COMPUTER COMPETENCY OF NURSING STUDENTS AT A UNIVERSITY IN THAILAND

By

SRIMANA NIYOMKAR

Submitted in partial fulfillment of the requirements

For the degree of Doctor of Philosophy

Dissertation Advisor: Professor Dr. Faye A Gary

Frances Payne Bolton School of Nursing

CASE WESTERN RESERRVE UNIVERSITY

May 2012

CASE WESTERN RESERVE UNIVERSITY

SCHOOL OF GRADUATE STUDIES

We hereby approve the thesis/dissertation of

Srimana Niyomkar

Candidate for the Ph.D. degree *.

(signed) Faye A Gary
(chair of the committee)

Elizabeth G. Damato

Christopher J. Burant

Neena Singh, MD.

(date) February 27, 2012

*We also certify that written approval has been obtained for any proprietary material contained therein.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF TABLES (continued)

LIST OF FIGURES

ACKNOWLEDGEMENTS

I would like to express my appreciation and gratitude to the many persons who made the completion of this study possible. First, I owe a debt of gratitude to my advisor and chairperson, Professor Faye A. Gary. Enough cannot be said about the outstanding contribution she has made toward my education. As an advisor, Dr. Gary was a gentle guide and a strong pillar of support throughout the study, candidacy preparation, and dissertation process. She wisely directed me with scholarly guidance, inexhaustible patience, insightful comments, and humor. Her input has been invaluable. I have learned much that will serve as the foundation for my career.

I am very grateful to all of the dissertation committee members for finding time in their busy schedules to assist me in the planning and completion of my doctoral research. I am deeply indebted to Associate Professor Elizabeth G Damato for her thoughtful guidance, compassion, understanding, and her continued support over the years. Also, she provided me with research experience, expertise, and wisdom when I worked with her on her research project. I would like to convey my sincere gratitude to Assistant Professor Christopher J Burant, for his constant encouragement, consistent support, and excellent delivery of statistical applications that were clear and concise so that I was able to accomplish this dissertation. I would like to extend my gratitude to Professor Neena Singh for her kindness, invaluable guidance, and timely advice. Without the sincere interest and help of these individuals, this study would not have been possible.

Special recognition and grateful acknowledgement is also extended to Professor Hui-Mei Hsu and his researchers for providing permissions to use their questionnaire for this study. Sincere thanks are extended to my colleagues in Thailand and my Thai friends

at Case Western Reserve University who assisted in the careful questionnaire translation, checking of questionnaire contents, and data collection processes. I also appreciate the time invested by undergraduate students from the School of Nursing at Chiangmai University who agreed to participate in this study. Without this extraordinary amount of assistance, I would never have been able to accomplish this research study. I am deeply thankful for everyone's support.

Additional thanks to the Thai government for the full scholarship that enabled me to undertake this doctoral education. Greatest thanks to my colleagues at Chiangmai University's School of Nursing for their support and hard work while I was away for my education in the United States.

Finally, sincere thanks are extended to my dad for his unending encouragement, remarkable guidance, and invaluable suggestions, and for giving me the insight that this study was worthwhile for the country. I am forever grateful to my beloved mom and both of my sisters for their unconditional love, ongoing support, and faithful encouragement.

Computer Competency of Nursing Students at a University in Thailand

Abstract

by

SRIMANA NIYOMKAR

During the past years, computer and information technology has been rapidly integrated into the education and healthcare fields. In the 21st century, computers are more powerful than ever, and are used in all aspects of nursing, including education, practice, policy, and research. Consequently, student nurses will need to utilize computer technology effectively to promote their educational advancement, support their professional practice, provide a higher quality of nursing care, and engage in the science and policy that are associated with nursing and improved health outcomes. However, literature regarding computer competency of nursing students is scarce, and it is unclear what skills they actually have during their time at a university.

The purpose of this cross-sectional correlational descriptive study was to investigate the computer competency of Thai nursing students, and examine the relationships among students' characteristics (age, academic year of matriculation, cumulative grade point average, and length of time spent with computers) and computer competency. Also, the predictors of computer competency were investigated.
The framework for this study was based on Bertalanffy's general system theory. A descriptive correlational design with stratified random sampling was conducted to recruit

a sample of 195 nursing students in the school of nursing at a university in Thailand. Self-administered questionnaires were used to collect data.

Nursing students reported that they had moderate computer competency. They spent approximately 4 hours each day using a computer. Computers were used not only for fulfilling academic requirements, but also for entertainment. The software applications that they used most were Internet browsers, word possessing programs, and Power Point, respectively. Age, academic year of matriculation, and length of time spent with computers were positively correlated with the computer competency of nursing students. All students' characteristics significantly explained 3% of the variance in computer competency. The empirical knowledge obtained from this study helps to inform educators and policy makers about the needs related to students' computer competency and the directions for future research, curriculum innovations, and policy implementation regarding computer competency for undergraduate nurses.

CHAPTER I

Introduction

Over the past years, the spread of the Internet and information technology has brought dramatic change to our lives and impacted every human activity. It has transformed the way people work, learn, and communicate. Computer technology has served professionals in every field of endeavor including education, business, industry, nursing, and health care systems. The incorporation of computer technology helps to improve the teaching and learning process at all levels of education. There is evidence that educators can achieve a better outcome by using information technology tools, such as multimedia, presentation handouts, commercial courseware, computer simulations, and website-based resources. These technologies, including online materials, can help students to access information 24 hours a day and at times more convenient for them. In industrial application, computer technology – including different types of application software – contributes to efficient management and workflow, and increases output and quality of productivity (Adomavicius & Gupta, 2009; Thomas, 2006).

In the health care environment, a wide range of computer technology is used in numerous dimensions such as clinical, administrative, research, and patient education. In the clinical dimension, computer technology can be used to observe and monitor patients with complex diseases, or help to generate records of clinical encounters. Computer technology can also be used to provide evidence-based decision support, quality clinical management, and clinical outcomes reporting (Hebda & Czar, 2009). With computer technology, healthcare providers have faster access to test results, medication dispensing, and patients' health history. Computer technology will continue to enable providers to

respond to patients' health need in a timely manner with health information at the providers' fingertips, and clinical decisions can be made and implemented quickly. From an administrative standpoint, technology systems can help systematically and rapidly manage billing, payroll, and accounting activities (Hebda & Czar, 2009). Also, it aids in scheduling staff, performing cost analysis, monitoring trends for budget purposes, conducting quality assurance and outcome analyses, and improving communications through electronic media which helps to facilitate the mission of an organization (Kudyba, 2010). From the research dimension, computer technology can help the researcher collect, retrieve, store, organize, and analyze data or information (Hebda & Czar, 2009).

Recent advancements in computer technologies, including Computer-Assisted Instruction and web-based methods, are used in patient education (Ornes & Gassert, 2007). An example of such innovation is the health kiosk, a public access touch screen computer that is used in health systems and other settings (Jones, 2009). Kiosks are used to educate patients about such health issues as alcohol consumption, smoking cessation, weight control, and routine HIV screening (Pendleton et al., 2010; Sun et al., 2010). They can also be used by a variety of cultural and ethnic families and communities, as well as members of different socioeconomic groups, across the life span. In addition to the kiosk, computer-based software is also used to educate patients. A study by Stromberg, Dahlstrom, and Fridlund (2006) reported significantly increased knowledge about heart failure in patients with this chronic condition who had used use a computer-based education program compared to their counterparts who received a standard education.

The increased use of health information technology worldwide has been promoted as having tremendous promise in improving the efficiency, cost-effectiveness, quality, and safety of patient-centered health care delivery in health systems (Amarasingham, Plantinga, Diener-West, Gaskin, & Powe, 2009; Smedley, 2005). Computer-based Patient Records or Electronic Medical Records (EMR) are good examples of how computer technology is being used for information transmission, data storage and, significantly, medical error reduction. In general, an EMR helps improve data integrity, increase productivity, reduce health care costs, improve quality of care, and increase caregiver satisfaction (Hebda & Czar, 2009; Miller, 2005; Tang & Lansky, 2005). The federal government called for the adoption of the EMR as a means to help transform the United States healthcare system, and it was a major feature in the health reform debate (Hebda & Czar, 2009). Well-documented research studies have provided the necessary foundation on which a federal mandate is promulgated that suggests that all American hospital and clinic systems must have an EMR system in place by 2015 (Joint Commission Resources, 2010).

The EMR system and its various components will address a variety of essential functions in patient care. For example, clinical messaging, patient status documentation, and clinical data repository are just a few of its numerous capabilities. These additional functions will be added to the already existing clinical decision support, which includes patient monitoring systems that rely heavily on computerization. Of importance is the use of EMR to educate patients and provide them with essential knowledge about self-care and symptom management of acute and chronic disease (Hillestad et al., 2005). The growth of these clinical information technologies has helped to reshape nursing practice

through improved productivity, enhanced quality, and enhanced communication effectiveness across disciplines and among nursing colleagues. That is to say, health professionals, patients and their families, and other support staff, through the use of technology, are able to provide more effective and efficient care across settings (Smedley, 2005). Therefore, nurses, who constitute one of the largest groups of health care professionals, and who have continuous contact with patients and other health care providers, should be able to effectively use computer technology to improve and enhance patient-centered care in a variety of settings (Willmer, 2007).

These advances in computer information technology require that 21st century nurses must acquire and maintain computer competency (Ornes & Gassert, 2007; Smedley, 2005; Weaver, Delaney, Weber, & Carr, 2006). A 2003 national survey by nurse administrators in the United States reported that using electronic mail effectively, operating basic Windows applications, and searching databases were critical information technology skills for nurses who were entering the workforce (McCannon & O'Neal, 2003). More recently, the Technology Informatics Guiding Education Reform Initiative posited that all nurses, in every role, must be prepared to make the computer and information technology the "stethoscope of the 21st century" (p. 3). (Technology Informatics Guiding Educational Reform [TIGER], 2007).

Problem Statement

It is essential that nurse computer competency become one of the necessary skills in the information age. Nevertheless, faculty members at schools of nursing in Thailand are not well informed about the levels of knowledge and skills that the students manifest during their matriculation in university programs. Even though computer knowledge and

skills are essential, the faculty members' lack of knowledge about the students' capacity to utilize the computer could be a barrier for nurse educators and the students. Faculty are charged with the responsibility of teaching the essential knowledge and skills that are critical for the future of nursing in Thailand and other countries in the region. Generally speaking, there is a dearth of information in Thailand and other nations about what practicing and student nurses currently know about computer technology (Creedy et al., 2007; McDowell & Ma, 2007).

The majority of research studies, many of which have been conducted in the United States, revealed that American nursing students had not acquired the computer competency that will be necessary for the 21st century, even though many of them have had opportunities to learn about computer technology throughout their educational process – including exposure in elementary, middle, and high school (Cartwright & Menkens, 2002; McDowell & Ma, 2007). Computer incompetency among students and practicing nurses can affect the efficiency of learning, access to knowledge, patient-related tasks, and the quality of care that is provided to individuals and families (Atack, 2003; Smedley, 2005). To address the deficit, many nursing schools in the United States have integrated informatics courses into their curricula (Saba & McCormick, 2006; Weaver et al., 2006). Although many academic nursing programs have incorporated informatics into their education requirements, there is a scarcity of literature that captures the level of computer competency that these students manifest (McDowell & Ma, 2007).

On the continent of Asia, a 2001 study found that Australian student nurses who successfully completed an informatics course as a part of their nursing program reported increased levels of computer confidence, computer knowledge, and skills related to

access, retrieval, and submission/recording of patient-related information (Shorten, Wallace, & Crookes, 2001). In the southeastern region of Asia, a study in Taiwan revealed that nursing students who received informatics education attained skills in searching, screening, integrating, analyzing, and applying their new knowledge to science and service more readily than students who were not exposed to the informatics courses (Ku, Sheu, & Kuo, 2007). Fewer data are available about nursing students in Thailand.

Also located in Southeast Asia, Thailand is a country of scenic diversity and ancient traditions. Located in the geographical heart (center) Southeast Asia, Thailand has a population of over 65 million people. In recent years, the Thai government and the Ministry of Public Health (MOPH) officials have recognized the potential of information technology to improve the quality of healthcare delivery systems. There has been an effort in most government agencies to implement information technology into healthcare systems in the country. An increasing number of organizations under the MOPH, including 67.1% of Thai hospitals and health centers, have developed and implemented computerized information systems across the nation (Kijsanayotin & Speedie, 2006). Although many information technology projects have been launched under the MOPH plan, only a few of these projects have met the stated goal of the plan. The MOPH plan continues to be monitored and evaluated. Of the many barriers that are associated with restrictive goal attainment, one of the most common contributing factors to limited computer usage is the lack of requisite computer knowledge and skill sets among health professionals, including nurses who comprise the majority (around 97,627) of the health care workforce (Government Public Relations Department, 2009; Kijsanayotin & Speedie, 2006). Therefore, the need for nurses to be skillful in the use of computer and

information technology is necessary for improved health services. The urgent need for nursing students to become well prepared in the multiple usages of information technology is directly linked to computer capabilities (Fetter, 2009a; TIGER, 2007).

Among Thai nursing students, it is unclear what computer knowledge and skill sets they or professional nurses have acquired, even when they are matriculating in academic institutions or entering the Thai workforce. Significantly, and for emphasis, there are no known data regarding nursing students' computer knowledge and skill sets in the nation. Faculties in nursing, and across the nation, debate the core essentials of computer-related skills that the students should have, or must have, at the time they successfully complete the academic program. The debate, without substantial data about the phenomenon, raises questions about the level of exposure to computers that Thai students in elementary, middle, and high schools have received. It also brings into focus the extent to which the faculty are informed about computer technology and learner needs. Again, data about computer education in Thai elementary, middle, and high schools are not readily available even though there is some evidence that students are exposed to computer literacy courses (Ministry of Education, 2008).

Some, but not all, faculty members in academic nursing assume that the students already have essential computer knowledge and skill sets; and they plan their academic work on this assumption. They may not have provided the needed basic informatics courses for their students despite the curricula demands in their courses. Again, because few data are available, nursing faculty do not have the information necessary to be well informed about student computer knowledge and skill sets. Instead, they make decisions based on opinions and impressions; there is no known solid evidence to support their

assumptions. Importantly, their assumptions are not consistent with the literature. From the scientific literature, it can be determined that nursing students in several countries, such as the United States, the United Kingdom, and Sweden, have been found to have limited computer competency (Bond, 2009; Elder & Koehn, 2009; McDowell & Ma, 2007; Ragneskog & Gerdnert, 2006). For clarity, these scientific literature bases did not include data about Thailand.

