%
	Total	257	100.0%
Computer Experience	Just started using in the past 6 months	6	2.3%
	In the past 2 years	0	0%
	More than 2 years	251	97.7%
	Total	257	100.0%

Frequency of Computer Use			
Several times a day	195	76.2%	
Once a day	46	18.0%	
Several times a week	13	5.1%	
Several times a month	1	0.4%	
Never	1	0.4%	
Total	256	100.0%	

### **Presentation of Data for Research Question One**

The first research question addressed by this study is “what are the psychometric properties of the SANICS among a population of BSN entry-level students”? In response to this question, the following discussion outlines the factor structure, internal consistency reliability, and responsiveness of the SANICS instrument.

#### **Principal Component Analysis**

Principal component analysis was performed to determine the factor structure of the 30-item SANICS (Table 4). Promax rotation with Kaiser Normalization was used to examine correlations among five factors: Basic Computer Knowledge And Skills; Clinical Informatics Role; Applied Computer Skills; Clinical Informatics Attitudes; And Wireless Device Skills. Almost all (27 of 30) factor loadings increased over pre-SOLO-IT. Five factors accounted for 71.6% of the variance in the 30 item scale (pre-SOLO-IT) and the percentage of variation increased to 77.3% post SOLO-IT.

Table 4

*Factor Structure Matrix Pre-and Post-SOLO-IT*

Structure Matrix (Pre-SOLO-IT)					
	Component				
	1	2	3	4	5
G1_Q1	.188	<b>.824</b>	.580	.403	.370
G1_Q2	.360	<b>.869</b>	.515	.375	.464
G1_Q3	.256	<b>.867</b>	.427	.431	.420
G1_Q4	.381	<b>.847</b>	.402	.334	.419
G1_Q5	.356	<b>.888</b>	.515	.335	.444
G2_Q1	<b>.599</b>	.373	.317	.229	.695
G2_Q2	<b>.595</b>	.383	.309	.483	.756
G2_Q3	<b>.632</b>	.607	.542	.111	.506
G2_Q4	<b>.714</b>	.565	.453	.218	.587
G2_Q5	<b>.692</b>	.449	.255	.443	.703
G2_Q6	<b>.813</b>	.186	.283	.174	.509
G2_Q7	<b>.840</b>	.195	.315	.176	.543
G2_Q8	<b>.627</b>	.233	.257	.376	.750
G2_Q9	<b>.776</b>	.465	.395	.301	.705
G2_Q10	<b>.863</b>	.376	.421	.259	.612
G2_Q11	<b>.799</b>	.423	.432	.281	.551
G2_Q12	<b>.531</b>	.309	.315	.369	.816
G2_Q13	<b>.597</b>	.437	.366	.443	.769
G2_Q14	<b>.582</b>	.430	.446	.425	.776
G2_Q15	<b>.635</b>	.495	.499	.407	.794
G3_Q1	.355	.517	<b>.897</b>	.252	.398
G3_Q2	.416	.543	<b>.919</b>	.268	.415
G3_Q3	.476	.481	<b>.881</b>	.308	.502
G3_Q4	.447	.547	<b>.904</b>	.341	.475
G4_Q1	.265	.405	.323	<b>.920</b>	.453
G4_Q2	.258	.431	.314	<b>.922</b>	.539
G4_Q3	.312	.411	.293	<b>.924</b>	.520
G4_Q4	.264	.427	.307	<b>.926</b>	.492
G5_Q1	.470	.505	.433	.455	<b>.824</b>
G5_Q2	.493	.477	.415	.430	<b>.837</b>

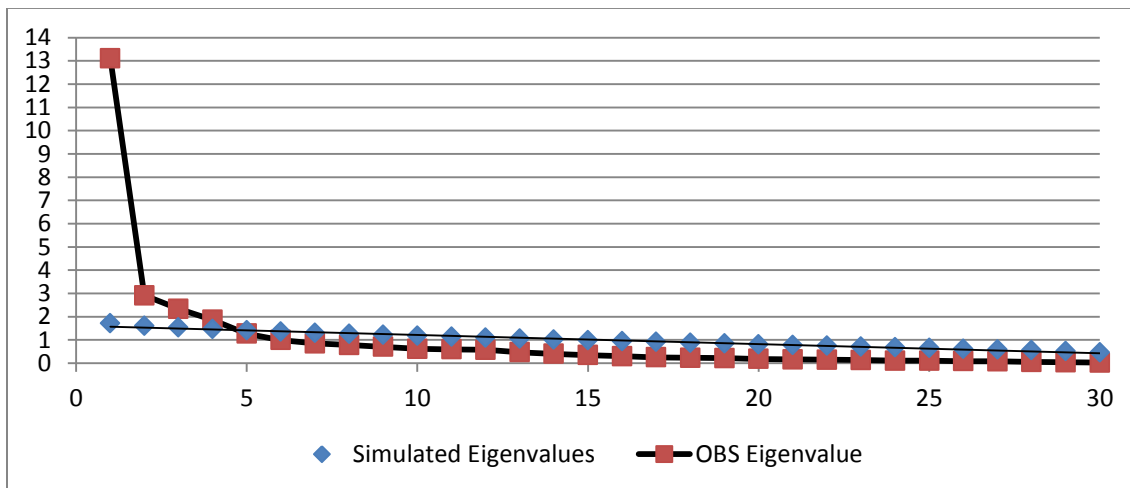
Structure Matrix (Post-SOLO-IT)					
	Component				
	1	2	3	4	5
G1_Q1	.472	<b>.908</b>	.667	.386	.403
G1_Q2	.509	<b>.920</b>	.638	.497	.446
G1_Q3	.464	<b>.915</b>	.557	.489	.282
G1_Q4	.547	<b>.909</b>	.587	.533	.361
G1_Q5	.502	<b>.941</b>	.624	.485	.383
G2_Q1	<b>.772</b>	.502	.497	.429	.683
G2_Q2	<b>.858</b>	.448	.351	.572	.478
G2_Q3	<b>.742</b>	.548	.697	.437	.240
G2_Q4	<b>.854</b>	.476	.630	.470	.396
G2_Q5	<b>.864</b>	.488	.588	.578	.448
G2_Q6	<b>.851</b>	.401	.369	.521	.463
G2_Q7	<b>.864</b>	.418	.428	.573	.474
G2_Q8	<b>.857</b>	.359	.357	.557	.456
G2_Q9	<b>.856</b>	.475	.494	.500	.395
G2_Q10	<b>.839</b>	.521	.632	.571	.552
G2_Q11	<b>.783</b>	.511	.701	.473	.553
G2_Q12	<b>.889</b>	.493	.515	.619	.561
G2_Q13	<b>.867</b>	.429	.428	.594	.579
G2_Q14	<b>.834</b>	.406	.499	.531	.655
G2_Q15	<b>.822</b>	.463	.590	.436	.630
G3_Q1	.445	.634	<b>.893</b>	.402	.450
G3_Q2	.493	.677	<b>.915</b>	.455	.459
G3_Q3	.549	.592	<b>.925</b>	.507	.480
G3_Q4	.532	.579	<b>.922</b>	.515	.493
G4_Q1	.632	.506	.496	<b>.932</b>	.394
G4_Q2	.645	.515	.542	<b>.944</b>	.520
G4_Q3	.643	.508	.501	<b>.955</b>	.500
G4_Q4	.642	.589	.548	<b>.940</b>	.510
G5_Q1	.700	.486	.612	.554	<b>.903</b>
G5_Q2	.687	.483	.591	.559	<b>.901</b>