Despite the lack of data, many Thai nursing faculty expect that freshmen entering colleges and/or universities will have certain levels of computer knowledge and skill sets. Their thinking is based on perceptions that computer technology in this century is often a component of the academic routine of the modern classroom (Inan & Lowther, 2010). Middle and high school students are expected to use and be familiar with computer technology as educational tools. But a word of caution is needed. About 38,000 public schools across Thailand lacked computers and other essential resources for computer literacy learning at the beginning of the 21st century (Borton, 2003). A number of questions emerge from this finding. For example, what computer skills do nursing students entering academic institutions possess? Do skills possessed by entering nursing students coincide with faculty perceived knowledge and skill levels? Do nursing students have basic skills in information technology that will enable them to progress through their educational program and prepare them for their roles as nurses in ever-evolving technology-based healthcare systems? What computer expertise should nursing students attain during their undergraduate education? Based on the scientific literature, two gaps emerge: (a) the presence of computer knowledge and skill sets is neither well understood nor documented; and (b) the lack of information technology courses in baccalaureate

programs could result in the Thai nursing students graduating without the essential computer competency that will be needed in the workforce in local and global settings.

This research was designed to address these two gaps. The purpose of this study was to describe the computer competency of Thai nursing students, and to predict the major variables that influence computer competency among Thai nursing students at Chiangmai University (CMU), the first institution of higher education in the northern region, and the first provincial university in Thailand (see Appendix A for information on Chiangmai). Chiangmai University is a leading university with academic excellence as defined by national and international standards, and it is projected to become a research-intensive university with high ethical and professional standards during the next few decades (Chiangmai University, 2010).

Chiangmai University was founded in 1964 as the first institution of higher education in northern Thailand, and the first provincial university in the kingdom. It is recognized as one of Thailand's nine "National Research Universities" and ranked 79th and 410th among Asian and world Universities, respectively (Chiangmai University, 2010). The university has a student body of about 37,977 individuals and is home to 21 academic programs, including medicine, dentistry, pharmacy, economics, engineering, education, law, science, humanities, architecture, fine arts, and agriculture. One of the popular programs at the university is the School of Nursing, where 785 baccalaureate students are enrolled in a 4-year program: 234 are freshmen; 196 are sophomores; 182 are juniors; and 173 are seniors. The School of Nursing also offers graduate programs: 588 students are enrolled in a Master of nursing science curriculum, and 67 students are enrolled in the Ph.D. nursing program.

Conceptual Framework

The conceptual framework for the study is based on the General System Theory proposed by Karl Ludwig von Bertalanffy (Bertalanffy, 1986). Other factors affecting computer competency are also delineated. Bertalanffy's general system theory is a grand theory that consists of concepts, models, and laws that are associated with any system, regardless of the nature of its particular elements (Bertalanffy, 1986). The theory has roots in many disciplines, such as the social science, natural science, mathematics, and technology. It also has been applied across disciplines, such as biology, communications, defense technology, education, and nursing (Chen & Stroup, 1993; Hanson, 1995; Roy, 2008). Based on the theory, a system refers to a complex of interacting elements or a set of parts connected to function as a whole for some purpose. The model provides three main concepts: input, process, and output. The system is affected by many inputs, which go through certain processes to produce certain outputs, which together, accomplish the overall desired goal of the system. In addition, there is a feedback mechanism from outcomes back to inputs. This dynamic and multifaceted interaction is simplified and shown in Figure 1.

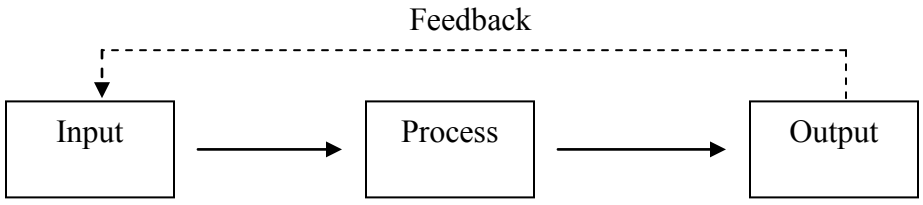


Figure 1. The essential characteristics of the general system theory model (Bertalanfy, 1986).

Concepts in the Proposed Model

The conceptual framework of the present study consists of three major concepts: inputs, which are termed as student characteristics; processes, which are termed as learning activity; and outcomes, which are termed as computer competency. Based on Shute (1992), learning activity or learning processes can be defined as any series, actions, or changes that directly impact the learning outcome. The learning process helps students to reach their desired outcomes or performance levels and serves to transition a learner from a novice to an expert, or from a position of computer incompetency to computer competency. Although the process of learning is an important concept, it is not included in the model. The current study will not specifically measure the students' learning activity – a very broad and variable phenomenon among nursing students. In general, Thai nursing students graduate from different high schools and regions of the nation. Within the elementary through high school educational systems, there are numerous approaches to and expectations about standards that exist among these national institutions. These realities have made it unlikely that the researcher will be able to address the multiple variables inherent in the students from the different Thai institutions that are located across the nation. Moreover, some students might have experienced computer learning by a self-directed approach using such resources as individual tutorials or exposure at home or in work situations. Still, others might have been exposed to teacher-directed approaches that reflect a range of methods and styles. In addition, there are differences in contexts and administrative expectations in the academic environments that could impact the nursing students' computer competencies. Hence, it would be difficult to assess the process of previous learning regarding computer literacy in the

nation through the purpose of this study. Therefore, the conceptual framework of the present study consists of two major concepts, input and output, as shown in Figure 2.

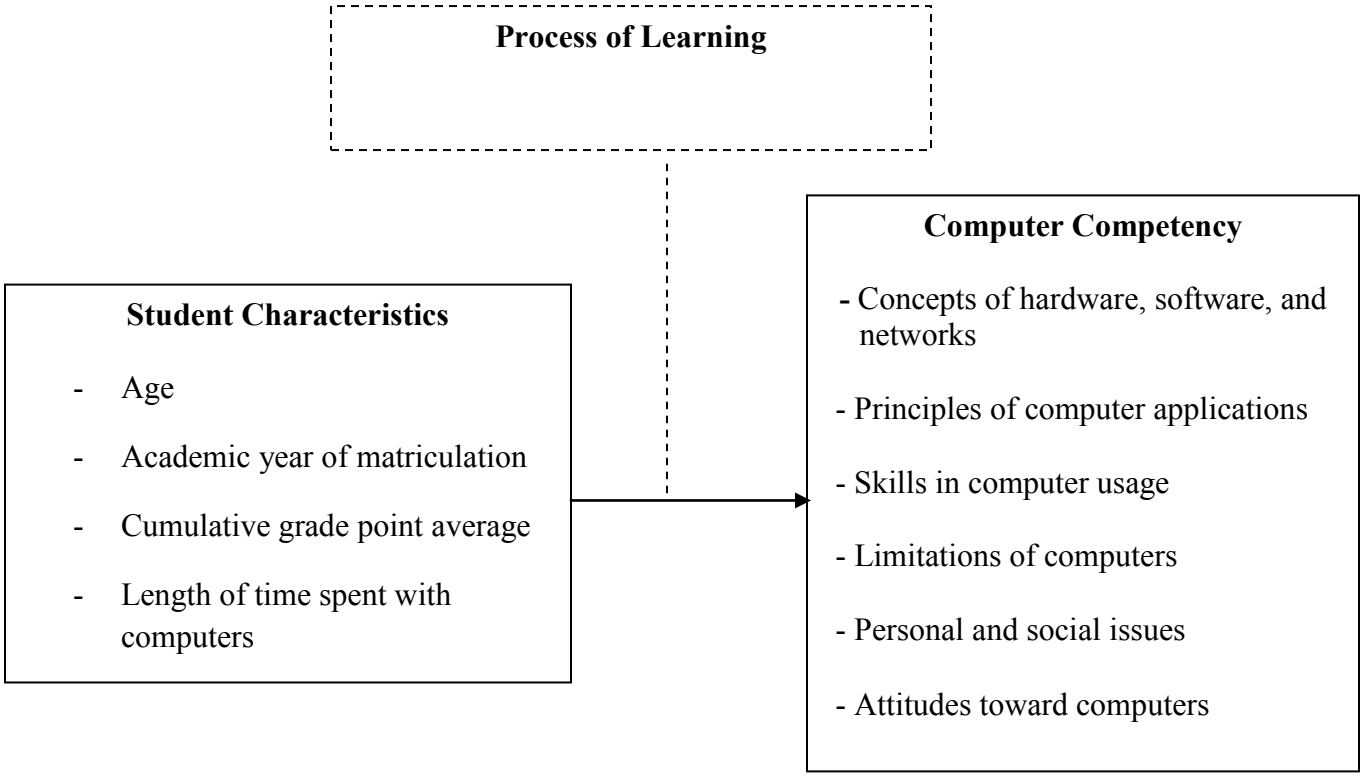


Figure 2. A conceptual framework of the study based on the general system theory

Within this framework, inputs refer to student characteristics and outputs refer to computer competencies of nursing students. In order to explore computer competency, student characteristics should first be identified. According to past research on computer competency, four variables are included in student characteristics: age of nursing students; academic year of matriculation including year 1, year 2, year 3, and year 4; cumulative grade point average; and length of time spent with computers (Hsu, Hou, Chang, & Yen, 2009; Johnson, Ferguson, & Lester, 2001; Lin, Lin, Jiang, & Lee, 2007; Mccanne, 2004; Rozell & Gardner, 2000). Outputs are represented as computer

competencies of nursing students consisting of six domains: concepts of hardware, software, and networks; principles of computer applications; skills in computer usage; limitations of computers; personal and social issues; and attitudes toward computers (Hsu et al., 2009).

Although there are limited scientific explanations for the six domains of computer competency, based on research and literature, the six domains will be delineated. (1) Concepts of hardware, software, and networks are defined as understanding basic components and functions of computer hardware and software systems, and computer networks. The concepts also include common computer terminology (Miller, 2010). (2) Principles of computer applications can be defined as understanding the general rules of a variety of software programs, including common computerized equipment in health care, such as computed tomography scans and magnetic resonance imaging. (3) Skills in computer usage can be defined as the ability to use application software such as word processing, spreadsheets, and statistical software (Elder & Koehn, 2009; McDowell & Ma, 2007). (4) Limitations of computers could include a narrow awareness of the constraints that computers present. Neither nursing students nor any other professional group should totally rely on computer functions alone because technology cannot replace critical thinking (Rosenberg, 2004). (5) Personal and social issues can be defined as concerns of today's computer-related matters arising from the increasing use of computer and computer-based electronic networks such as the Internet. Important issues to remember in computer usage include ethical, security and confidentiality, privacy, and access concerns that continue to expand along with the technology (Rosenberg, 2004). (6) Attitudes toward computers are complex internal states of nursing students that affect

their choices of actions and behaviors toward computers (Scarpa, Smeltzer, & Jasion, 1992). Attitudes are learned within a social context and are influenced by previous experiences. They help to shape and determine behavior (Daft & Lane 2010; McBride & Nagle, 1996). These six domains of computer competency can be conceptualized as the three categorizations of Bloom's Taxonomy of Educational Domains, which are knowledge, skills, and attitudes (Bloom, 1974). According to Bloom, after learning episodes, the learners should acquire new knowledge, skills, and attitudes.

Definition of Terms

The following theoretical and operational definitions will be defined in the present study. These terms include two dimensions: theoretical and operational definitions.

Computer Competency

Theoretical Definition. Computer competency is an individual's ability to effectively use computer technology and adapt his or her knowledge and skills to a variety of particular uses and settings (Hobbs, 2002). Specifically, computer competency refers to an individual's ability to operate a computer system, have a basic understanding of the operating system, use computer application software to perform a personal or job-related tasks, use Web browsers and search engines on the Internet to retrieve and store needed information, and communicate with others (Gupta, 2006).

Operational Definition. In this study, computer competency will be measured by the computer competency questionnaire developed by Hsu and colleagues (2009). The content areas in the questionnaire are classified into six dimensions: concepts of hardware, software, and networks; principles of computer applications; skills in computer

usage; limitations of computers; personal and social issues; and attitudes toward computers (Hsu et al., 2009).

Computer Experience

Theoretical Definition. Computer experience is the term used to describe the totality of the observable, direct or indirect human-computer interactions which transpire across time and settings (Smith, Caputi, Crittenden, Jayasuriya, & Rawstorne, 1999). It has generally been defined in terms of the amount and intensity of the person's computer usage. In this study, computer experience refers to a nursing student's previous hands-on computer use that could have occurred in settings such as the home or the school.

Operational Definition. This computer experience will be measured by the total number of computer classes, the total number of years using computers in his or her life, the frequency of using computers which is recorded in hours per day, and computer ownership which is categorized into yes or no responses on the questionnaire.

Length of Time Spent with Computers

Theoretical Definition. The amount of time that a nursing student has previously engaged in hands-on computer use.

Operational Definition. The subjects' self-report of the number of years he or she has used the computer over the duration of their lives.

Age

Theoretical Definition. Age is defined as the total years of life of a nursing student who is a subject of the study.

Operational Definition. Age will be measured by the subject's self-report of age in years.

Academic Year of Matriculation

Theoretical Definition. Academic year of matriculation is defined as the number of years that a student has studied at Chiangmai University, and his or her self-reported academic classification.

Operational Definition. A self-report of the student's academic years will be recorded as year 1, year 2, year 3, and year 4, and documented as their matriculation period.

Cumulative Grade Point Average (GPA)

Theoretical Definition. Cumulative Grade Point Average is defined as the mean GPA calculated over time for each student who is enrolled in Chiangmai University.

Operational Definition: Cumulative GPA will be self-reported by the students, and recorded as a single numeric value on a confidential demographic data questionnaire.

Research Questions

The research questions for the study were:

1. What are the demographic characteristics of the nursing student body matriculating at Chiangmai University during the first semester (June – October) of 2011?

2. What is the self-reported computer experience of Thai nursing students who are matriculating at Chiangmai University during the first semester of 2011?

3. What is the level of self-reported computer competencies of Thai nursing students who are matriculating at Chiangmai University during the first semester of 2011?

4. Is there a bivariate relationship between a nursing student's personal characteristics (age, academic year of matriculation, cumulative grade point average, and length of time spent with computers) and computer competencies?

5. Do a student's personal characteristics such as age, academic year of matriculation, cumulative grade point average, and length of time spent with computers predict computer competencies?

Significance

Health professionals have begun to implement computer technology such as hospital information systems and electronic medical records in order to improve the efficiency, quality, and safety of health care delivery and patient outcomes (Medicare Payment Advisory Commission [MEDPAC], 2004). The increased use of computer technology in health care systems enhances the need to strengthen nurses' computer competencies. Computers are now a major tool in health care delivery and computer competency is one of the required skills of the 21st century nursing workforce. Undergraduate nursing students should prepare themselves to possess adequate computer competencies that will be/are a basic expectation in health systems across the world (Barnard, Nash, & O'Brien, 2005; Elder & Koehn, 2009; Magg, 2006). According to Jiang, Chen, and Chen (2004), student nurses with computer competencies should be able to adapt quickly to their computer-driven work environment when compared to their counterparts who have not attained this knowledge and skill set.