## Parallel Analysis

Parallel analysis was conducted to determine which factors to retain. This simulation method compared observed eigenvalues with eigenvalues from a random sample consisting of the same number of variables and observations. All scores were over 0.50 on the primary loading of items after rotation, which was the cut off for retention of items. Observed and simulated eigenvalues intersected at the five factor level, further validating the five factors of the SANICS (see Figure 3).

Figure 3

### *Parallel Analysis*



## Psychometric Analysis: Comparisons with Original SANICS Study

Construct validity refers to an instrument's ability to measure constructs adequately (Shuttleworth, 2014). The presence of statistically significant differences between pre and post-SOLO-IT suggest the construct validity of the SANICS is good. Effect size of the thirty items showed a medium to large effect.

Internal consistency reliability was determined using Cronbach's  $\alpha$  for each of the five sub-scales: Applied Computer Skills, Clinical Informatics Role, Wireless Device Skills, Basic Computer Knowledge and Skills, and Clinical Informatics Attitudes.

Comparisons of factor loadings and Cronbach's  $\alpha$  were made between: 1) pre/post SOLO-IT and 2) those reported by Yoon and colleagues (2009) (see Table 5). Cronbach's  $\alpha$  was higher post-SOLO-IT (.95-.97) compared to pre-SOLO-IT (.92-.95), and compared to the original SANICS study (.89-.94) for each of the five sub-scales of the instrument. These alphas would be considered in the excellent range (Nunnally & Bernstein, 1994). Almost half (14 of 30) of the factor loadings were .90 or greater following SOLO-IT completion, compared to 23% (7 of 30) pre-SOLO-IT.

Table 5

*Factor Structure Compared to Original SANICS Study*

	<b>Yoon SANICS (BS/MS)</b>	<b>Pre-SOLO-IT SANICS (BSN)</b>	<b>Post-SOLO-IT SANICS (BSN)</b>
<b><u>Clinical Informatics Role (5 items)</u></b>	<b><math>\alpha = .91</math>, <b>n = 328</b>, <b>M (SD) =</b> <b>2.62 (.91)</b></b>	<b><math>\alpha = .92</math>, <b>n = 251</b>, <b>M (SD) =</b> <b>2.65 (1.29)</b></b>	<b><math>\alpha = .96</math>, <b>n = 240</b>, <b>M (SD) =</b> <b>3.52 (.96)</b></b>
As a clinician (nurse), participate in the selection process, design, implementation and evaluation of systems.	.83	.82	.91
Market self, system, or application to others	.82	.87	.92
Promote the integrity of and access to information to include but not limited to confidentiality, legal, ethical, and security issues	.82	.87	.92
Seek resources to help formulate ethical decisions in computing	.83	.85	.91
Act as advocate of leaders for incorporating innovations and informatics concepts into their area of specialty	.83	.89	.94

<b><u>Basic Computer Knowledge and Skills</u></b> <b><u>(15 items)</u></b>	<b><math>\alpha = .94,</math> <b>n = 321,</b> <b>M (SD) =</b> <b>3.86 (.71)</b></b>	<b><math>\alpha = .94,</math> <b>n = 247,</b> <b>M (SD) =</b> <b>3.66 (1.15)</b></b>	<b><math>\alpha = .97,</math> <b>n = 238,</b> <b>M (SD) =</b> <b>4.10 (.82)</b></b>
Use telecommunication devices	.73	.60	.77
Use the Internet to locate, download items of interest	.70	.60	.86
Use database management program to develop a simple database	.68	.63	.74
Use database applications to enter and retrieve information	.81	.71	.85
Conduct on-line literature searches	.74	.69	.86
Use presentation graphics to create slides, displays	.74	.81	.85
Use multimedia presentations	.74	.84	.86
Use word processing	.72	.63	.86
Use networks to navigate systems	.75	.78	.86
Use operating systems	.74	.86	.84
Use existing external peripheral devices	.79	.80	.78
Use computer technology safely	.80	.53	.89
Navigate Windows	.77	.60	.87
Identify the basic components of the computer system	.77	.58	.83
Perform basic trouble-shooting in applications	.81	.64	.82
<b><u>Applied Computer Skills: Clinical Informatics (4 items)</u></b>	<b><math>\alpha = .89,</math> <b>n = 330,</b> <b>M (SD) =</b> <b>2.45 (1.03)</b></b>	<b><math>\alpha = .93,</math> <b>n = 255,</b> <b>M (SD) =</b> <b>2.25 (1.36)</b></b>	<b><math>\alpha = .95,</math> <b>n = 240,</b> <b>M (SD) =</b> <b>3.24 (1.07)</b></b>
Use applications for diagnostic coding	.71	.90	.89
Use applications to develop testing materials	.69	.92	.92
Access shared data sets	.75	.88	.93
Extract data from clinical data sets	.77	.90	.92
<b><u>Clinical Informatics Attitudes</u></b> <b><u>(4 items)</u></b>	<b><math>\alpha = .94,</math> <b>n = 332,</b> <b>M(SD) =</b> <b>3.74 (.97)</b></b>	<b><math>\alpha = .95,</math> <b>n = 255,</b> <b>M(SD) =</b> <b>3.82 (1.14)</b></b>	<b><math>\alpha = .97,</math> <b>n = 242,</b> <b>M(SD) =</b> <b>4.15 (.85)</b></b>
Recognize that health computing will become more common	.82	.92	.93
Recognize human functions that cannot be performed by computer	.83	.92	.94
Recognize that one does not have to be a computer programmer to make effective use of the computer in nursing	.83	.92	.96
Recognize the value of clinician involvement in the design, selection, implementation, and evaluation of applications, systems in health care	.78	.93	.94
<b><u>Wireless Device Skills (2 items)</u></b>	<b><math>\alpha = .90,</math> <b>n = 328,</b> <b>M(SD) =</b> <b>2.75 (1.16)</b></b>	<b><math>\alpha = .95,</math> <b>n = 255,</b> <b>M(SD) =</b> <b>3.44 (1.25)</b></b>	<b><math>\alpha = .96,</math> <b>n = 242,</b> <b>M(SD) =</b> <b>4.07 (.84)</b></b>
Use wireless device to download safety and quality care resources	.77	.82	.90
Use wireless device to enter data	.76	.84	.90