Many studies indicate that the quality of nursing care will improve with the increased use of computers and information technology. It is a basic assumption that the nursing care of patients will improve through the use of computers. For example, the

accurate documentation of the patient's health status should become more clinically dynamic and useful; the number of errors should be reduced; and the accountability of all professionals, including nurses, will be stressed in the service of improving overall quality of care (Elder & Koehn, 2009; Raja, Mahal, & Masih, 2004). There is little dispute that computer competency is vital to the nursing profession, and for improved quality of health care. This amazing technology will also enhance the communication between and among all health care providers. Importantly, it will make available mechanisms for health systems to share vital patient information, reduce the time now needed for documentation of clinical services, and limit the possibility of error through more accurate recordings of data (Kudyba, 2010). Hence, there is a need to understand the extent to which nursing students are educated to utilize computer technology across a variety of dimensions, including patient care, accurate clinical documentations, research analysis, communications, and family-centered patient education (MEDPAC, 2004).

In 2004, the United States White House issued an executive order calling for the nationwide adoption of interoperable electronic medical records within a decade (by 2015) and establishing the position of the National Coordinator for Health Information Technology (Joint Commission Resources, 2010). In fewer than 90 days, a significant strategic plan in what is now being called the "decade of health care information technology" was released to make the idea a reality (Stein & Deese, 2004). With further support from numerous political leaders and scientific information, the movement to improve the quality of care and reduce health care costs through advanced clinical technology has firmly taken root in the American society. Incorporating this move toward the integration of health information technology at a national level in health systems with

practicing and student nurse populations requires the development of basic computer and information competencies within the workplace. Health systems that are adapting electronic computer systems must have an effective means to ensure that current and future nurses are competent in the use of computers and information technology (Curran, 2003; Little et al., 2003).

Across the world from the United States, in Thailand, empirical studies about Thai nursing students' computer competency have yet to be reported. Little is known about Thai undergraduate nursing students' computer competency levels. The readers should recall that almost all of the scientific literature reviewed for this current study has been generated from western countries such as the United States, the United Kingdom, and Sweden. Secondly, several schools of nursing in Thailand do not have informatics courses in their baccalaureate programs (Prachusilpa, 2007). Thirdly, many Thai nursing faculty members assume that their students enter nursing schools with some computer competency; yet there is no information to support this assumption which is not consistent with the literature. For emphasis, nurses, in general, are thought to have limited computer knowledge and skills. The literature suggests that nursing students in several countries such as the United States, Australia, Sweden, China, and Taiwan have limited computer competencies (Bond, 2009; Elder & Koehn, 2009; Kenny, 2002; McDowell & Ma, 2007; Ragneskog & Gerdnert, 2006), and this finding should be of concern to all nurse educators. Lastly, while computing courses are widely available in institutions of higher education in Thailand, they are not yet a part of the mandated curricula in many schools of nursing (Baromarajonani College of Nursing, 2009; Faculty of Nursing, 2009). Therefore, it should be imperative in schools of nursing to explore the

extent of the need to better understand computer competencies among Thai nursing students, and then develop instructional interventions that will provide the appropriate outputs, and the reasonable levels of knowledge and skills in computer usage across settings. Such information gleaned from the exploration could be utilized to improve student learning and enhance the knowledge and skills that are directly linked to improved overall patient-centered care. Similar approaches could be implemented at Chiangmai University in northern Thailand.

The findings from this study will provide essential information about a current level of computer competency among Thai nursing students at Chiangmai University. Study findings can be used to guide evidence-based curriculum development as to whether informatics courses should be integrated into program requirements, and the content that would best inform the student nurses. Nurses who have the necessary computer knowledge and skill sets should be able to enter a variety of healthcare systems, provide quality nursing care that utilizes technology and computer-based information, help reduce medical errors, improve the quality of patient care, and enhance safety.

Summary

A dearth of information as to what Thai nursing students currently know about computer technology is evident. To understand and develop students' computer competencies, nursing leaders should be aware of the level of knowledge and competencies that currently exist among students at Chiangmai University. This quantitative study will be implemented to help determine nursing students' computer competencies in terms of concepts of hardware, software, and networks; principles of computer applications; skills in computer usage; limitations of computers; personal and

social issues; and attitudes toward computers. Also specific variables that predict nursing students' computer competencies will be examined.

In order to understand the gestalt of nursing students' computer competency, undergraduate nursing students at every educational level at a university in Thailand were invited to participate in the study. Not only will this study provide benefits for both faculty and students regarding computer competencies, but also the findings could contribute to the identification of additional variables for valuable future research studies. Furthermore, this study could generate additional questions, such as what should be taught in curricula about computer technology in nursing education, and to what extent are faculty members prepared to teach these skills? Additional questions center around practice and workforce issues. It is not yet known what specific computer knowledge and skill sets will be expected from recent nurse graduates who enter the Thai workforce. In addition, computers are essential tools for research, the advancement of science and nursing, and the generation of health policy. All of these domains are components of the MOPH that address the need to improve the quality of life for all Thai people (MOPH, 2008).

CHAPTER II

Literature Review

This literature review highlights studies that help to inform the proposed investigation. Various definitions of computer competency that have been frequently cited in the literature are briefly discussed. Also, the review addresses attributes of computer competency, computer competency among nursing students, informatics in nursing education, factors influencing computer competency in nursing, computer education implementation in Thailand, and Thai nursing education challenges. Also, a common definition of computer competency that is frequently used in the literature is integrated into this review. The chapter concludes with a discussion about the School of Nursing at Chiangmai University, and the northern region of Thailand that is its home.

Definition and Attributes of Computer Competency

Advances in computer and information technology have required that student nurses be knowledgeable in computer technology for several reasons, including promoting their education, accessing the expanding repositories of health information in their practices, and providing essential care to patients, families, and communities. As such, recent efforts among nurse educators, worldwide, have focused on computer competency of nursing students. Themes about the importance of technology to nursing science and patient care have emerged in the literature, and it continues to proliferate. However, the definition of computer competency varies widely and is not clearly stated in the literature. Many different terms are used to describe computer competency, each with a nuanced definition. These include computer competency, computer literacy, computer skills, computer knowledge, computer proficiency, information literacy, and

informatics competency (Cole & Kelsey, 2003; Hulick & Valentine, 2008; Smedley, 2005; van Braak, 2004). Most researchers use these terms interchangeably and inconsistently. However, the term "computer competency" is most often used interchangeably with and treated as synonymous to terms such as "computer literacy" and "computer skills," which refer to an individual's ability to effectively use available computer information systems available and adapt his or her skill set to a variety of settings (Hobbs, 2002; Hulick & Valentine, 2008). There is an explanation that helps to support and guide this research: Computer competency refers to an individual's ability to operate a computer system, have a basic understanding of the operating system, use computer application software to perform a personal or job-related task, and use Internet Web browsers and search engines on the Internet to retrieve needed information and communicate with others (Gupta, 2006). Within the context of this proposed research, computer competency of undergraduate nursing students includes the understanding and ability to complete computer-related tasks, and to utilize electronic technology effectively in education, practice, policy, and research. Computer competency reflects the students' level of performance in terms of their capacity to use computer technology in all areas of their career, and to apply these principles and practices in ever-expanding healthcare and educational systems.

According to Hobbs (2002), the attribute of computer competency can be divided into three categories: knowledge (cognitive), attitudes (affective), and skills (psychomotor). Hobbs (2002) conducted a comprehensive review of published instruments designed to measure qualities associated with computer competency over the past 12 years. The review occurred between 1988 and 2000. Findings from his

investigation can be conceptualized into the three abovementioned domains, which are congruent with Bloom's Taxonomy of Educational Domains (cognitive, affective, and psychomotor).

Bloom's Taxonomy is often used in academic nursing and numerous other disciplines such as psychology and sociology. An underlying assumption is that any task stimulates one of these three psychological domains: cognitive, affective, and psychomotor. The cognitive domain addresses intellectual capability, knowledge, and understanding of concepts. Knowledge is an understanding of the terminology and facts that allow one to comprehend, apply, analyze, and evaluate phenomena (Norton, 1998). The affective domain addresses the attitudes and feelings that result from perceptions, as well as the learning process that the individual might have experienced. Attitudes are complex mental states involving beliefs and feelings of favorability or unfavorability toward an object, person, or behavior (Burger & Blignaut, 2004). Finally, the psychomotor domain involves manipulative or physical skills and the ability to behave efficiently in a situation that requires action; it is associated with practice or rehearsal (Reilly & Oermann, 1990). Collectively, the three domains from Bloom and Hobb overlap with Gupta's findings (Bloom, 1974; Gupta 2006; Hobbs, 2002).

Measuring Computer Competency

Nursing students' computer competency can be measured by self-reported data. Different, but related, studies about computer competency reveal various components of computer mastery. As a rule, the components of computer competency are classified by types of applications, such as word processing, spreadsheets, databases, presentation graphics, computerized statistical analysis, and Internet usage (Elder & Koehn, 2009;

Gassert & McDowell, 1995; Hollander, 1999; McDowell & Ma, 2007). For the purpose of this study, computer competency consists of six domains: concepts of hardware, software, and networks; principles of computer applications; skills in computer usage; limitations of computers; personal and social issues; and attitudes toward computers (Hsu et al., 2009). The questionnaire of Hsu and colleagues (2009) is used in this study because it is available in the scientific literature; its components correspond with all three attributes of computer competency (as defined by Bloom and Hobbs): computer knowledge, computer skills, and computer attitudes. That is to say, among the six domains of Hsu and colleagues, the four domains including "concepts of hardware, software, and networks," "principles of computer applications," "limitations of computers," and "personal and social issues" can be grouped under "computer knowledge" as defined by Bloom. "Skills in computer usage" and "attitudes toward computers," respectively, as defined by Hsu and colleagues are equivalent to "computer skills" and "computer attitudes" as defined by Bloom.

Computer Competency Among Nursing Students

Over the past 10 years, the spread of the Internet and information technology has brought dramatic changes to our lives and has impacted almost all human activity. The increased use of health information technology worldwide has been declared to have tremendous promise for improving the efficiency, cost-effectiveness, quality, access, and safety of health delivery across the global community (Hebda & Czar, 2009). Many types of information technology, such as electronic medical records (EMR), computerized physician order entries (CPOE), medication administration records (MARs), decision support systems, nurse charting/documentation, laboratory order entry and

communications, and radiology imaging archiving and disseminating systems, are now common practices in some health systems. These new and innovative approaches have been implemented to help improve access to care, reduce medical errors, enhance the delivery of safe and quality care, and promote better health outcomes for individuals and populations (Hebda & Czar, 2009). Numerous studies have assessed the relationship between health information technology and patient quality of care. Researchers have demonstrated that health information technology enhances preventive health care delivery, improves the process of care delivery, reduces morbidity and mortality, and helps to address issues that are related to health disparities, including premature morbidity and mortality (Amarasingham et al., 2009; Institute of Medicine, 2000; O'Connor et al., 2005).

However, the success of this implementation relies on hardware, software, and human resources, especially nurses, who make up the majority of the workforce in the healthcare system. For example, nurses frequently use computers to enter and review physician orders and progress notes, and other pertinent patient care information from a variety of sources; to access laboratory and imaging results; to collect and record data; and to document responses and behaviors from patients and health professionals (Hobbs, 2002). Also, medical equipment such as electronic thermometers, intravenous pumps, and cardiac monitors are closely linked to technology. Nurses are typically the professionals who are responsible for monitoring and interpreting their outputs. The use of information technology could resolve long-standing issues associated with privacy, confidentiality, and respect for the individual. Numerous benefits are predicted to become evident, including improving the quality of health care and reducing and eliminating health

disparities (Custodio, Gard, & Graham, 2009; Halamka, 2010). With the aid of technology, clerical work performed by nurses in past years has been/and should continue to be reduced. One outcome is that nurses should have more time for direct patient care (Hebda & Czar, 2009), which ought to improve health outcomes across populations and settings. Again, the growing use of this technology in health care systems gives rise to the need for increased computer competency among nurses. In other words, computer competency is now one of the required skills of the 21st century nursing workforce (Dulong & Gassert, 2008; Fetter, 2009a). Recent graduates are expected to possess computer technology skills along with nursing knowledge as they enter the workforce. Worldwide, health care settings such as hospitals and clinics require that nurses, particularly novice nurses, be able to demonstrate competence and exude a sense of self-efficacy in the use of computer information technology in their practice, research, and education activities (Ornes & Gassert, 2007; Ragneskog & Gerdnert, 2006).

Although nursing students' computer competency is one of the critical factors for successful use of the health information system, the current level of their competency is still unclear among leaders in schools of nursing in Thailand, other nations in the southeastern region of Asia, and the United States. Leaders in schools of nursing have not developed a consensus about the definition of computer competency. In addition, they do not know the level of computer competency that these nursing students have achieved during the course of their matriculation at a university. There is a dearth of information regarding the basic question of what nurses and nursing students currently know about computers and information technology and its utility in healthcare systems (Ali, Hodson-Carlton, & Ryan, 2002; McDowell & Ma, 2007). The majority of research studies

conducted in the United States and European countries revealed that nursing students do not possess the desired computer competency for the next millennium, even though they were expected to learn about and were exposed to computer technology throughout their formative education, from elementary through high school (Ali et al., 2002; Bond, 2009; Cartwright & Menkens, 2002). In addition, according to survey data published by the National League for Nursing (2008a), nurse educators from the leading professional organizations (e.g., American Nurses Association) suggested that nursing graduates who matriculated in all education programs are not adequately prepared for their expected roles and responsibilities that are linked with computer and informatics competencies.

In a study that centered on health professionals (nurses, pharmacists, interns, residents, fellows, and physicians), nursing students were the most likely to be non-users of the Internet (Jacko, Sears, & Sorensen, 2001). This finding is consistent with another study that posited that Internet skill levels of nursing students tend to be poor or minimal, when other than the most basic tasks are considered, such as entering an address in a web browser (Bond, 2006). Half of the students in the study could not effectively locate information on the Internet. Also, in a Canadian study, the researchers demonstrated that computer-related improvement was needed among student nurses. In fact, they should be able to demonstrate skills that are related to the Internet, create PowerPoint documents, use electronic mail, and perform other essential tasks (McKee, 2007). Another study showed that nurses were more wary of using computers than were other healthcare professionals such as doctors, pharmacists, and laboratory staff; they also made more negative comments about computer use (Kirshbaum, 2004). A longitudinal study that evaluated the self-reporting of computer competencies of nursing students over an 8-year

time period revealed an increased level of experience with word processing, electronic mail, and the World Wide Web; however, participants did not show an increase in the level of experience with spreadsheets, databases, and the use of statistical programs (McDowell & Ma, 2007). The researchers also concluded that nursing education has, in general, failed to provide novice nurses with the tools necessary to work in technology-rich health care systems (McDowell & Ma, 2007). Overall, these negative findings have an undesirable impact on the overall performance of nurses. But information technology can be used as a tool for gaining knowledge, as well as to improve quality patient care (Fetter, 2009b).