## **Presentation of Data for Research Question Two**

The following discussion answers the next question posed by this research: Is the SANICS responsive over time when used to measure informatics competencies following completion of SOLO-IT? Study participants were asked to rate perceived informatics competencies for each of 30 SANICS items using a five-point Likert Scale, from one (strongly disagree) to five (strongly agree). Two sample t-tests were used to determine means, standard deviation, and sample sizes for each SANICS sub-scale category (Clinical Informatics Role, Basic Computer Knowledge and Skills, Applied Composite Skills, Clinical Informatics Attitudes, and Wireless Device Skills). It was not possible to pair sample data due to the unplanned loss of an item on the post-survey (during a Blackboard upgrade) which requested the respondent's student identification number. Responsiveness of the SANICS was examined to test the hypothesis that there would be a significant difference in SANICS scores between pre-SOLO-IT and post-SOLO-IT.

All mean differences were significantly higher on each of the five SANICS sub-scale categories following completion of SOLO-IT ( $p < 0.001$ ). Differences from pre-score to post-score are listed below from greatest to least amount of difference and are further delineated on Table 6:

1. Applied Computer Skills (+2.02)
2. Clinical Informatics Role (+.87)
3. Wireless Device Skills (+.63)
4. Basic Computer Knowledge and Skills (+.44)
5. Clinical Informatics Attitudes, (+0.33).

Interestingly, differences in mean SANICS scores pre- to post-SOLO-IT were greatest in two sub-scale categories not specifically covered by SOLO-IT’s introductory content (“Applied Computer Skills” and “Clinical Informatics Role”). An explanation for this finding could relate to the advanced wording of some of the competencies listed under this item, and will be further discussed in the “Limitations” section of Chapter Five.

Table 6

*Average Scores for Each SANICS Sub-Scale Pre/Post SOLO-IT*

	Pre-SOLO-IT SANICS n= 256		Post-SOLO-IT SANICS n= 242		Pre-SOLO-IT SANICS -vs- Post-SOLO-IT SANICS	
	<u>Mean</u>	<u>SD</u>	<u>Mean</u>	<u>SD</u>	<u>P-value</u>	<u>Conclusion</u>
Basic Computer Knowledge and Skills	3.66	1.07	4.10	0.81	P < .001	Post-SOLO-IT is higher
Applied Computer Skills	1.87	1.10	3.89	0.87	P < .001	Post-SOLO-IT is higher
Clinical Informatics Role	2.65	1.27	3.52	0.97	P < .001	Post-SOLO-IT is higher
Clinical Informatics Attitude	3.82	1.14	4.15	0.85	P < .001	Post-SOLO-IT is higher
Wireless Device Skills	3.44	1.25	4.07	0.84	P < .001	Post-SOLO-IT is higher

Mean SANICS scores following SOLO-IT completion were then compared with scores from the original SANICS study conducted by Yoon, et al. (2009) in a population of BS/MS students taking an informatics course. The population for this study consisted of all students participating in a curriculum which emphasized informatics tools for patient safety, modeling, and monitoring. The curriculum included didactic lectures on informatics for patient safety and web-based reporting of hazards and near misses. Significantly higher mean SANICS scores

were reported post-SOLO-IT on all five sub-scales compared to the mean SANICS scores reported on the original SANICS study ( $p < 0.001$ ) (see Table 7).

Table 7

*SANICS Scores Post-SOLO-IT Compared to Original SANICS Study*

	Yoon SANICS n=332 (BS/MS)		Post-SOLO-IT SANICS N=242 (BSN)		Post-SOLO-IT SANICS -vs- Yoon SANICS	
	<u>Mean</u>	<u>SD</u>	<u>Mean</u>	<u>SD</u>	<u>P-value</u>	<u>Conclusion</u>
Basic Computer Knowledge and Skills	3.86	0.71	4.10	0.81	p<.001	Post-SOLO-IT is higher
Applied Computer Skills	2.45	1.03	3.89	0.87	p<.001	Post-SOLO-IT is higher
Clinical Informatics Role	2.62	0.91	3.52	0.97	p<.001	Post-SOLO-IT is higher
Clinical Informatics Attitude	3.74	0.97	4.15	0.85	p<.001	Post-SOLO-IT is higher
Wireless Device Skills	2.75	1.16	4.07	0.84	p<.001	Post-SOLO-IT is higher

**Value of SOLO-IT**

Post-training SANICS surveys were identical to pre-training SANICS surveys, except for the addition of 10 optional Likert scale items rating the overall effectiveness of SOLO-IT. At the completion of the final assignment in SOLO-IT, students were asked to rate the value of the training on a 1-5 Likert scale. Composite rating of all items was 4.0. Scores were highest on the items “I found instructions in SOLO-IT clear and easy to understand” (4.1), “SOLO-IT provided information in a manner that was easy to comprehend” (4.1), and “I feel confident I could now

use Blackboard” (4.2). Scores were lowest on the items “using SOLO-IT was appropriate for my learning as a nursing student” (3.8), and “I would recommend SOLO-IT to other students” (3.6) (see Table 8).

Table 8

*Value of SOLO-IT*

<b>Value of SOLO-IT</b>	<b>N</b>	<b>Mean</b>	<b>SD</b>
Using the SOLO-IT course was appropriate for my learning as a nursing student.	241	3.8	0.88
I found the SOLO-IT site easy to use and follow.	241	4.0	0.82
I found instructions in SOLO-IT clear and easy to understand.	240	4.1	0.78
The layout and design of SOLO-IT was user friendly.	241	4.0	0.79
SOLO-IT provided information I need.	239	4.0	0.80
I felt comfortable doing assignments in SOLO-IT	242	4.0	0.80
SOLO-IT provided information that will prepare me for success as a student.	241	4.0	0.78
SOLO-IT provided information in a manner that was easy to comprehend.	242	4.1	0.67
I feel confident that I could now use the online learning course site, Blackboard	241	4.2	0.67
I would recommend SOLO-IT to other students	241	3.6	1.02
Composite		4.0	

## **Summary**

This chapter presented the factor structure, internal consistency reliability, and responsiveness of the SANICS instrument before and after SOLO-IT training, and compared those findings with the original SANICS research conducted by Yoon and colleagues (2009). Evidence was presented which supports the reliability and validity of the SANICS as a tool to measure perceptions of informatics competencies before and after a self-directed, online, informatics training intervention. The next chapter will discuss implications of these findings for the nursing profession.

## **Chapter V**

### **Discussion**

The previous chapter presented findings from this study. This chapter will include a discussion of those findings, their implications for nursing practice, and recommendations for future studies. Limitations of this study will also be described.