One recent study in Sweden found that nursing students regarded their computer skills as sufficient for their current and future work as registered nurses in health settings (Ragneskog & Gerdnert, 2006). This finding may result from the fact that two-thirds of the students were familiar with using computers; the majority of them had access to the Internet at their homes, and computer training was integrated into the curricula of many secondary schools in Sweden. Elder and Koehn (2009) surveyed nursing students in the United States. The students were asked to self-rate their computer skills and to complete the computer competencies assessment, which is a computer-graded questionnaire. The results showed that, in general, the students' mean ratings of their computer skills were high ($M = 3.94$, $SD = 0.59$). As expected, mean scores for word processing were higher than other programs such as database, spreadsheet, and graphics presentations skills. The mean scores for Internet-related computer skills were also high ($M = 4.43$, $SD = 0.63$). The deviations were high too. However, the findings suggested that although the students in the study rated their computer skills to be high or near "expert" level in some areas,

their computer assessment scores indicated only marginal skills necessary to achieve a successful academic grade in their classes. It appeared that the students did not have an adequate grasp of basic computer knowledge. In addition, the authors reported that the students had a portion of the skills necessary to be proficient in a computerized environment, but they lacked the know how that was required to excel in college coursework, including word processing. It was also hypothesized that these nurses will not have adequate computer knowledge and skills to provide quality patient care in health delivery settings (Elder & Koehn, 2009) unless they are systematically exposed to additional curricular content and skills acquisition.

Thai Nursing Students' Computer Competency

The level of computer competency of nursing students in Thailand, as in other countries, is not well understood. Empirical studies about this topic have yet to be reported in the scientific literature. Although many Thai nursing faculty assume that their students enter nursing schools with some computer competency, this information is not consistent with the literature, which revealed that nursing students in several countries, including developed nations, had limited computer competency (Ali et al., 2002; Bond 2009; Cartwright & Menkens, 2002; Kenny, 2002). Bond's study (2009) revealed that although there is an anecdotal expectation in the United Kingdom that every student coming out of high schools be skillful in using a computer, the reality is that student nurses are not yet ready to use computers to support their educational pursuits at the beginning of their practice exposure in academic institutions. Moreover, several schools of nursing in Thailand have not provided informatics courses in their baccalaureate programs (Prachusilpa, 2007). It is reasonable to infer that the informatics competency of

Thai nursing students is insufficient for the electronic health environment. To solve nursing students' computer knowledge and skill set limitations, integrating informatics into nursing programs could be one of the solutions.

Informatics in Nursing Education

Informatics, derived from the French word "informatique," which refers to all aspects of the computer milieu, emerged in the 1960s with the introduction of computers in the health care industry (Saba & Riley, 1997). Informatics or information technology in healthcare has been very beneficial to nursing and to health care systems, and is also reshaping nurses' work environments, and how health care is assessed and delivered (Priselac, 2003). The benefits to nurses who use information technology are numerous. They include the quality of patient information, robustness of communication and documentation, improved interdisciplinary collaboration, reductions in repetitive tasks, time savings for bedside care, and better nurse-related work outcomes. Of significance is the related improved patient safety and quality of care that might be more difficult to measure and evaluate (Hebda & Czar, 2009; Kudyba, 2010; Swartz, 2004). These benefits and the increased use of computer technology in health care systems accompany the need to increase nurses' computer competencies (Hebda & Czar, 2009; Institute of Medicine, 2000; Kirkley, Johnson, & Anderson, 2004) and to encourage the use of this technology in all dimensions of nursing. It is very important for contemporary nursing professionals to be computer literate. Preparing nurses to be computer literate and able to manipulate informatics tools and systems efficiently in their practice and research is one of the responsibilities of the nursing profession, including nursing schools where curricular matters and outcome measures are determined and evaluated.

To strengthen nurses' computer competencies, nursing informatics – a specialty that integrates nursing science, computer science, and information science to help with management and communication information in nursing practice – was generated and developed. It is now an integral part of the nursing profession, and is linked with most of nursing's activities and professional expectations. The goal of nursing informatics is to improve the health of populations, communities, families, and individuals by optimizing information management and communication (American Nurses Association, 2001; McGonigle & Mastrian, 2009). The development of nursing informatics began from nurses' insights into various countries, and from organizational efforts on the state, national, and international levels in the early 1970s (Saba, 2001).

Evidence of the incorporation of nursing informatics into nursing education gradually started to emerge in the 1980s. During that era, a number of workshops for nurses on computer technology were sponsored by universities, healthcare systems, and professional organizations in nursing and other health-related disciplines. Examples of organizations that addressed the education of nurses in informatics and computer technology included the National League for Nursing (2008b). This professional organization focused on educational issues and credentials, and provided required certification for schools of nursing. It has recommended that computer technology and nursing informatics should become an integral part of nursing education, proposing it as a requirement for the accreditation of education programs in all schools of nursing (Elder & Koehn, 2009; Ornes & Gassert, 2007). In addition, a number of nurse leaders agreed to integrate nursing informatics into nursing education curricula because comprehensive informatics competencies were valuable and essential to the nursing profession (Staggers,

Gassert, & Curran, 2001; Weaver et al., 2006). Importantly, informatics competencies are required by major professional organizations such as The Joint Commission. This organization has the clout to accredit health delivery systems. Negative consequences are linked with reimbursement and quality ranking. The American Academy of Nursing is another major organization that supports nursing informatics across several domains, including research, education, and service delivery (Bakken, 2001; Carty & Rosenfield, 1998; McNeil & Sodom, 2000). In 1997, the Division of Nursing of the Health Resources and Services Administration convened the National Nursing Informatics Work Group to advise the National Advisory Council on Nurse Education and Practice (NACNEP) about priorities for nursing informatics education and practice in the United States. From these recommendations, the National Informatics Agenda for Nursing Education and Practice was generated; recommendations for including nursing informatics concepts in nursing curricula were a few of its major outcomes and these new requirements were implemented soon thereafter (NACNEP, 1997). In just a few years, many nursing schools offered either integrated or freestanding informatics courses as components of their undergraduate curricula (NACNEP, 1997). In a 2004 report of findings from a national survey of nursing education programs in the United States, researchers found that nursing informatics was taught in 50% of the nursing education programs across the United States (McNeil et al., 2005). As of 2010, there are no data about the current state of nursing informatics education in the United States.

On the other side of the world, in Thailand, nursing informatics is a relatively new phenomenon. The first national conference on nursing informatics was held 11 years ago in Bangkok (Volrathongchai, Abbott, & Phuphaibul, 1999). The primary purposes of the

conference were to exchange knowledge on the development of nursing informatics and to validate the International Classification for Nursing Practice's (ICNP) nursing problems list that had been developed by the International Council for Nurses, a component of the World Health Organization. The meeting resulted in the establishment of the Nursing Informatics Society of Thailand and 120 nurses signed as its inaugural members (Volrathongchai et al., 1999). However, the integration of nursing informatics into nursing education in country has progressed slowly. Nursing schools have not yet offered a specific nursing informatics program in their curricula. Significantly, the stated outcome competencies have not yet been defined and disseminated. Evidence of the presence of information technology and nursing informatics is obvious, however; almost every nursing school in the nation has fully or partially incorporated information technology into the teaching and learning process at their institutions (Baromarajonani College of Nursing, 2009; Faculty of Nursing, 2009).

Although integrating nursing informatics in nursing programs has helped to develop and affect computer competencies for nurses, there are other variables involving students' computer competencies that have been neither identified nor examined. Disentangling these variables is the next logical step.

Factors Influencing Computer Competency in Nursing

Few studies have attempted to disentangle the variables that influence computer competency among nursing students in baccalaureate programs in Thailand and in neighboring regions in Asia. In general, the variables that have been studied are related to students' personal characteristics, such as age, academic years at a university, previous computer experience, and cumulative grade point averages (Curtis, Hicks, & Redmond,

2002; McCanne, 2004; McKee, 2007; Morewitz, Shaw, Clark, & Mullins, 2004). Several attempts have been made to correlate these characteristics with computer competency. However, these variables were found to be inconsistent predictors of computer competencies among nursing students. Therefore, they need further investigation. Recent studies have yielded inconsistent results, and the findings are sometimes contradictory (Johnson et al., 2001; Maag, 2006; McKee, 2007; Morewitz et al., 2004).

Age and Computer Competency

Today, computer technology is ubiquitous. It is generally believed that computer technologies are used effectively and with confidence by much of the younger population, but less so among elders (Hardy, Heeler, & Brooks, 2006). Past generations used computers mainly in their employment; the current generation uses computers as a part of their social lives, and for academic learning (Hardy et al., 2006). They are not surprised by or reluctant to utilize the rapidly changing technologies. Instead, the current generation of adolescents and young adults tends to eagerly look forward to advances in technology, and is quick to integrate these new technologies into their everyday lives. Increasingly, students are being exposed to a digital environment at younger ages than were their older counterparts. Therefore, some studies have shown a negative relationship between age and computer competency. Graveley, Lust, and Fullerton (1999) reported that American undergraduate nursing students' computer skills were negatively correlated with students' ages ($N = 183$). Older students reported a lower level of computer skills. Also, McKee (2007) revealed that younger Canadian nursing students were associated with greater computer literacy ($N = 81$). The older group of students were less likely to be computer literate than their younger counterparts. By contrast, in

the United States, a national study, *Nursing Students' Attitudes toward Technology,* in 52 schools of nursing discovered that younger nursing students displayed significantly lower computer technology confidence and positive attitudes than did the older nursing students (Maag, 2006). The other two exceptions are the Taiwanese and South Korean studies (Hsu et al., 2009; Lin et al., 2007). These studies indicated that age had a significantly positive impact on the computer literacy of nurses. That is, as age increased, their average computer literacy level increased. It is important to note that other factors such as clinical work experiences may be a factor related to increased computer competency. Also, Bond (2004) reported that it was access – not age – that is the determinant for computer ability among nurses. Honey (2004) also reported that respondents who had convenient access and spent more hours per week using a computer reported higher levels of computer skills than did respondents who had inconvenient access, and spent fewer hours per week using a computer. Other variables, they concluded, must also be considered.

Academic Years of Matriculation and Computer Competency

A review of the research literature yields limited studies that have assessed the relationship between academic years of matriculation and computer competency among nursing students in Thailand and other countries such as the United States. However, three studies about undergraduate students and computer competencies were associated with academic year of matriculation and computer competency (Johnson, Ferguson, & Lester, 1999, 2001; Morewitz et al., 2004). Findings are mixed; the relationship between academic years of matriculation and computer competency needs additional exploration. Because no research studies were found in the nursing literature, the researcher investigated other disciplines such as agriculture and medicine. The first study of

Johnson, Ferguson, and Lester (1999) posited that computer knowledge among undergraduate students who were enrolled in introductory university agriculture courses increased with class level and matriculation. That is, seniors tended to have greater computer knowledge scores than did juniors, sophomores, and freshmen, with extent of knowledge decreasing with each respective year. Johnson, Ferguson, and Lester (2001) repetitively studied the computer competency of agricultural students. They compared computer experience and computer competency between freshmen and senior students. The study revealed that both freshmen and senior students had a variety of computer experiences, with a majority in both groups owning a computer and completing one or more computer courses at the university. However, seniors scored higher on a computer knowledge examination than did freshmen. Seniors also had a higher level of overall computer self-efficacy than did the freshmen. Another survey with medical students confirmed that students' class years were correlated with self-reported computer knowledge (Morewitz et al., 2004). However, the findings displayed a different direction in the relationship. A larger percentage of students in their sophomore year reported good or very good computer knowledge than did students in their junior year. The rationale for the differences in the findings could possibly be that students in different class years may have had a variety of levels of computer training and exposure, which influenced their self-reported computer knowledge. In addition, as curricular change occurs at academic institutions, it is anticipated that computer courses and opportunities for informal computer and technology learning will increase along with the expectations that students will have some level of mastery of the technology (Morewitz et al., 2004).

Cumulative Grade Point Average and Computer Competency

Grade point average is an academic achievement that influences the person's causal attributions for success or failure (Rozell & Gardner, 2000). Across the globe, it is a frequently used measure of academic success. Evidence of the impact of academic performance on computer-related performance is provided by several studies. In the 1980s, Dambrot, Silling, and Zook (1988), for example, found that students who failed a college computer course had a significantly lower high school grade point average than did those who passed the same material. Similarly, about a decade later, Lee (1999) reported a positive relationship between high school computer-related competency and grades point average. This is consistent with a study in 2004 in which McCanne (2004) found a positive relationship between grade point average and computer skills of high school students. Although no study was identified regarding the relationship between grade point average and nursing students' computer competencies, these cited studies could imply that computer competencies may vary according to the nursing students' grade point averages. The relationship between grade point average and computer competencies among nursing students is an area that should be carefully explored.

Computer Experience and Computer Competency

In the informatics literature, there has been little consensus on the definition of computer experience; as a result, a variety of instruments and methods have been used to identify computer experiences, leaving little agreement about the meanings of the major variables in the research (Kay, 1993; Potosky & Bobko, 1998). Based on empirical evidence, computer experience could express, for example, the frequency of computer use (e.g., hours per day or week), or the length of time (e.g., weeks, months, years) spent

with computers at home, school, or in an office, and the number of computer courses successfully completed. In addition, the extent of prior computer training, usage of a variety of software applications, type of computer owned/used, computer ownership, and home access to computers are other consideration to ponder (Cork, Detmer, & Friedman, 1998; Hsu et al., 2009; Liaw, 2002; Smith et al., 1999; van Braak, 2004). Although there are many ways to express computer experiences, the amount of regular computer use or length of time having used computers is often used to describe a fundamental or essential component of computer experiences (Beckers & Schmidt, 2003; Smith et al., 1999). In the proposed study, total length of time (years) that a student nurse has been using computers in his or her life will be a measure of an important student characteristic (independent variable) to predict computing performance. Nevertheless, according to Leach and Caputi (as cited in Yaghmaie, 2007), a measure of years of experience alone is not the most accurate indicator of computer experience; yet these researchers did not suggest another predictor. Using the number of years of computer use presents some concerns when endeavoring to measure computer competency. For example, an individual with only a few years of computer exposure may have had a high-quality experience, whereas others may have had many years of experience, but of a lesser worth (Yaghmaie, 2007).

Recent studies about computer experiences of nursing students are scarce. In a study of Finnish nursing students, 23% of the participants had experiences with computer technology at their sites of employment, and 49% had completed a foundation of computer technology courses before entering the nursing school (Saranto & Leino-Kilpi, 1997). Two studies in the United Kingdom revealed that students and professional nurses

lacked the time for information and communication technology activities; moreover, student nurses reported that they did not think that they were encouraged to use computers in clinical settings by nurses and other health care providers (Bond, 2009; Willmer, 2007). This scenario is compounded by insufficient computer hardware, lack of information about the essence and value of information and communication technology, and deficits in budgets and other financial resources for students that are necessary for their engagement with computer technology (Willmer, 2007). Another study in the United Kingdom posited that nursing students thought that staff nurses had poor computer skills (Bond, 2009).

Curtis, Hicks, and Redmond's (2002) study of Irish nursing students indicated that the majority have some form of computer training. Thirty-seven percent of the participants who had received training gained it during their matriculation in academic programs. Fifty-seven percent of the participants who had some form of computer training received word processing instructions, 40% became oriented to spreadsheet usage, and 34% learned how to use the Internet for their academic and clinical learning needs (Curtis et al., 2002). A 2006 study in Sweden reported that of the total 247 nursing students, 66% had access to the Internet from their homes, 83% had access to e-mail, 87% knew how to send and receive e-mail, and 64% knew how to attach a document to an email message (Ragneskog & Gerdnert, 2006).

A 2006 study found that Taiwanese undergraduates spent about 19 hours per week using computers, of which 5 hours were academic related. They used computers not only for fulfilling their academic requirements and searching for information, but also for

entertainment, such as movie and television watching, computer game playing, Internet friend making, and shopping (Tien & Fu, 2006).

A path analysis model to find determinants of university students' computer competencies in Belgium demonstrated that self-perceived computer competencies were affected by the length of time students spent with computers (number of months) and the intensity of computer use (the total number of hours per week that a student spent working with a computer) (van Braak, 2004). A study conducted in Taiwan revealed that the number of hours per day that Taiwanese nurses spent using computers significantly influenced computer competency (Hsu et al., 2009). Another study in Taiwan revealed that time spent using computers positively affected the computer competencies reported by college students in Taiwan (Hsiao & Lin, 2005). By contrast, a study conducted in South Korea showed that the number of hours per day that South Korean nurses spent using computers was not a significant factor that influenced computer competency (Hsu et al., 2009). Other confounding variables, such as the ages of nurses, previous computer courses, prior computer training, and computer attitudes, might account for the difference in outcomes between the study in South Korea by Hsu and colleagues (2009) and the other three studies conducted in Belgium and Taiwan (Hsiao & Lin, 2005; Hsu et al., 2009; van Braak, 2004).

In summary, students' characteristics have been hypothesized to influence computer competency, but most of these factors have yielded inconsistent findings and are not yet well delineated. Numerous factors could account for these inconsistent findings, including (a) varied social, cultural, geographical, and socioeconomic backgrounds of the populations; (b) the range of years when the studies were conducted;

and (c) the inconsistent definitions that are used to explain the phenomena of computer competency among nursing students.

Computer Education Implementation in Thailand

Based on a recent dramatic increase in computer usage in schools around the world, it is crucial that Thailand's Ministry of Education (MOE) act to promote technology learning at all levels of learning in the nation. Thailand's education leaders already began to use technology in higher education in the 1990s, before the economic crises (Suanpang & Petocz, 2006). Following the economic crisis, Thailand continued to maintain its desire to be economically and educationally competitive in the current information-based society in the South-East Asia region and other world communities (Miller, 2009). This focus has helped to guide its educational reform. The National Education Act, the first act related to the educational reform movement in the nation was passed in 1999 (Suanpang & Petocz, 2006). The key elements of the reform focused on improving the efficiency and effectiveness of student learning. Policies were established in order to respond to this major National Education Act of 1999. One of the policies, " Learning Technology to Reach the Unreached in Thailand," was proposed with the following actions: (a) providing useful software, content, and necessary supporting information in the technology curriculum; (b) training teachers for literacy in computer and Internet usage; (c) enhancing the capabilities of organizations that can provide support and services to schools by forming a network of agencies; and (d) continuously monitoring and evaluating the use of technology for education (Kaewsaiha, 1999).

In 2002, the government announced plans to install computers connected to the Internet in all high schools by the year 2005. In addition, the vision of the Ministry of

Information and Communication Technology as stated in the National Information and Communication Technology Education master plan aspires for every student to have access to information and communication technology for learning at a reasonable cost and of adequate quality (Thuvasethkul & Koanantakool, 2002). Later, in 2008, the MOE officials announced a master plan concerning educational development in information technology. This policy stated that every public and private school would provide a computer information course for students in each educational year (Ministry of Education, 2008). As a result, Thai students are expected to take computer-related or computer competency courses. However, because this policy was launched in 2008, it is not clear whether all schools have been able to implement the plan. Outcomes related to students' computer performances have not been carefully examined and disseminated.

Thai Nursing Education Challenges

Generally speaking, the lack of informatics competency has been identified as a major barrier to providing effective nursing care worldwide (Fetter, 2009a). The gap in computer competencies among practicing nurses is embedded in the Thai nursing education system. That is, nursing schools in Thailand do not have specific nursing informatics programs in their curricula, even though plans and strategic initiatives are in place (Prachusilpa, 2007). Few nursing schools have offered courses on computer application or informatics; even when they do, few credit hours are assigned to the curriculum. Some school curricula have informatics topics embedded in other classes, such as nursing management and leadership. In addition, schools might also elect to implement computer technology courses as electives in a general or specialized education category; there is no guarantee that every student will enroll in these courses. Yet, other

models are in place: some schools implement an informatics course in a free elective category, and students determine whether this is an essential element for their learning.

Until now, there has been no coordinated approach to informatics competency within the bachelor of nursing science curricula in Thailand's nursing schools. It is remarkable that, while computing courses are widely available in colleges, they are not yet a component of the mandated curricula in most nursing schools. This situation can cause nursing students to receive limited informatics exposure and widen the gap between the knowledge and skills that are needed in practice and the efforts that occur in academia. Also, reality could have a negative impact on nursing students because informatics is a necessary tool that students use to master the content in most courses because they access and acquire knowledge with high efficacy in effort and time. Unlike Thailand, in the United States, to prepare the next generation of nurses with the necessary computer competencies to function within an electronic health environment, many nursing schools in the United States have increased students' informatics competency requirements through mandatory courses in curricula (American Nurses Association, 2005; McNeil et al., 2005). Importantly, there is strong support for nursing informatics from the American Nurses Association; nursing informatics was first recognized as a nursing specialty in 1992. Within a decade, nursing informatics had developed into a highly specialized field of study, in which masters and doctoral degrees were conferred on those who completed a set of rigorous requirements. These innovations have helped nurses to develop both their practice and knowledge domains in information technology related to nursing work (American Nurses Association, 2008; Hebda & Czar, 2009; Hebert, 2000).

Background of the Chiangmai University School of Nursing

The School of Nursing, Chiangmai University, located in the north of Thailand in Chiangmai Province, began as a nursing division in the School of Medicine in Bangkok, in 1959. The goal was to begin the program in Bangkok and then establish a medical school in the north and move the nursing school to the same site. In 1960, a Practical Nurse Program began, and a Diploma in Nursing Course was initiated in 1961. In 1965, the School of Medicine was incorporated into Chiangmai University, and in 1972 the School of Nursing became a separate school within the University, and was located on the same campus. The first Bachelors of Nursing Science Program began in 1966, followed by the first Masters Degree Program in 1986. Later, a doctoral program was initiated in 1997 (Faculty of Nursing, 2010a). The school's vision is to become a leading nursing academic institution at the international level, and to produce quality scholars and exceptioanal research by the year 2012. The mission of the school is to provide education, research, and community service, and to promote and preserve Thai culture (Faculty of Nursing, 2010a).

The School of Nursing at Chiangmai University is a large organization consisting of 142 full-time faculty members, and 147 full-time academic support staff. There are around 1,500 students, both undergraduate and graduate, studying at the university. Three levels of study are offered: undergraduate, masters, and doctoral degrees (Faculty of Nursing, 2010b). The School of Nursing aims to produce graduates who can practice in, and provide leadership for both hospital and community-based settings throughout the nation. Nursing graduates are expected to have these four competencies: (a) apply information technology in learning, nursing practice, and management; (b) apply

knowledge of nursing science and other science that is relevant to the health of human beings, the environment, and to nursing practice; (c) practice quality nursing in health promotion, disease prevention, nursing care, primary medical care, and rehabilitation with individuals, families, groups and communities; and (d) be skillful in teaching, advising, counseling, and promoting competencies of an individual, family, or group (Faculty of Nursing, 2008).

Throughout 2009, the School of Nursing has been preparing for a review of its undergraduate curriculum. In a faculty meeting, it was suggested that the informatics courses be integrated into a revised undergraduate curriculum. As a result, the course, *Software for Everyday Life*, was added as an elective course for undergraduate students. However, to date, no mandatory informatics courses have been offered at other levels of the nursing curricula (Faculty of Nursing, 2010c).

Summary

Nursing students' computer competencies are a major concern of nursing leaders and educators all over the world. Scientific literature supports the value of computer competency as one of the necessary skills for nurses in the information age. To use technology effectively for the advancement of patient care, nursing students must possess sufficient computer knowledge and a variety of computer skills. However, the degree to which nursing students have acquired computer competencies is not well understood, and limited data are available to help with the unraveling of the variables that should be systematically studied. Most studies suggested that nursing students might not have the expected level of computer competency, resulting in an ineffective quality of patient care, compromised academic achievement, and limited exposure to research and evidence-

based practice. Therefore, the value of the integration of nursing informatics into nursing education curricula needs to be addressed with a sense of urgency. The urgency is driven by patient safety, quality care improvement, the reduction of morbidity and mortality, research that is needed to enlighten practice, and informed practice that is necessary to guide research.

Some significant variables that have been thought to influence computer competency have been presented in this review. The literature on computer competency and related topics suggests that nursing students' ages, academic years of matriculation, length of time spent with computers, and cumulative grade point average are important antecedents of computer competency.

One of the significant gaps in the literature is the lack of empirical studies regarding the computer competencies among nursing students in Thailand. Most, but not all, of the studies were conducted in Western developed countries where culture, education, and health care systems are conceptualized and organized somewhat differently from those in Thai institutions. A challenge that was uprooted in the literature is the lack of a specific nursing informatics program and few formal information technology courses in Thailand's nursing education systems. The proposed study will help to fill significant gaps by providing descriptive data regarding computer competency and important related variables that influence nursing students' levels of expertise in the field. The findings will help ensure that nursing faculty gain a better understanding of the baseline computer skills of their students prior to the implementation of nursing informatics in curricula. This scientific approach will help improve and strengthen the computer competencies of nursing students in Thailand. Indeed, if a specific set of

requirements could be implemented, perhaps Thai nurses could become leaders in computer technology for the improvement of health outcomes in local and global communities.

CHAPTER III

Methodology

The purpose of this study was to investigate the computer competencies among nursing students at Chiangmai University and identify the effect of specific personal characteristics (e.g., age, academic year of matriculation, cumulative grade point average, and length of time spent with computers) on computer competency. This chapter presents the methods that were used to collect and analyze data for this study. The chapter includes the following sections: pilot study, setting, and research design including sampling, instrumentation, data collection procedures, data analysis plan, and concerns related to the protection of human subjects.

Pilot Study

To ensure that the study was feasible in terms of research design, reliability and validity of the Thai version of the instruments, the procedures for recruitment, and data collection, a pilot study was conducted. In the pilot study, 20 Thai nursing students from all four academic levels in the undergraduate nursing program at Chaingmai University were invited to participate. The participants in the pilot study mirrored the same inclusion and exclusion criteria as delineated in the main study, but the participants were not included in the primary study. The results of pilot testing were used for several purposes: to pilot test the recruitment, procedures, instruments, and to refine all other aspects of the research process. Particular attention was given to students' responses to written materials with the intent of ensuring that participants understood all vocabulary and questions in the research package, and to clarify any parts of the process that might be confusing.

Setting

The pilot and primary studies were conducted at the School of Nursing, Chiangmai University, in Chiangmai province, which is located in the northern region of Thailand. Chiangmai is the principal city of northern Thailand and the capital of the province. It covers an area of 20,107 square meters, the largest city in the north and the second largest in land area in Thailand. The city and its surroundings are embedded in a uniquely indigenous cultural identity. One of several indigenous people who live in the region are the Chiang Mai, who have their own customs, belief, dialects, traditional architecture, and cuisine. Chiangmai people also continue their renowned tradition as handicraft experts, producing items in silk, wood, silver, textiles, ceramics, pottery, and more. Economic benefits are derived also from the exporting of these items to other parts of the world, and are a major source of their income.

Located 435 miles from Bangkok, the capital city of Thailand, Chiangmai is home to a population of 1.6 million people, and has the fourth largest population in the nation. Numerous cultural groups live in the city and its surrounding areas: Thai, Chinese descendants, and hill tribes who migrated from the southern part of China about a century ago. Collectively, these groups make up multicultural clusters who have emerged as unique subgroups with their own languages, customs, and cultures. The hill tribes include, for example, the Hmong, Akha, Lahu, and Lisu. People from these diverse groups work as farmers and craftsmen. The average personal income for all groups per capita in Chiangmai is about 69,870 baht/year (around 2,300 USD/year) compared to 90,864 baht/year (around 3,000 USD/year) as the average Thai personal income (Office of the National Economic and Social Development Board, 2008). The variance in per

capita income is probably due to Chiangmai's prevalent farmland as opposed to the large number of industries in Bangkok and other provinces.

This study took place from August to September 2011 at Chiangmai University, a public institution that is regulated by the Ministry of Education of Thailand. Chiangmai Univerity was selected because it is the only public university in the Chiangmai province and the largest university in the northern region of the nation. Its mission is to provide education to northern Thai students and to prepare a large portion of the healthcare workforce for the region. Chiangmai University was founded in 1964 and was the first institution of higher education in northern Thailand. It is also known as the first provincial (city) university in the Kingdom of Thailand. The university provides 21 academic programs. One of the popular programs at the university is the School of Nursing, where 785 baccalaureate students are enrolled in a 4-year program: 234 freshmen, 196 sophomores, 182 juniors, and 173 seniors. Of the 785 students, 729 are females. Enrollment tends to decrease from the freshmen to senior level for several reasons: (a) students must maintain a certain grade point average score, and the cut off score has to be in a certain percentile, (b) students might elect to pursue a different career path and enroll in some other academic program at the university, and (c) students withdraw from a school because of predicted reasons, including illnesses, and other life circumstances.

The university provides dormitory housing for all college students. In their first year of study (freshmen), nursing students live in the dormitory on the main campus and interact with students across the entire university. During the next three years (sophomores, juniors, seniors), the nursing students live in the school of nursing

dormitory on the health science campus. The dormitory housing for nursing students is constructed in a specific area of the campus, and structured in a specific manner. Each dormitory floor houses a specific academic classification. That is, sophomores live on the fourth floor, juniors on the third floor, and seniors on the second floor. A building manager is responsible for scheduling all activities for students, and the upkeep of the building and surroundings. Housekeeping staff live in the building and are available 24 hours. A computer laboratory with wireless Internet is provided in the dormitory where students can have continuous access to the technology to supplement their learning. This service is available to all students without additional cost.

Research Design

A cross-sectional descriptive correlational design was used to address the research questions in this study. The cross-sectional study is based on the assumption that collecting data will be done at a single point in time (Burns & Grove, 2007). This design was selected for the study in order to describe, explore, and explain relationships that exist between and among specific variables in a study. According to Burns and Grove (2007), a descriptive study is designed to gain more information about characteristics associated with a particular field of study, such as age, academic year of matriculation, cumulative grade point average, and length of time spent with computers. Its primary purpose is to provide a "snap shot" of situations as they naturally occur. As such, in this study, a descriptive design was used to obtain an overall one-time description of Thai nursing students' self-reported computer competencies. The setting was the School of Nursing in Chiangmai University, Chiangmai Province, northern Thailand.