#### **Sample Size and Return Rates**

This study used a sample of 498 nursing students tested on the 30 item SANICS before (n=256) and after (n=242) completion of SOLO-IT. The number of participants in this study exceeded the minimum of 100 subjects recommended to evaluate psychometric properties of an instrument (Sapnas & Zeller, 2002). Response rates for both pre- and post-SOLO-IT were high at 94.4% and 89.2%, respectfully.

#### **Study Participants**

As is typical for an undergraduate nursing program, the majority of students were female (89.5%) and between the ages of 20-39 (83.7%). Most students reported frequent use of computers, with 94.2% reporting use several times a day for more than two years. The younger age of participants and the frequency of computer usage suggest that most students were exposed to computers during or prior to secondary school. However, despite the self-described familiarity with computers, this younger group of nursing students still reported significant increases in perceived competencies for each SANICS sub-scale following completion of SOLO-IT. This finding is described in more detail in the discussion to follow.

#### **Research Question #1**

- What are the psychometric properties of the SANICS among a population of BSN entry-level students?

The psychometric properties of the SANICS have been well described by Yoon and colleagues (2009) with their combined sample of 337 BSN/MSN students. Reliability and validity of the instrument was evident with their sample. Findings from this study also support the SANICS as a psychometrically sound instrument when used before and after informatics training in a population of undergraduate nursing students. Principle component analysis supported the five factor structure of the SANICS, and was consistent with findings from the original study. Reliability of the instrument was high and percent of variation for almost all factors increased from pre- to post, as well as loadings within factors. Parallel analysis showed all scores to be  $> .50$  after rotation, and simulated eigenvalues validated the five factors of the scale.

Cronbach's  $\alpha$  measurements confirmed the internal consistency of related items within the 93 item scale. Cronbach's  $\alpha$  was in the excellent range (.95-.97) following SOLO-IT when compared with pre-training and original SANICS scores. None of the inter-item correlations was less than  $\alpha = .89$ . Reliability coefficients of .70 or higher are usually considered acceptable by most researchers (Bruin, 2006).

### **Research Question #2**

- Is the SANICS responsive over time when used to measure informatics competencies following completion of SOLO-IT?

The independent two sample t-test is “the most basic statistical test that measures group differences...[and] analyzes significant differences between two group means” (Mertler & Vannatta, 2010, p. 14). Independent t-tests confirmed the responsiveness of the SANICS over time and also measured the five categorical factors of the scale: 1) Clinical Role, 2) Basic Computer Knowledge, 3) Applied Computer Skills, 4) Clinical Informatics Attitudes, and 5)

Wireless Device Skills. Significantly higher mean scores following SOLO-IT were reported on each of the five SANICS' five sub-scales, compared to pre-SOLO-IT ( $p < 0.001$ ) and, when compared to the original SANICS study ( $p < 0.001$ ). This finding further supports the responsiveness of the SANICS over time, when used to measure perceived informatics competencies of nursing students. Each SANICS sub-scale score increased following SOLO-IT (from a low of 1.87 pre-training to 3.89 post-training for the "Applied Computer Skills" category, to the highest sub-scale scores for the "Basic Computer Knowledge and Skills" category, which went from 3.66 pre-to 4.10 post-training). A competency score of 3.0 or greater would be consistent with "perceived competence" (Yoon, et. al, 2009).

Differences from pre-score to post- score were greatest in the sub-scale categories "Applied Computer Skills" (+2.02) and "Clinical Informatics Role" (+.87). These sub-scales contained items, such as "use applications for diagnostic coding", "extract data from clinical data sets", "act as advocate of leaders for incorporating innovations and informatics concepts into their area of specialty". Such a large increase from pre- to post-training suggests SOLO-IT may have effectively introduced more advanced practice application concepts to entry level nursing students who would not be expected to have experience or familiarity with these principles. The areas with the least change from pre- to post- SOLO-IT were " Basic Computer Knowledge and Skills" and "Wireless Device Skills", as might be expected in a younger population of nursing students already accustomed to using computers and wireless devices.

### **Value of SOLO-IT**

Post-training items to evaluate program effectiveness indicate that students valued the online presentation and content offered by SOLO-IT. Composite score for all items was 4.0, with the highest score reported for the item "I feel confident I could now use the online learning



course site, Blackboard” (4.2). Program evaluation scores further support the potential value of online informatics training as a tool to prepare and familiarize students with the educational technologies used during nursing program matriculation.

### **Limitations**

The sample population for this study was confined to one academic institution in the mid-west which may limit generalizability to other settings. A one-group pre/post-test design does not control for potentially confounding variables, such as history, maturation or regression artifact (Johnson & Christensen, 2004).

Lack of randomization and the requirement (rather than the option) for entry level students to complete SOLO-IT training could have also confounded study findings. Students who felt they already possessed requisite computer and information literacy skills may have reluctantly completed the training, and may have even resented the lack of an option to waive the training requirement. Likewise, students who struggled with technology skills may have found the online nature of the training insufficient for their learning needs, since it lacked immediate, in-person feedback. Successfully completing SOLO-IT and receiving a completion certificate may have given struggling students a sense of informatics competency, even when further remediation may have been indicated.

Measurements of computer competency were based on self-perceptions which may not accurately represent ability to demonstrate competency. Participants in this study may have wanted to present themselves in a positive light, thus enhancing self-perceptions and biasing study findings. Study subjects "have a tendency to want to present (themselves) in the best light, and this may conflict with the truth” (Polit & Hungler, 1995, p. 312-13).

Completion of SOLO-IT provided many competency demonstration exercises and knowledge acquisition assignments (quizzes). An average of two attempts per assignment was necessary for most students to successfully pass each module and achieve the total minimum completion score of 92%. Repeated attempts allowed students to review content and practice/repeat demonstration exercises, but also resulted in high scores for every student successfully completing the training (overall completion average was 97%). Such high completion scores made the point spread within the data quite narrow and prevented an opportunity to correlate students' demonstrated abilities in SOLO-IT with their perceived competencies, as rated on the SANICS.

The confounding variables of age and lack of nursing experience may have impacted students' understanding of some of the SANICS items. The majority of students (58.4%) fell into the 20-29 year old age group. As first year students, it can be assumed these students had little, if any, direct nursing experience. Competency on the SANICS assumed that students possessed a certain degree of critical thinking skills. However, entry level nursing students may not have understood some of the more complex items on the SANICS. For example, students with no nursing experience may have lacked the background to fully comprehend and accurately self-assess the competency item, "Recognize the value of clinician involvement in the design, selection, implementation, and evaluation of applications/systems in health care". Higher post-scores could have simply reflected more familiarity with the item following informatics training, rather than actual improved competency.

This study examined informatics competencies as reported by student perceptions via pre/post surveys comprised of SANICS items. Actual demonstrations of informatics competencies could provide comparative, objective data that would more accurately measure

competency, and facilitate remediation strategies specific to the learning need. Sufficient research exists delineating the lack of informatics competency among nurses and nursing students. However, the lack of published studies examining the role of nursing informatics competency training precluded comparisons or lessons gleaned from similar training interventions.

Finally, the possibility for a conflict of interest exists given the intervention for this study (SOLO-IT) was also designed and implemented by the researcher. Full disclosure of this association will be made in all forms of reporting and in the dissemination of research findings.

### **Implications for Future Research**

This study was limited to a single population of undergraduate nursing students. Future studies should correlate demonstrated and perceived competencies, and should include the validation of competency instruments which measure informatics training interventions among diverse populations of undergraduate and graduate programs and with nurses in clinical practice.

During the course of the study, the version of Blackboard was updated by the university, requiring the SOLO-IT course be imported into the new version. During this process, the item on the post-survey which prompted students to enter their numerical identification number was inadvertently omitted, making it impossible to pair post- with pre-training responses. Future studies should include numerically paired codes which could allow for paired comparisons of scores for each participant, as well as correlations of actual skill demonstrations with perceived competency scores.

While nursing informatics competencies have been described for more than a decade, a comprehensive review of the literature revealed a surprising lack of research studies describing training interventions to address the problem of insufficient informatics competencies among

nursing professionals. Published literature describing valid, reliable assessment tools to measure the effect of informatics competency training among nurses or nursing students was also sparse. Limitless opportunities exist for the creation, delivery, and evaluation of validated informatics training products and instruments which can help ensure a highly qualified nursing profession, capable of using and applying informatics in practice. Solution-driven research is recommended to proactively address the need for a technologically competent nursing workforce.

### **Summary**

This study explored the psychometric performance of the SANICS. Evidence was presented which supports the SANICS as a psychometrically sound instrument when used in a population of BSN entry-level nursing students. Archived pre/post SOLO-IT data were used to confirm the factor structure and internal consistency reliability of the SANICS. This study effectively demonstrated the responsiveness of the SANICS over time and supported its use as a valid tool to measure pre- and post- informatics competencies associated with an online informatics training intervention. Significant differences in each sub-scale mean score before and after completion of SOLO-IT further supported the construct validity of the SANICS.

Results of this study suggest that SOLO-IT may be an effective tool for improving perceptions of computer competencies among entry level BSN students. Future studies are recommended which include paired samples of nurses and nursing students from various populations which would allow for more extensive correlations. Finally, research is recommended to correlate perceived informatics competencies with actual skill demonstrations.

Technology infused healthcare is rapidly evolving in an era of reform and expanding regulatory demands. The concept of “competency” must be continually re-defined if metrics are to remain current and reflective of a requisite informatics skillset for informed nursing practice.

As the nation's largest consumers of health information technologies, it is no longer acceptable for a coalition of 20 nursing informatics societies to endorse the European Computer Drivers' License (ECDL) as the recommended solution for the lack of informatics competencies among nurses. The ECDL was developed for use by a wide range of industries and does not address the essential computer skills required in healthcare, or the unique challenges faced in the healthcare setting (HIPAA, meaningful use, interoperability, etc.). Diffusion of informatics competency in the face of ubiquitous change in healthcare will likely remain unrealized until the profession of nursing responds with empirically grounded training innovations and validated instruments which directly respond to the technological needs of today's Registered Nurse.

## Appendix A: Self-Assessment Nursing Informatics Competency Scale

Permission to use the SANICS granted by the authors

For each statement, indicate your current level of competency on the scale of 1 to 5, where:  
1 = Not competent, 2 = Somewhat competent, 3 = Competent, 4 = Proficient, and 5 = Expert.

	Not competent	Somewhat competent	Competent	Proficient	Expert
<b>1. As a clinician (nurse), participate in the selection process, design, implementation and evaluation of systems</b>	1	2	3	4	5
<b>2. Market self, system, or application to others</b>	1	2	3	4	5
<b>3. Promote the integrity of and access to information to include but not limited to confidentiality, legal, ethical, and security issues</b>	1	2	3	4	5
<b>4. Seek available resources to help formulate ethical decisions in computing</b>	1	2	3	4	5
<b>5. Act as advocate of leaders for incorporating innovations and informatics concepts into their area of specialty</b>	1	2	3	4	5
<b>6. Use different options for connecting to the internet (phone line, mobile phone, cable, wireless, satellite) to communicate with other systems (e.g., access data, upload, download)</b>	1	2	3	4	5
<b>7. Use the Internet to locate (e-learning, teleworking), download items of interest</b>	1	2	3	4	5
<b>8. Use database management program to develop a simple database and/or table</b>	1	2	3	4	5
<b>9. Use database applications to enter and retrieve information</b>	1	2	3	4	5
<b>10. Conduct on-line literature searches</b>	1	2	3	4	5
<b>11. Use presentation graphics (e.g., PowerPoint) to create slides, displays</b>	1	2	3	4	5
<b>12. Use multimedia presentations</b>	1	2	3	4	5
<b>13. Use word processing</b>	1	2	3	4	5
<b>14. Use networks to navigate systems (e.g., LAM, WLAN, WAN)</b>	1	2	3	4	5
<b>15. Use operating systems (e.g., copy, delete, change directories)</b>	1	2	3	4	5
<b>16. Use existing external storage devices (e.g., network drive, CD, DVD, USB flash drive, memory card, online file storage)</b>	1	2	3	4	5
<b>17. Use computer technology safely</b>	1	2	3	4	5

<b>18. Navigate Windows (e.g., manipulate files using file manager, determine active printer, access installed applications, create and delete directories)</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>19. Identify the basic components of the computer system (e.g., features of a PC, workstation)</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>20. Perform basic trouble-shooting in applications</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>21. Use applications for diagnostic coding</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>22. Use applications to develop testing materials (e.g., e-learning)</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>23. Access shared data sets (e.g., Clinical Log Database, Minimum Data Set)</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>24. Extract data from clinical data sets (e.g., Clinical Log Database, Minimum Data Set)</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>25. Recognize that health computing will become more common</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>26. Recognize that the computer is only a tool to provide better nursing care and that there are human functions that cannot be performed by computer</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>27. Recognize that one does not have to be a computer programmer to make effective use of the computer in nursing</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>28. Recognize the value of clinician involvement in the design, selection, implementation, and evaluation of applications, systems in health care</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>29. Use wireless device (PDA or cellular telephone) to locate and download resources for patient safety and quality care</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>30. Use wireless device (PDA or cellular telephone) to enter data</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>

## Appendix B: Course Overview and Grading Criteria

### **SOLO for a DELTA©: An Online Informatics Training Course**

Successful Online Learning and Orientation (SOLO)  
for a DELTA (Digitally Enhanced Learning and Technological Arena)©

In order to prepare you for success in the nursing program, the nursing faculty at Xavier University would like you to complete a nursing informatics training course called **SOLO for a DELTA (SOLO)**. This training course is embedded into an off-site distance learning platform called **CourseSites©** and is operated by **Blackboard©**.