Sample

The target population of the study consisted of undergraduate nursing students at Chiangmai University. All participants in the study were full-time matriculating nursing students at Chiangmai University. The inclusion criteria for the sample in this study were nursing students who were in one of the four academic levels, and who were currently enrolled in this 4-year baccalaureate program. Randomly selected students were invited to participate in the research study. Because the participants were volunteers, they had the option of accepting or refusing the invitation from the researcher to participate in the research. The exclusion criteria for this study included (a) students who were matriculating in an international bachelor of nursing science program at Chiangmai University, such as Chinese and American students, (b) students who participated in the pilot study that was an antecedent to this proposed study, and (c) those students who decided not to participate in the study. The researcher determined that international students (n = 70) were excluded because they may have been educated in different academic settings that may have other program requirements and cultural expectations. In addition, among the international group, some students may have had more or less exposure to computer applications than would their Thai counterparts. The international students did not reflect the "average" educational experiences of a typical Thai student, the focus of this study.

Sampling Plan

Stratified random sampling was used to select nursing students matriculating in each academic year to participate in the study. According to Burns and Grove (2007), stratified random sampling is a method used to enable random sampling to occur while

limiting the time and costs that will be required to recruit a sample from a large population. The main advantages of stratified random sampling are convenience, economy, and efficiency. The sampling plan had specific steps.

First, the total population was partitioned into separate groups called strata. These strata were pre-determined by the students' academic classifications. That is to say, the strata were composed of the four main academic levels in the baccalaureate nursing program which are designated as freshmen, sophomores, juniors, and seniors. Second, the total population units were divided into sections. In the undergraduate nursing program, there were four sections for each academic year. The number of nursing students in each section and level (year) is shown in Table 1.

Third, a random sampling process was used. To begin the random sampling process, the researcher randomly chose participants by selecting one section from each of the four academic levels. At the end point, a random sample of all nursing students enrolled in each of the four academic years was represented in the study.

Table 1

Number of Nursing Students in Each Section by Year, Fall 2010 (Faculty of Nursing, 2010d).

Year	# in section 1	# in section 2	# in section 3	# in section 4
1	58	58	59	59
2	49	49	49	49
3	45	45	46	46
4	43	43	43	44

Sample Size Determinations

The sample size of nursing students was determined by power analysis. According to Cohen (1988), power analysis is the most robust approach for indicating sample size. Three main parameters were used to determine sample size: significance level (alpha), power level, and effect size (Polit & Beck, 2008). Significance level is the probability of rejecting a null hypothesis when it should not be rejected (Cohen, 1988). A type I error occurs when the researcher wrongly rejects the null hypothesis. By convention, most researchers set the alpha level at 0.05 which means that the researcher would attain a correct conclusion from the data 95 out of 100 times. The second parameter is power level. Power is the ability of a statistical test to detect an effect assuming that the effect actually exists. It is the probability of rejecting a null hypothesis when it is false (Burns & Grove, 2007). A type II error occurs when the researcher has wrongly accepted the null hypothesis. A power of 0.80 has been suggested for use in most areas of behavioral science research (Burns & Grove, 2007). Therefore, an alpha of 0.05 and a power of 0.80 were used in this study. The effect size in this study was calculated based on several approaches. Using a previous study that explored the factors that influence computer literacy in Taiwanese and South Korean nurses (Hsu et al., 2009), the researcher determined sample size with application for this study. The results of Hsu's study reported that computer experience explains 41% of the variance in computer competency (R^2 = .41). An effect size of 0.69 was estimated when using the formula of $R^2/1\text{-}R^2$ (Cohen, 1988). Therefore, a large effect size of 0.69 for regression analysis was used for the current study. This is an extremely large number, considering that Cohen (1992) states a large effect size is 0.35.

Finally, G*Power 3 was used to calculate the sample size (Faul, Erdfelder, Lang, & Buchner, 2007), with four parameters, including four independent variables: age, academic year of matriculation, length of time (years) spent with computers, and grade point average; power= 0.80; alpha = 0.05; and strong size effect = 0.69. With these parameter calculations, a total of 23 subjects enrolled in all academic levels was required as the minimum adequate sample size to detect an effect size of 0.69 with 80% probability at alpha of 0.05 (two-tailed) (Burns & Grove, 2007).

However, because the effect size was based on a single previous study, this study used a larger sample size to ensure the robustness of the study. Increasing sample size was the best method to raise the statistical power in the study. Also, as the power increases, the chance of a type II error decreases (Corty, 2007). Therefore, one section of each of the four academic groups was selected randomly. The students in the randomly selected section were invited to participate in the study. As a result, 195 nursing students were required (year 1 = 58, year 2 = 49, year 3 = 45, year 4 = 43) to participate in this study to ensure robustness. The size of the sample in each academic year that was randomly selected is shown in Table 2. With the sample size of 195, the effect size, which is calculated using the G*Power 3, is 0.06. The results showed that 195 subjects should be adequate for detecting a moderately small effect size of 0.06. As a result, the total sample size in this study was 195.

Table 2

Number of Nursing Students in Each Year Randomly Selected to Participate in the Study.

Year	Number of Students
Freshmen, Year 1	58
Sophomores, Year 2	49
Juniors, Year 3	45
Seniors, Year 4	43
Total	195

Instruments

The instrument consisted of two questionnaires: (a) the Student Demographic Questionnaire; and (b) the Computer Competency Questionnaire. Each instrument is described below.

The Demographic Data Questionnaire

The Demographic Questionnaire was developed by the researcher to provide background data on the students. This questionnaire contained information such as age in years (ratio level), gender (nominal level), family income (ratio level), hometown (nominal level), type of high school (nominal level), academic year of matriculation (interval level), computer classes taken (nominal level and ratio scale), frequency of computer use (ordinal level), and computer ownership (nominal level).

The Computer Competency Questionnaire

Nursing students' computer competency was measured by the Computer Competency Questionnaire, which was originally developed by Bryson (1991). He developed a comprehensive list of competencies from nurse educators' perceptions about

the number and types of computer competencies needed for successful matriculation in a baccalaureate nursing program. The seven domains of computer competency defined by the Minnesota Education Computer Consortium – programming and algorithm skills; skill in computer usage; hardware and software principles; major uses and applications; limitations of computers; personal and social aspects; and relevant values and attitudes – provided the basic framework for Bryson's study (Bryson, 1991). Utilizing the abovementioned domains, Jiang, Chen, and Chen (2004) attempted to identify the computer competencies required for the Taiwanese nursing profession to be able to competently meet the evolving demands of providing nursing service in the nation. They adopted Bryson's (1991) domains to construct the questionnaire. Because Bryson's work was done more than a decade ago, Jiang and colleagues (2004) modified the domain titles and competencies. Items were withdrawn and new computer competency items were added (Jiang et al., 2004). The Delphi technique, a method that is often used for gathering opinions and achieving a consensus, was deployed in their study. Through literature reviews, panelist suggestions, expert comments, teaching, and work experiences, in sync with the three rounds of the Delphi questionnaire, the elements of computer competency were sorted and categorized. Collectively, 94 items in seven domains were developed for the revised instrument used in the Taiwan study as follows: concepts of hardware, software, and networks (18 items); principles of computer applications (17 items); skills in computer usage (20 items); program design (12 items); limitations of computers (9 items); personal and social issues (12 items); and attitudes toward computers (6 items). Within these seven domains, program design was ranked by the panel of experts as the least important competency. Program design consists of 12 items ranging from "be able

to read a short computer program" to "be able to design a short computer program." Reliability and validity of Jiang et al.'s Computer Competency Questionnaire were not identified in the literature.

However, Hsu et al. (2009) modified Jiang et al.'s (2004) Computer Competency Questionnaire to explore computer competencies of nurses in Taiwan and South Korea, another neighbor to Thailand. The modified version had 97 items, with the same seven domains: concepts of hardware, software, and networks (18 items); principles of computer applications (15 items); skills in computer usage (25 items); program design (12 items); limitations of computers (9 items); personal and social issues (12 items); and attitudes toward computers (6 items). The construct validity of the questionnaire was approved by three experts who have academic degrees in both nursing and information management. The Cronbach's alpha of computer competency was 0.98. All Cronbach's alpha values of each domain were higher than 0.80, indicating acceptable reliabilities. Specifically, the values of each domain were delineated: concepts of hardware, software, and networks (0.91); principles of computer applications (0.93); skills in computer usage (0.96); program design (0.91); limitations of computers (0.91); personal and social issues (0.88); and attitudes toward computers (0.83).

The most recently modified computer competency instrument as tested by Hsu and colleagues (2009) will be used in this study. This version was published in 2009 and has been used with several different populations in the neighboring countries of Taiwan and South Korea. However, the program design domain will not be included in the current computer competency questionnaire because this competency domain is not typically required for nursing students (Staggers, Gassert, & Curran, 2001). The rationale

for exclusion is based on a study by Staggers et al. (2001), which was conducted to determine comprehensive nursing informatics competencies for registered nurses in the United States. Through a literature review and as a result of suggestions from a panel of nursing informatics experts, the competencies were placed into four distinct skill levels of practicing nurses: beginning nurse, experienced nurse, informatics specialist, and informatics innovator. The programming knowledge and skills are not even in the competency lists of beginning nurses. To the contrary, beginning nurses are expected to have fundamental information management and computer technology skills. These skills include using a word processor; using Computer-Aided Instruction as a learning tool; using a hospital information system such as applications to document patient care, billing data, and decision support systems; using computerized patient monitoring systems; using a computerized library database; and using software for statistical computations (Staggers et al., 2001).

As a result, the modified Computer Competency Questionnaire used in the current study consisted of six domains with a total of 85 items: concepts of hardware, software, and networks (18 items); principles of computer applications (15 items); skills in computer usage (25 items); limitations of computers (9 items); personal and social issues (12 items); and attitudes toward computers (6 items). The answers for each item were classified into 4-point Likert scales: 1 = extremely disagree, 2 = disagree, 3 = agree, 4 = extremely agree. The computer competency was determined by the weighted sum of items in the six domains. An average score of 1.00 - 2.00 meant that nursing students self-rated their computer competency as low. An average score of 2.01 - 3.00 meant that nursing students self-rated their computer competency as moderate. An average score of

3.01 - 4.00 meant that nursing students self-rated their computer competency as high. Each domain had a total score to be used in the analyses.

Because the validity of the original computer competency questionnaire has not been well documented, exploratory factor analysis was performed in this current study to help develop the construct validity and obtain additional psychometric properties about the instrument. Exploratory factor analysis is a statistical procedure used to identify the latent structure of the items, and in general to create a parsimonious model (Pett, Lackey, & Sullivan, 2003). It identifies clusters of items that are highly correlated and these distinct clusters represent explicit constructs.

Preliminary analysis for factor analysis involves examining the data cleaning and testing the assumption. The important assumption is the presence of a reflector indicator model. In a reflective model, a latent variable is posited as the common cause of item or indicator behavior (Brown, 2006). The causal action flows from the latent variable to the indicators. Manipulation of the latent variable causes a change in indicator behavior. Inversely, direct manipulation of a particular indicator is not expected to have a causal effect on the latent variable (Brown, 2006). After this assumption was met, frequency analyses were performed to ensure adequate variance in all variables. Also, data were examined for normal distributions, sample size, missing data, miscodes or univariate outliers by examining Mahalanobis Distance.

Translation Process

The computer competency questionnaire was originally developed in English and has never been administered to nursing students in Thailand. Back translation, the most common and highly recommended procedure for translating, was used as a guideline to

translate the original English version of the instrument into the Thai version (Hilton & Skrutkowski, 2002). For the translation process, two bilingual translators who were fluent in both English and Thai, and knowledgeable about the content of computer competency were invited to translate the instrument from English into Thai. Second, the Thai version was back-translated into English by two other translators who were fluent in both languages; they were blinded to the original versions. The purpose of the blinding in this step was to ensure that the meaning of the English version was adequately translated into the Thai version (Hilton & Skrutkowski, 2002). Third, the investigator compared the original and back-translated versions for clarity and accuracy. If there were discrepancies between the English and Thai versions, the problematic items were revised by the investigator and the translators, and the back translation process was repeated until the investigator and the bilingual translators were in agreement with the translations.

Data Collection Procedures

A self-administered questionnaire distributed by the researcher to the nursing students in four classrooms was used to collect data in this study with the following steps:

Step 1: The researcher contacted the Dean of the School of Nursing at Chiangmai University by letter, and requested permission to conduct the study at the School of Nursing (see Appendix B for the letter to the Dean). After permission had been received from the Dean of CMU School of Nursing, the study was proposed to the Institutional Review Board (IRB) of CMU School of Nursing.

Step 2: After obtaining the IRB approval from CMU School of Nursing in Thailand, the study was proposed to the IRB of Case Western Reserve University (Case).

Also, the approval from the IRB at CMU School of Nursing was submitted in the package to the Case Western Reserve University IRB.

Step 3: After obtaining the IRB approval from Case Western Reserve University, the researcher contacted the academic support staff at the CMU School of Nursing to ask for class schedules, and lists of student sections for all four years that represented the different academic levels. Then, the researcher randomly selected student sections by drawing a piece of paper from a box that had a section number on it; one section each for freshman, sophomore, junior, and senior students was randomly selected and individuals were invited to participate.

Step 4: Subsequently, the researcher contacted the students' instructors in each randomly selected section to arrange for questionnaire distribution at the end of an academic study period (the "free" time during students' school days). The instructor informed the students about the topic, and the day and time for the study one week before the scheduled data collection. Also, the instructors informed students that participation was voluntary (see Appendix C for instruction to the faculty members). This fact was reinforced to the students during data collection.

Step 5: In the class, during the data collection, the researcher introduced herself and explained the purpose and the importance of the study. All participants were informed that their participation was completely voluntary, that their responses would be treated confidentially, and that complete anonymity was assured (see Appendix D for the script). Then, the researcher invited students to ask questions about the study. All of the students' questions were answered. The researcher encouraged the students to ask questions to ensure that they understood the study and were comfortable participating in

the research. Students who were not interested in the study were free to leave the classroom. They had the option to return to a free study period or engage in other activities that were typically done on the college campus. After all students who did not wish to participate in the study had left the classroom, the researcher closed the classroom door and began the data collection activities. The questionnaire package contained a cover letter describing the study, the Demographic Questionnaire, and the Thai Version of the Computer Competency Instrument.

The data collection began after the researcher distributed a questionnaire package to the participants in the classroom. She remained with them, through the entire data collection, to ensure that the process had integrity, that questions could be addressed, and that the completed instruments were secure, private, and safe.