#### **Why do I need SOLO for a DELTA?**

SOLO (Successful Online Learning and Orientation) for a DELTA (Digitally Enhanced Learning and Technological Arena) helps prepare nursing students for success by providing a self-guided, online framework where new and experienced learners can work at their own pace to develop (or improve) overall informatics competencies. One of SOLO's key features is the ability for students to self-select supplemental resources and tutorials to use as much or as often as needed. In SOLO, all students are encouraged to repeat exercises, assignments, or quizzes with no limit on time or number of submissions.

#### **Is SOLO for a DELTA required?**

Yes. All new incoming graduate and undergraduate students will be required to complete SOLO for a DELTA as a graded assignment in one of their courses: N 130 [BSN], N505 [MSN], N550 [MIDAS], N 496 [RN-MSN] and N556 [CNL]. SOLO for a DELTA is also a course pre-requisite for N 854: Advanced Informatics [ALL MSN, including FNP].

SOLO is recommended early in the nursing program since the information contained in SOLO will help prepare you with the foundational technological skills necessary for the nursing program and for nursing practice.

Successful completion of SOLO is a pre/co-requisite for N 854 and is associated with assignment credit in the courses listed above. *Once you have completed SOLO, you will not have to repeat it during the course where it is required (but you will still receive assignment credit/grade, if appropriate).* Once SOLO is completed, you will receive a Certificate of Completion with your final score. Be sure to keep this certificate, and show it to your instructor as proof that you successfully completed the SOLO for a DELTA Informatics Training Course.

#### **How long will it take to complete SOLO?**

The average time to complete SOLO is approximately 4 hours (with a range of 2-22 hours, depending upon your experience and comfort level with computer applications).



Length of time varies widely, since students are encouraged to repeat exercises, assignments, and quizzes as often as needed, in order to demonstrate competency. There is no limit in the amount of time spent on a module, or the number of times an assignment or quiz can be re-submitted.

SOLO can also be accessed as often as needed in order to complete all six modules listed below. Since each module builds upon information from previous modules, it is recommended the course be completed within a one-two week period from the start date.

### **What informatics competencies are taught in SOLO for a DELTA?**

SOLO consists of the following six modules:

- Module I- Introduction to SOLO: Introduces nursing students to the features of SOLO and the Blackboard platform.
- Module II- Navigating the Computer and Web: Introduces nursing students to the parts and functions of the computer and presents practice exercises for browsing the web.
- Module III- Computer Applications: Presents computer applications commonly used by nurses, including spreadsheets, documents, and presentation software.
- Module IV- Information Literacy: Presents library and web based research tools that support information literacy and Evidence Based Practice
- Module V- Preparation for Research: Presents an overview of professional writing and publication principles.
- Module VI-Issues for the Professional e-Nurse: Introduces future e-nurses to professional issues encountered in the clinical setting.

### **When do I start SOLO?**

Once you have enrolled into the SOLO course, you will first be asked to participate in a survey as part of a research study. Completion of surveys is strictly voluntary, but will greatly assist us in evaluating the effectiveness of the SOLO course. As part of the study, you will do the following:

- 1) Prior to beginning SOLO, complete an anonymous 30 item survey. The survey will involve ranking your present informatics skills and competencies on a scale from 1 to 5.
- 2) After completing SOLO, repeat the same anonymous survey (with some additional items included for course evaluation purposes).
  - Survey data are collected via a secure off-site server with SSL encryption.
  - Refusal to participate in the data collection procedures associated with SOLO cannot be tracked, and there are no penalties for lack of participation or type of response.
  - Choosing to enter and complete the survey will indicate your permission to participate.

You will need to complete SOLO during the first two months of the semester as a required assignment in one of the courses listed at the beginning of this document.

### **How do I enroll into the SOLO Course?**

- 1) It's easy! Check your Xavier email! We will e-mail your enrollment invitation. When you receive it, click on the link provided in the e-mail to be taken to CourseSites where you will register.
  - Select a user name that does not include your actual name or other identifiers (eg. Nurse1234), since pre and post course survey data will be paired anonymously by user names. Pairing of anonymous data will allow us to determine how much (if any), perceptions of informatics competency changed as a result of SOLO.
  - Data will be reviewed and reported in aggregate form only and cannot be traced to individual users.
- 2) Once you create your account, you will be automatically enrolled and can begin.
- 3) For your convenience, a SOLO Instructional Manual (Word document) is available at the bottom of the first page of the SOLO course.
- 4) When you complete the course and all modules have been graded, a Completion Certificate will be available in CourseSites. The certificate can be printed or saved. Your instructor may require you to submit this certificate as proof you that you successfully completed the course.
- 5) It is recommended that you add completion of SOLO for a DELTA Informatics Training Course to your resume!

An application requesting four continuing education (CE) units of credit has been submitted to the Ohio Board of Nursing. If/when that application is approved, CE credit will be awarded and a certificate provided to those who successful completed all six modules of SOLO for a DELTA.

### **What if I need help?**

No problem! We are here to help! Simply contact the SOLO Help Desk at [help@collaborative-health-consultants.com](mailto:help@collaborative-health-consultants.com). We will look into your issue and respond within 12 hours (excluding weekends and holidays).

Wishing you every success on your SOLO journey and in your nursing education,

Judi A. Godsey, RN, MSN  
SOLO Course Designer; Assistant Professor and Informatics Coordinator  
Xavier University School of Nursing

## SOLO for a DELTA©: An Online Informatics Training Course

Successful Online Learning and Orientation (SOLO)  
for a DELTA (Digitally Enhanced Learning and Technological Arena)©

### Grading Criteria

<b>SOLO for a DELTA Objectives and Competency Demonstrations/Activities</b>	Needs to Repeat Module and Assignme nt	Needs to Repeat Module and Assignme nt	Needs to Review and/or Repeat Module and Repeat Assignme nt	Recomme nd Review of Module. Repeat or Correct and Re-submit Assignme nt	Achieved Maximum Points Allowable - No need to repeat Module or Assignme nt	POINTS
<p><b><u>Module I Objectives:</u></b> Introduction to SOLO: Introduces nursing students to the features of SOLO and the Blackboard platform. Objectives for this module include:</p> <ul style="list-style-type: none"> <li>• Describe the purpose of the Successful Online Learning Orientation (SOLO) course</li> <li>• Navigate the Blackboard platform</li> <li>• Perform a browser and software check in order to enable the necessary functions for course completion</li> </ul> <p><b><u>Module II Objectives</u></b> Navigating the Computer and Web: Introduces nursing students to the parts and functions of the computer and presents practice exercises for browsing the web. Objectives for this module include:</p> <ul style="list-style-type: none"> <li>• Describe the parts and functions of a personal computer</li> <li>• Explore the use of the internet as a tool to inform nursing practice</li> <li>• Demonstrate the ability to use and manage an email account</li> <li>• Demonstrate understanding of the importance of anti-virus protection</li> <li>• Demonstrate the ability to back up computer files</li> </ul>						
<p><b>For Modules I and II, you will demonstrate competencies by performing these activities:</b></p> <ol style="list-style-type: none"> <li>1. Show What You Know: Computers Quiz (5 points)</li> <li>2. Show What You Know: Internet Quiz</li> </ol>	<b>0-1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	
	<b>0-1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	