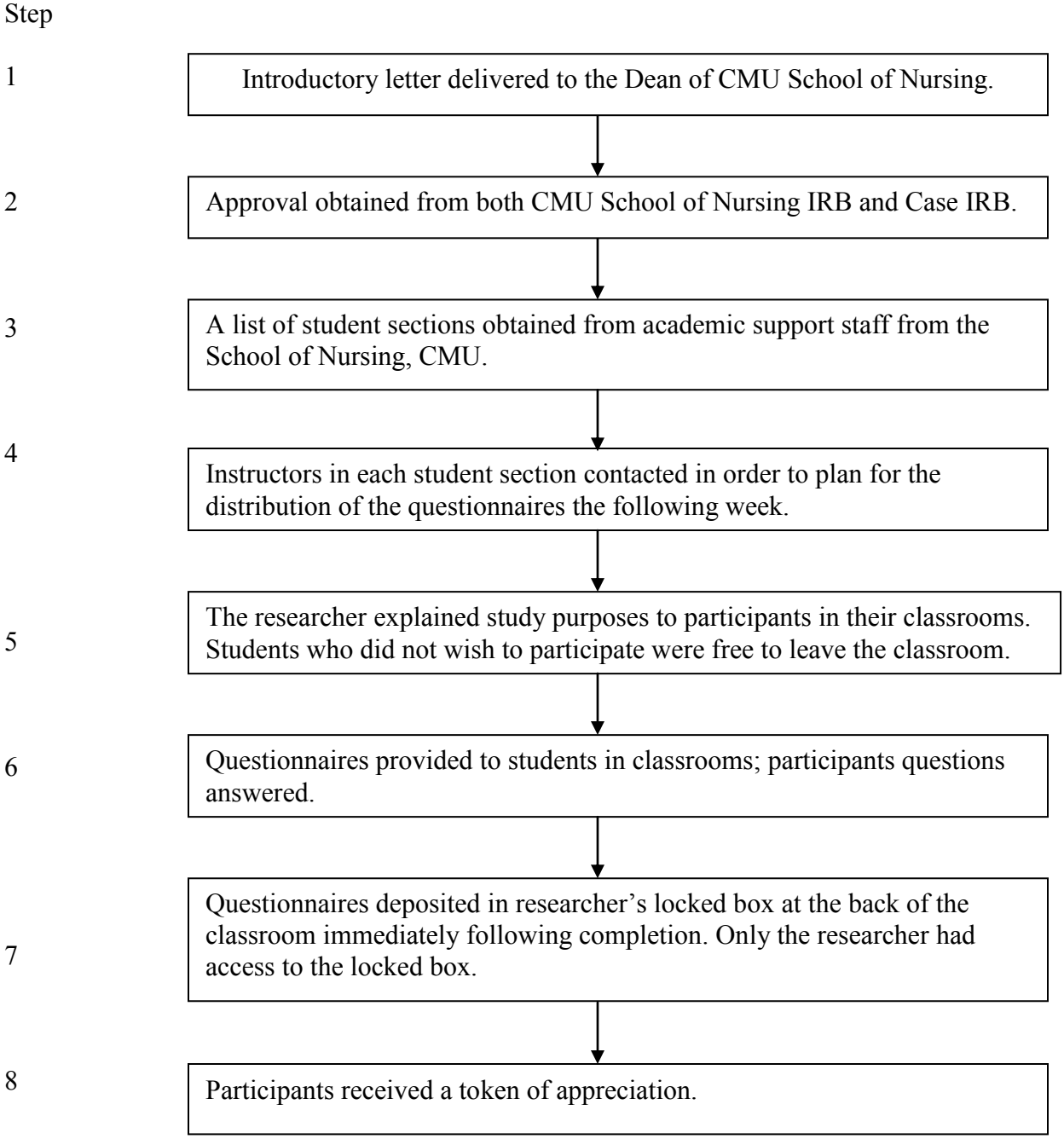
Step 6: Each participant was asked to individually complete the questionnaire which took around 30 minutes. Anonymity of the participants on the questionnaire was emphasized by asking the students to refrain from placing their names on the questionnaire and from conferring with their peers during the process of data collection. Although the questionnaires were completed in a classroom, the participants, who had been interested in the study initially but later changed their decisions, were free to withdraw from the study. They could leave the classroom at any time. There were no repercussions for not completing the instruments.

Step 7: To protect confidentiality, the students placed completed questionnaires in a locked box that was located in the back of the classroom on the day that data were collected. The locked box was collected by the researcher at the end of the session. The

box remained locked and under the researcher's supervision. Only the researcher had the key to access the data in the locked box.

Step 8: After questionnaires had been completed, each participants received a small token of appreciation, which was a highlighter; all were thanked by the researcher. A flow chart for data collection is shown in Figure 3.

Figure 3. Flow Chart for Data Collection



Data Analysis

Statistical Analysis

The purposes of this study are to explore computer competency among Thai nursing students and to predict the major variables that influence computer competency among Thai nursing students. Research questions raised in this study include the following.

Research Question 1. What are the demographic characteristics of Thai nursing students who are matriculating at Chiangmai University? To answer this question, frequencies and percentages for categorical variables, means and standard deviations for continuous variables of the students' demographic characteristics were calculated.

Research Question 2. What is the computer experience among Thai nursing students who are matriculating at Chiangmai University? To answer this question, frequencies and percentages for categorical variables, means and standard deviations for continuous variables of the computer experience were calculated.

Research Question 3. What is the level of computer competency among Thai nursing students who are matriculating at Chiangmai University? To answer this question, means and standard deviations for continuous variables of computer competency were calculated.

Research Question 4. Is there a relationship between a nursing student's characteristics (age, academic year of matriculation, cumulative grade point average, and length of time spent with computers) and computer competency? To answer this research question, Pearson's product moment correlation coefficient was employed to examine the relationships among the dependent variable (computer competency) and the independent

variables (age, academic year of matriculation, cumulative grade point average, and length of time spent with computers). All of these independent variables are ratio scales.

Research Question 5. Do student characteristics such as, age, academic year of matriculation, cumulative grade point average, and length of time spent with computers predict computer competency? To answer this question, multiple regression was employed to estimate the magnitudes of the total effects of age, academic year of matriculation, cumulative grade point average, and length of time spent with computers on computer competency.

Data Screening Procedure

Preliminary analysis involved examining the data cleaning and testing the assumptions for Pearson's product moment correlation and multiple linear regression. The steps to test the assumptions for both statistics included an assessment for (a) adequate variance in all variables by examining the dispersion of scores. The assumption is met when the values of any variable do not fall predominantly at one or two consecutive scores; (b) normality by plotting scores on histogram, and examining skewness and kurtosis. The range of skewness should be within absolute values of three, and the range of kurtosis should be within absolute values of eight (Mertler & Vannatta, 2005); (c) absence of influential cases by determining that the Cook's D is not more than one (Field, 2005); (d) linearity by examining scatterplots (for Pearson's product moment correlation) or partial plots (for multiple regression) between independent and dependent variables (Corty, 2007; Velleman & Welsch, 1981). This assumption is assessed by comparing linear with cubic and quadratic lines of best fit based on differences in total R square values (R^2), and checking for differences that exceed 2% of the additional

explained variance. If a difference in R^2 among linear, cubic, and quadratic is less than 0.02, the relationship is linear; (e) constant error variances (homoscedasticity) by examining scatterplots of Studentized Deleted Residuals (*SDR*). If the spread of *SDR* is less than a 3 to 1 fan, there is equal variance of residuals; (f) normally distributed error variance by plotting residuals on a histogram, and examining skewness and kurtosis. The assumption is met when the histogram displays a symmetric bell-shaped curve, and skewness and kurtosis are in the standard range. Another assumption for multiple regression to be examined was absence of multicollinearity, a strong correlation between two or more predictors in a regression model. Multicollinearity exists when tolerance is <.20, and Variance Inflation Factor (VIF) is greater than 10 (Field, 2005).

Data Management

A data codebook for SPSS version 19.0 was developed to identify each variable for both the demographic questionnaire and the nursing students' computer competency questionnaire. Each returned questionnaire was assigned a number to ensure that the researcher had organized files. Before coding, each questionnaire was carefully checked for clarity and completeness. Then, data were coded as numbers and entered into a computer database using SPSS for Windows software. The researcher double checked all entered data against the original data to identify errors. All questionnaires and the data set will be kept in the researcher's office, in the CMU School of Nursing, in a locked file drawer for five years (August 2011 to August 2016) to ensure confidentiality and privacy. The practice is required by the MOPH in Thailand. The researcher used a personal computer with password protection to do data entry and analysis. Data entry began as soon as the first set of data was available. A backup database was created after each

entry. Only the researcher has had access to the data, the passcodes, and the computer that contained the data.

Protection of Human Subjects

Approval for protection of human subjects was obtained from the IRB committee of the School of Nursing at Chiangmai University and the Case Western Reserve University Institutional Review Boards. Participants were informed about the study through a cover letter, and during the face-to-face introduction of the study at the time that they were assembled in a classroom. The participants could refuse to participate or could withdraw from the study at any time without being penalized or losing any benefits to themselves in their roles as students. Even if the students agreed to participate in the study, they could have changed their decision and withdrawn during the data collection process. If they chose to withdraw, they were assisted in leaving the room and joined their peers in other activities on campus. The students' responses were treated as confidential data and complete anonymity was ensured. All participants were asked to complete two questionnaires in classroom, which they were instructed to place in the researcher's locked box in the classrooms, and under the supervision of the researcher. A waiver for written informed consent for the participants' signature was requested because there was not any personally identifying information on the questionnaire. Consent was implied by the completion and return of the questionnaires to the researcher's locked box. To maintain confidentiality and anonymity, participants were asked to refrain from writing their names or codes on the questionnaires. Therefore, participants' responses were not linked to any personally identifying information. All of the information that participants provided to the researcher was kept in a locked cabinet in the researcher's

office at the CMU School of Nursing. The office was locked when the researcher was not present.

CHAPTER IV

Results

The primary purpose of this cross-sectional study was to describe and explore the computer competency of Thai nursing students, and to predict the major variables (age, academic year of matriculation, cumulative grade point average, and length of time spent with computers) that influence computer competency among Thai nursing students at Chiangmai University. This chapter presents the pilot study results, results of research questions, statistical analysis corresponding to each research question, and summary. In addition, the factor analysis of the computer competency questionnaire was performed to gain more in-depth knowledge about its psychometric property. The sample for this study consisted of 195 Thai nursing students who were attending Chiangmai University during the first semester of 2011.

Pilot Study Results

A pilot study was conducted to determine the validity and reliability of the Thai version of the Computer Competency Questionnaire. The results from three bilingual (Thai and English) Thai experts in informatics showed the content validity index of the questionnaire was 0.95. The reliability of the questionnaire was determined using a sample of 20 nursing students in Chiangmai University. The Cronbach's alpha coefficient for the pilot study was high at 0.94 for the total scale: 0.89 for concepts of hardware, software, and networks (18 items); 0.81 for principles of computer applications (13 items); 0.79 for skills in computer usage (27 items); 0.79 for limitations of computers (9 items); 0.86 for personal and social issues (12 items); and 0.43 for attitudes toward computers (6 items).

To confirm the reliability of the questionnaire, the internal consistency was recalculated in the main study sample of 195 nursing students in Chiangmai University. The results from Cronbach's alpha confirmed that the questionnaire was reliable. An overall alpha score was 0.94 for the total scale: 0.82 for concepts of hardware, software, and networks, 0.75 for principles of computer applications, 0.87 for skills in computer usage, 0.86 for limitations of computers, 0.79 for personal and social issues, and 0.74 for attitudes toward computers.

Results for Research Questions

Prior to analysis, the data were screened to ensure accuracy. Simple descriptive statistics were used as a primary step to check the quality of the data. A full statistical description including frequency distribution, mean, standard deviation, range, minimum, maximum, skewness, and kurtosis was conducted for all variables. In addition, assumptions underlying Pearson's product moment correlation and multiple regression analysis were examined prior to statistical analysis to ensure that no violation of the assumptions existed. In this study, the preliminary data analysis revealed that both primary and secondary assumptions of Pearson's product moment correlation and multiple regression were met. In addition, all variables had tolerance values > .10, and VIF < 10, indicating that multicollinearity was not found in this model. After completing the preliminary data analysis, the main data analysis was performed by using SPSS software package (version 19.0). The following research questions were analyzed:

Research Question 1

What are the demographic characteristics of the nursing student body matriculating at Chiangmai University during the first semester (June – October) of 2011?

The demographic characteristics of the 195 nursing students in this study are presented in Table 3. The response rate of participants was 100%. Most students (94.9%) in the sample were female, with an age range of 18 to 23 years. The mean age of participants was 19 years with a standard deviation of 1.28. Most of the students (97.4%) were from the northern region of Thailand, 1% were from the southern and northeastern regions, and 0.5% were from the eastern region. The number of students in each academic year of matriculation from year 1 to year 4 was close in number. The sample consisted of 58 (29.7%) freshmen, 49 (25.1%) sophomores, 45 (23.1%) juniors, and 43 (22.1%) seniors. Seventy-six percent of the sample (76.9%) indicated that their self-reported cumulative grade point average was more than 3.00. The majority of the subjects (40.5%) had a cumulative grade point average range of between 3.01 - 3.50. Thirty-six percent (36.4%) had a cumulative grade point average range of 3.51 - 4.00. Most of them (77.9%) graduated from public schools, and almost all of them (96.4%) graduated from high school with a high cumulative grade point average of more than 3.00. Over 46.7% lived in a nursing dormitory, 26.2% lived in main campus dormitories, and 16.4% lived with parents. Some were from families with a low socioeconomic status. According to the National Statistical Office (2011), the average monthly income of Thai families is 23,544 baht (30 baht = 1 USD). In this study, 33.8% of the participants reported that their parents had a monthly income of less than 10,000 baht. Additionally, 27.7% of the

participants reported that their parents had a monthly income between 10,001 - 20,000 baht. However, 23.6% of the participants reported that their parents had a monthly income of more than 30,000 baht.

Table 3

Demographic Characteristics of the Sample (N = 195)

Characteristics	*N* (%)
Gender	
Male	10 (5.1%)
Female	185 (94.9%)
Age	
18 years	32 (16.4%)
19 years	57 (29.2%)
20 years	44 (22.6%)
21 years	40 (20.5%)
22 years	20 (10.3%)
23 years	2 (1%)
Region	
Northern region	190 (97.4%)
Northeastern region	2 (1%)
Eastern region	1 (0.5%)
Southern region	2 (1%)
Academic year of matriculation	
Freshmen	58 (29.7%)
Sophomores	49 (25.1%)
Juniors	45 (23.1%)
Seniors	43 (22.1%)
Nursing school cumulative GPA	
2.51-3.00	45 (23.1%)
3.01-3.50	79 (40.5%)
3.51-4.00	71 (36.4%)
Types of high school	
Public school	152 (77.9%)
Private school	43 (22.1%)
High school cumulative GPA	
2.51-3.00	7 (3.6%)
3.01-3.50	44 (22.6%)
3.51-4.00	144 (73.8%)

Table 3 (*continued*)

Demographic Characteristics of the Sample (N = 195)

Characteristics	*N* (%)
Resident status	
Main campus dormitory	51 (26.2%)
Nursing dormitory	91 (46.7%)
Parents' house	33 (16.9%)
Private dormitory	21 (10.3%)
Parental monthly income (in baht, 30 baht = 1 USD)	
Less than 5,000	10 (5.1%)
5,001-10,000	56 (28.7%)
10,001-15,000	26 (13.3%)
15,001-20,000	28 (14.4%)
20,001-25,000	13 (6.7%)
25,001-30,000	16 (8.2%)
30,001-35,000	8 (4.1%)
35,001-40,000	7 (3.6%)
More than 40,000	31 (15.9%)

Research Question 2

What is the self-reported computer experience of Thai nursing students who are matriculating at Chiangmai University during the first semester (June – October) of 2011?