<p align="center"><b>SOLO for a DELTA</b></p> <p align="center"><b>Objectives and Competency</b></p> <p align="center"><b>Demonstrations/Activities</b></p>	Needs to Repeat Module and Assignment	Needs to Repeat Module and Assignment	Needs to Review and/or Repeat Module and Repeat Assignment	Recommend Review of Module. Repeat or Correct and Re-submit Assignment	Achieved Maximum Points Allowable - No need to repeat Module or Assignment	POINTS
(5 points)						
<p align="center"><b><u>Module III Objectives</u></b></p> <p>Computer Applications: Presents computer applications commonly used by nurses, including spreadsheets, documents, and presentation software. Objectives for this module include:</p> <ul style="list-style-type: none"> <li>• Apply the document construction principles of Microsoft Word, Excel, and Power Point</li> <li>• Demonstrate the ability to save and edit documents</li> <li>• Demonstrate the ability to use and edit Excel spreadsheets</li> <li>• Create a PowerPoint slide presentation</li> </ul>						
<p><b>For Module III, you will demonstrate competencies by performing these activities:</b></p> <ol style="list-style-type: none"> <li>1. Show What You Know: Microsoft Word (5 pts)</li> <li>2. Show What You Know: Excel (10 points)</li> <li>3. Show What You Know: Power Point (10 points)</li> </ol>	<p align="center"><b>0-2</b></p> <p align="center"><b>0-2</b></p> <p align="center"><b>0-2</b></p>	<p align="center"><b>3-5</b></p> <p align="center"><b>3-5</b></p> <p align="center"><b>3-5</b></p>	<p align="center"><b>6-7</b></p> <p align="center"><b>6-7</b></p> <p align="center"><b>6-7</b></p>	<p align="center"><b>8-9</b></p> <p align="center"><b>8-9</b></p> <p align="center"><b>8-9</b></p>	<p align="center"><b>10</b></p> <p align="center"><b>10</b></p> <p align="center"><b>10</b></p>	
<p align="center"><b><u>Module IV Objectives</u></b></p> <p>Information Literacy: Presents library and web based research tools that support information literacy and Evidence Based Practice. Objectives for this module include:</p> <ul style="list-style-type: none"> <li>• Describe the basic principles of nursing research</li> <li>• Demonstrate effective use of search engines</li> <li>• Locate scholarly articles and journals that support nursing research and Evidence Based</li> </ul>						

<p align="center"><b>SOLO for a DELTA</b></p> <p align="center"><b>Objectives and Competency Demonstrations/Activities</b></p>	Needs to Repeat Module and Assignment	Needs to Repeat Module and Assignment	Needs to Review and/or Repeat Module and Repeat Assignment	Recommend Review of Module. Repeat or Correct and Re-submit Assignment	Achieved Maximum Points Allowable - No need to repeat Module or Assignment	POINTS
<p>Practice</p> <ul style="list-style-type: none"> <li>• Demonstrate the process for locating and evaluating scholarly websites</li> <li>• Discuss safeguards that should be applied when using social media</li> </ul> <p align="center"><b>Module V Objectives</b></p> <p>Preparation for Research: Presents an overview of professional writing and publication principles. Objectives for this module include:</p> <ul style="list-style-type: none"> <li>• Describe how to avoid plagiarism</li> <li>• Explain some of the common issues associated with copyright</li> <li>• Demonstrate the basic principles of scholarly writing using American Psychological Association (APA) format</li> <li>• Explore the role of Evidence Based Practice (EBP) in nursing</li> <li>• Describe the importance of nursing research posters as a means to disseminate research findings</li> </ul>						
<p><b>For Modules IV and V, you will demonstrate competencies by performing these activities:</b></p> <ol style="list-style-type: none"> <li>1. Show What You Know: Locate a Research Article; Complete an Assignment (30 points)</li> <li>2. Show What You Know: Plagiarism Assignment (10 points)</li> <li>3. Show What You Know: Research and APA Quiz (10 points)</li> </ol>	<p><b>0-9</b></p> <p><b>0-2</b></p> <p><b>0-2</b></p>	<p><b>10-19</b></p> <p><b>3-5</b></p> <p><b>3-5</b></p>	<p><b>20-25</b></p> <p><b>6-7</b></p> <p><b>6-7</b></p>	<p><b>26-29</b></p> <p><b>8-9</b></p> <p><b>8-9</b></p>	<p><b>30</b></p> <p><b>10</b></p> <p><b>10</b></p>	
<p align="center"><b>Module VI</b></p> <p>Issues for the Professional e-Nurse: Introduces future e-nurses to professional issues encountered in the clinical setting. Objectives for this module include:</p> <ul style="list-style-type: none"> <li>• Explore the role of informatics in</li> </ul>						

<p align="center"><b>SOLO for a DELTA</b></p> <p align="center"><b>Objectives and Competency Demonstrations/Activities</b></p>	Needs to Repeat Module and Assignment	Needs to Repeat Module and Assignment	Needs to Review and/or Repeat Module and Repeat Assignment	Recommend Review of Module. Repeat or Correct and Re-submit Assignment	Achieved Maximum Points Allowable - No need to repeat Module or Assignment	POINTS
<p>healthcare</p> <ul style="list-style-type: none"> <li>• Describe how Information Technology (IT) is transforming health care</li> <li>• Describe changes to healthcare due to the ARRA and ACA</li> <li>• Describe the roles and responsibilities of nursing in the area of health IT and PHI</li> <li>• Explain the difference between EHR and EMR</li> <li>• Outline opportunities for nursing in today's technology rich healthcare environment</li> </ul>						
<p><b>For Module VI, you will demonstrate competencies by performing these activities:</b></p> <ol style="list-style-type: none"> <li>1. Show What You Know: ACA, ARRA, and ACO Quiz (5 points)</li> <li>2. Show What You Know: EHR, EMR, PHR Quiz(5 points)</li> </ol>	<p align="center"><b>0-1</b></p> <p align="center"><b>0-1</b></p>	<p align="center"><b>2</b></p> <p align="center"><b>2</b></p>	<p align="center"><b>3</b></p> <p align="center"><b>3</b></p>	<p align="center"><b>4</b></p> <p align="center"><b>4</b></p>	<p align="center"><b>5</b></p> <p align="center"><b>5</b></p>	
<p align="center"><b>TOTAL POINTS</b></p>						

## Appendix C: Power Analysis

Central and noncentral distributions
Protocol of power analyses

**t tests** – Means: Difference between two independent means (two groups)

**Analysis:** A priori: Compute required sample size

**Input:**

Tail(s)	=	One
Effect size d	=	0.4668343
$\alpha$ err prob	=	0.05
Power (1- $\beta$ err prob)	=	0.95
Allocation ratio N2/N1	=	1

**Output:**

Noncentrality parameter $\delta$	=	3.3174810
Critical t	=	1.6525081
Df	=	200
Sample size group 1	=	101
Sample size group 2	=	101
Total sample size	=	202
Actual power	=	0.9516809

Clear

Save

Print

Test family: t tests

Statistical test: Means: Difference between two independent means (two groups)

Type of power analysis: A priori: Compute required sample size – given  $\alpha$ , power, and effect size

**Input Parameters**

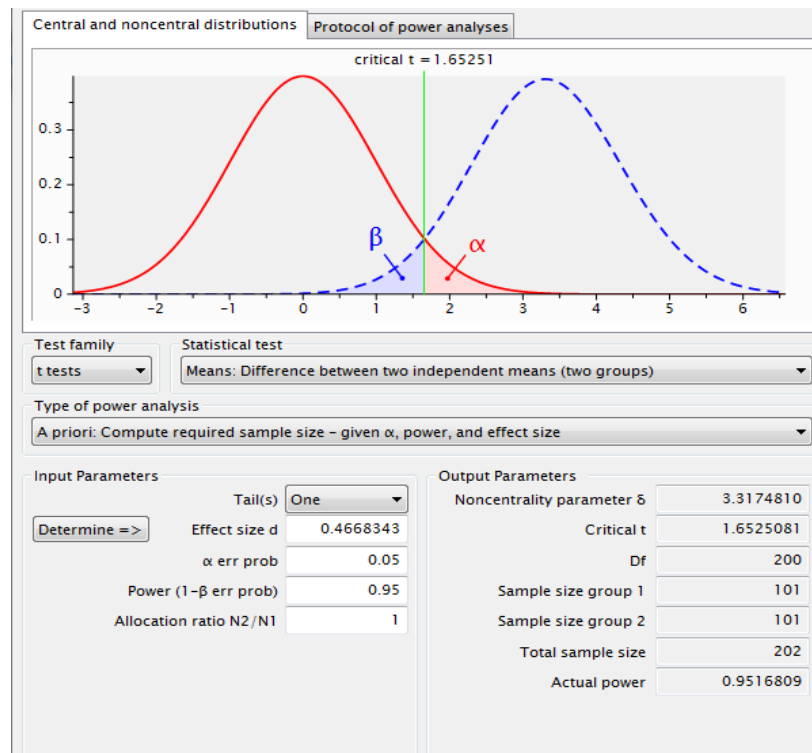
Tail(s) One

Determine =>

Effect size d	0.4668343
$\alpha$ err prob	0.05
Power (1- $\beta$ err prob)	0.95
Allocation ratio N2/N1	1

**Output Parameters**

Noncentrality parameter $\delta$	3.3174810
Critical t	1.6525081
Df	200
Sample size group 1	101
Sample size group 2	101
Total sample size	202
Actual power	0.9516809



## Appendix D: University of Hawaii IRB Approval

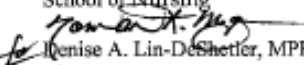


UNIVERSITY  
of HAWAII  
MĀNOA

Office of Research Compliance  
Human Studies Program

December 9, 2014

TO: Judi Godsey, RN  
Principal Investigator  
School of Nursing

FROM:  Denise A. Lin-Deshafter, MPH, MA  
Director

SUBJECT: CHS #22691- "Towards an Informatics Competent Nursing Profession: Validation of the Sanics Instrument Before and After Online Informatics Training"

This letter is your record of the Human Studies Program approval of this study as exempt.

On December 9, 2014, the University of Hawai'i (UH) Human Studies Program approved this study as exempt from federal regulations pertaining to the protection of human research participants. The authority for the exemption applicable to your study is documented in the Code of Federal Regulations at 45CFR 46.101(b)(Exempt Category 4).

Exempt studies are subject to the ethical principles articulated in The Belmont Report, found at <http://www.hawaii.edu/irb/html/manual/appendices/A/belmont.html>.

Exempt studies do not require regular continuing review by the Human Studies Program. However, if you propose to modify your study, you must receive approval from the Human Studies Program prior to implementing any changes. You can submit your proposed changes via email at [uhirb@hawaii.edu](mailto:uhirb@hawaii.edu). (The subject line should read: Exempt Study Modification.) The Human Studies Program may review the exempt status at that time and request an application for approval as non-exempt research.

In order to protect the confidentiality of research participants, we encourage you to destroy private information which can be linked to the identities of individuals as soon as it is reasonable to do so. Signed consent forms, as applicable to your study, should be maintained for at least the duration of your project.

This approval does not expire. However, please notify the Human Studies Program when your study is complete. Upon notification, we will close our files pertaining to your study.

If you have any questions relating to the protection of human research participants, please contact the Human Studies Program at 956-5007 or [uhirb@hawaii.edu](mailto:uhirb@hawaii.edu). We wish you success in carrying out your research project.

1960 East-West Road  
Biomedical Sciences Building B104  
Honolulu, Hawaii 96822  
Telephone: (808) 956-5007  
Fax: (808) 956-8681

An Equal Opportunity/Affirmative Action Institution



## Appendix E: Xavier University IRB Approval

December 18, 2012

Judi Godsey  
Xavier University  
ML 7351

Re: Protocol #1241, *Perceptions of Informatics Competencies Among Pre and Post Licensure Nursing Students Before and After Completion of Online Informatics Training*

Dear Dr. Godsey:

The IRB has reviewed the materials regarding your study, referenced above, and has determined that it meets the criteria for the Exempt from Review category under Federal Regulation 45CFR46. Your protocol is approved as exempt research, and therefore requires no further oversight by the IRB.

If you wish to modify your study, including the addition of data collection sites, it will be necessary to obtain IRB approval prior to implementing the modification. If any adverse events occur, please notify the IRB immediately.

Please contact our office if you have any questions. We wish you success with your project!

Sincerely,

A handwritten signature in black ink that reads "Morell E. Mullins, Jr." with a stylized flourish at the end.

Morell E. Mullins, Jr., Ph.D.  
Chair, Institutional Review Board  
Xavier University

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