Nursing students reported a range of computer experience. As shown in Table 4, most students (93.3%) have their own computers; of these, one-fourth of the students (25.1%) have had computers for more than 7 years, and one-fourth (26.2%) have had computers between 1 and 3 years. The students' mean duration of computer ownership was 2.96 years with a standard deviation of 1.54. A majority of the students (42.1%) have used computers between 10 and 12 years, 32.3% have used computers between 7 and 9 years, and only 1.5% of the respondents have used computers less than 3 years. The mean years of computer utilization was 9.23 with a standard deviation of 1.93.

More than half of the students (55.4%) used computers every day, 33.8% used computers almost every day, 8.7% used computers several times a week, 1.5% used computers several times a month, and only less than 1 percent (0.5%) almost never used computers. The mean hours that nursing students used computers were almost 4 hours a day with a standard deviation of 1.71. Almost half (48.2%) used a computer between 2 and 4 hours a day, 26.2% used a computer between 4 to 6 hours a day, and 22.0% used computer less than 2 hours a day.

The main purpose for the nursing students using computers was access to the Internet. Nearly all (96.9%) of the nursing students reported the Internet as the software program they used most often, followed by Word processing (89.7%), and Power Point (75.4%). Two-thirds of students (66.7%) used computers for game-playing as a purpose, and 53.8% used it for picture and photo editing. However, the four software applications that nursing students used least were Excel (13.8%), website design (5.6%), statistics (1.5%), and programming (1.5%).

Regarding Internet usage, the majority of nursing students (99%) primarily used it for free surfing on the "Net." While 91.8% of nursing students used the Internet for purposeful research in education, 85.6% used it for participation in chat rooms, and 69.2% for game playing. Meanwhile, nearly half (49.7%) used it for time-killing, and one-third (30.8%) for shopping.

Nearly all (99%) nursing students had taken some mandatory computer courses before entering the nursing school, and the majority (88.2%) started their first mandatory computer class when they were in elementary school; also the majority started their first mandatory computer class at grade 4. Half of the total sample (50.7%) reported having

taken fewer than six computer courses whereas 44.1% had completed 6 to10 computer-related courses in elementary through high school. The majority (82.1%) had never taken computer courses provided by Chiangmai University.

Table 4

Computer Experience of the Sample (N = 195)

Computer experience	*N* (%)	*M*	*SD*
Computer ownership			
Yes	182 (93.3%)		
No	13 (6.7%)		
Duration of computer ownership		2.96	1.54
Less than 1 year	19 (9.7%)		
1-3 years	51 (26.2%)		
3-5 years	40 (20.5%)		
5-7 years	23 (11.8%)		
More than 7 years	49 (25.1%)		
Years of computer utilization		9.23	1.95
Less than 3	3 (1.5%)		
4-6	27 (13.9%)		
7-9	63 (32.3%)		
10-12	82 (42.1%)		
More than 12	20 (10.4%)		
Frequency of computer usage			
Every day	108 (55.4%)		
Almost every day	66 (33.8%)		
Several times a week	17 (8.7%)		
Several times a month	3 (1.5%)		
Almost never	1 (0.5%)		
Hours per day of computer usage		3.69	1.71
Less than 2	43 (22.0%)		
2.01-4.00	94 (48.2%)		
4.01-6.00	51 (26.2%)		
More than 6	7 (3.5%)		

Table 4 (*continued*)

Computer Experience of the Sample (N = 195)

Computer experience	*N* (%)	*M*	*SD*
Purpose of computer usage			
Internet/WWW	189 (96.9%)		
Word processing	175 (89.7%)		
Power Point graphic	147 (75.4%)		
Computer games	130 (66.7%)		
Picture and Photo editing	105 (53.8%)		
Excel	27 (13.8%)		
Web design	11 (5.6%)		
Statistics	3 (1.5%)		
Programming	3 (1.5%)		
Primary use for the Internet			
Free surfing on the Net	193 (99.0%)		
Purposeful research of education	179 (91.8%)		
Participation in chat room	167 (85.6%)		
Sending/receiving email	139 (71.3%)		
Game playing	135 (69.2%)		
Document download	112 (57.4%)		
Time-killing	97 (49.7%)		
Shopping	60 (30.8%)		
Book research and ordering	47 (24.1%)		
Mandatory computer-related course in primary/secondary school			
Yes	193 (99%)		
No	2 (1%)		
First mandatory computer class			
Primary school	172 (88.2%)		
Secondary school	21 (10.8%)		
First mandatory computer class school grade level			
Grade 1	42 (21.5%)		
Grade 2	2 (1%)		
Grade 3	25 (12,8%)		
Grade 4	57 (29.2%)		
Grade 5	28 (14.4%)		
Grade 6	16 (8.2%)		
Grade 7	19 (9.7%)		
Grade 8	2 (1%)		
Grade 10	2 (1%)		

Table 4 (*continued*)

Computer Experience of the Sample (N = 195)

Computer experience	*N* (%)	*M*	*SD*
Computer courses taken		5.46	3.167
Less than 6 courses	99 (50.7%)		
6-10 courses	86 (44.1%)		
More than 10 courses	10 (5.1%)		
Taken computer courses provided by Chiangmai University			
Yes	35 (17.9%)		
No	160 (82.1%)		

Research Question 3

What is the level of self-reported computer competencies for Thai nursing students who are matriculating at Chiangmai University during the first semester of 2011?

Computer competency was measured with the Computer Competency Questionnaire, which comprised six domains: (a) concepts of hardware, software, and networks; (b) principles of computer applications; (c) skills in computer usage; (d) limitations of computers; (e) personal and social issues; and (f) attitudes toward computers. The computer competency items were rated on a scale from 1 (extremely disagree) to 4 (extremely agree). An average score of 1.00 - 2.00 meant that nursing students self-rated their computer competency as low. An average score of 2.01 - 3.00 meant that nursing students self-rated their computer competency as moderate. An average score of 3.01 - 4.00 meant that nursing students self-rated their computer competency as high.

As shown in Table 5, nursing students reported that they had moderate computer competency. Looking at each domain, attitudes toward computers, personal and social issues, and limitations of computers were at a high level. The other three domains (skills in computer usage; principles of computer applications; and concepts of hardware, software, and networks) were at a moderate level. Among the six domains of computer competency, attitudes toward computers was rated as the highest computer competency that nursing students possessed, whereas skills in computer usage was the lowest domain.

Table 5

Mean, Standard Deviation, and Interpretation of Nursing Students' Computer Competency

Variable	*M*	*SD*	Interpretation
Overall computer competency	2.90	0.27	moderate
- Concepts of hardware, software, and networks	2.82	0.35	moderate
- Principles of computer applications	2.71	0.32	moderate
- Skills in computer usage	2.62	0.37	moderate
- Limitations of computers	3.41	0.41	high
- Personal and social issues	3.08	0.37	high
- Attitudes toward computers	3.42	0.37	high

As shown in Table 6, the mean score of computer competency in concepts of hardware, software, and networks in each item was mostly at a moderate level. The item with the highest mean score was knowledge of basic computer usage, such as how to login/logout of a computer, and how to use a mouse ($M = 3.74$, $SD = 0.46$). On the other hand, the item with the lowest mean score was knowledge of the difference between analog and digital signals ($M = 2.11$, $SD = 0.79$).

Table 6

Mean and Standard Deviation of Nursing Students' Computer Competency in Concepts of Hardware, Software, and Network in Terms of Items

Concepts of hardware, software and networks	*M*	*SD*
- Know the basic usage of a computer	3.74	0.461
- Know the usage of file management functions	3.35	0.627
- Know how to operate computer systems	3.33	0.579
- Know how to setup communication software	3.19	0.767
- Can assemble basic components of computer hardware	3.10	0.917
- Know how to install software drivers for peripherals	3.09	0.830
- Can resolve common error situations	3.01	0.722
- Know the common computer terminology	2.87	0.636
- Know input and output devices of computers	2.83	0.664
- Know today's popular types of computer systems	2.77	0.746
- Know the basic components of a computer's hardware system	2.62	0.696
- Know common network hardware devices	2.58	0.716
- Know basic principles of computer networks	2.54	0.636

Table 6 *(continued)*

Mean and Standard Deviation of Nursing Students' Computer Competency in Concepts of Hardware, Software, and Network in Terms of Items

Concepts of hardware, software and networks	*M*	*SD*
- Know the basic components of a computer's software system	2.53	0.636
- Know today's major network types	2.48	0.620
- Know basic structures of computer networks	2.42	0.624
- Know important milestones in the evolution of computer technology	2.23	0.760
- Know the difference between analog and digital signals	2.11	0.789

As shown in Table 7, the mean score of computer competency in principles of computer applications in each item was mostly at the moderate level. The item with the highest mean score was knowledge of how to send, and receive emails and how to transfer files through networks ($M = 3.69$, $SD = 0.52$). By contrast, the item with the lowest mean score was knowledge of applications of robotics and expert systems in nursing ($M = 1.94$, $SD = 0.65$).

Table 7

Mean and Standard Deviation of Nursing Students' Computer Competency in Principles of Computer Applications in Terms of Items

Principles of computer application	*M*	*SD*
- Can send, receive mails and transfer files through networks	3.69	0.515
- Know how to apply computers for personal use	3.58	0.554
- Can use computerized self-learning equipment	3.39	0.521
- Know about common computerized equipment in health care	3.06	0.747
- Know there are video discs for nurses' continuing education	2.80	0.939
- Know software tools that can be used in nursing	2.45	0.767
- Know what a nursing information system is	2.41	0.606
- Know about computer applications in medical decision analysis	2.31	0.778
- Know about applications of computer networks in nursing	2.24	0.695
- Know what today's major nursing information systems are	2.23	0.595
- Know simulation software for continuing education and training	2.19	0.767
- Know the highlights in the evolution of computer in nursing	2.06	0.602
- Know about applications expert systems in nursing	1.94	0.652

As shown in Table 8, the mean score of computer competency for skills in computer usage in each item was mostly at the moderate level. However, two items that were rated in the low levels were knowing how to use statistical software, such as Statistical Package for the Social Sciences and Statistical Analysis System (M = 1.89, SD = 0.64), and being able to use statistical software for nursing research (M = 1.97, SD = 0.70). The highest mean score item was to be able to use the Internet to search for information (M = 3.72, SD = 0.49).

Table 8

Mean and Standard Deviation of Nursing Students' Computer Competency for Skills in Computer Usage in Terms of Items

Computer usage skills	*M*	*SD*
- Can use the World Wide Web to search for information	3.72	0.492
- Can use presentation editing software	3.63	0.516
- Can use presentation editing software for patient education	3.49	0.569
- Can use computers as self-learning tools	3.42	0.599
- Know how to use common peripherals	3.37	0.761
- Know how to manage and store files	3.35	0.668
- Can use a spreadsheet program	3.06	0.678
- Can use word processing software	2.98	0.905
- Know that HIS are useful in running efficiency of hospital	2.90	0.770
- Can convert files for different application software	2.90	0.867
- Can use a library information retrieval system	2.84	0.800
- Can generate nursing documents by using word processing	2.79	0.948

Table 8 (*continued*)

Mean and Standard Deviation of Nursing Students' Computer Competency for Skills in Computer Usage in Terms of Items

Computer usage skills	*M*	*SD*
- Can use a spreadsheet program as a management tool	2.59	0.764
- Can use database software to construct nursing databases	2.57	0.837
- Know how to create multimedia files	2.56	0.908
- Can use common computerized equipment for patient monitoring	2.48	0.795
- Know how to edit multimedia files	2.48	0.893
- Understand the output data from computerized equipment	2.47	0.755
- Can use HIS to store/retrieve and transfer data	2.47	0.788
- Can use nursing information systems	2.40	0.728
- Can use HIS to do nursing work	2.39	0.794
- Know what a hospital information system is	2.26	0.695
- Can use packaged software to create web pages	2.12	0.809
- Can maintain nursing information systems	2.11	0.676
- Can create multimedia files for web pages	2.08	0.782
- Can use statistical software for nursing research	1.97	0.699
- Know how to use statistical software	1.89	0.640

As shown in Table 9, the mean score of computer competency in limitations of computers in each item was at a high level. The item with the highest mean score was knowing that the computer is only a tool to provide better nursing care, which cannot replace the role of nurses (M = 3.58, SD = 0.54). On the other hand, the item with the lowest mean score was knowing that computers in use today do not have adequate ability to accurately interpret human language (M = 3.28, SD = 0.64).

Table 9

Mean and Standard Deviation of Nursing Students' Computer Competency in Limitations of Computers in Terms of Items

Limitations of computers	*M*	*SD*
- A computer is only a tool to provide better nursing care	3.58	0.535
- Computers are not intelligent in themselves	3.49	0.541
- Know about problems of data integrity	3.44	0.583
- Know that computer users are the ones who make mistakes	3.41	0.588
- Know limitations and reliability of computerized patient monitoring systems	3.41	0.630
- Know that computer files need to be backed up	3.39	0.627
- Know the reasons for slow response time	3.35	0.603
- A computer program has limitations in its capability	3.31	0.609
- Know that computers do not have good enough ability to interpret natural language	3.28	0.640

As shown in Table 10, the mean score of computer competency in personal and social issues in each item was mostly at a high level. Only three items were rated at a moderate level: (a) the basic technique of encryption and access control (M = 2.52, SD = 0.83); (b) the laws regarding protecting personal information in computers (M = 2.57, SD = 0.78); (c) the copyrights regarding computer programs and electronic files (M = 2.59, SD = 0.76). By contrast, the item with the highest mean score was knowing the importance of computer technology (M = 3.47, SD = 0.56).

Table 10

Mean and Standard Deviation of Nursing Students' Computer Competency in Personal and Social Issues in Terms of Items

Personal and social issues	*M*	*SD*
- Know the importance of computer technology	3.47	0.559
- Know how data is collected and used	3.37	0.544
- Computer can be used as a tool for quality control	3.30	0.597
- Computer viruses	3.28	0.607
- The importance of confidentiality	3.24	0.708
- Ergonomics and computers	3.24	0.588
- Computers may result in manpower shifts	3.23	0.612
- The use of computers might result in dehumanization of care	3.09	0.811
- How to prevent and handle attacks by viruses	3.01	0.626
- The copyrights regarding computer programs and files	2.59	0.757
- Laws regarding protecting personal information in computers	2.57	0.779
- The basic techniques of encryption and access control	2.52	0.833

As shown in Table 11, the mean score of attitudes toward computers in each item was at a high level. The item with the highest mean score was not being afraid of using computers (M = 3.77, SD = 0.48). The item with the lowest mean score was knowing where to find resources to resolve computer problems (M = 3.14, SD = 0.67).

Table 11

Mean and Standard Deviation of Nursing Students' Computer Competency in Attitudes Toward Computers in Terms of Items

Attitudes toward computers	*M*	*SD*
- Not being afraid of using computers	3.77	0.480
- Know that females can be computer literate	3.66	0.537
- Develop positive attitude toward life-long learning	3.38	0.548
- Know that a computer will not be a powerful nursing tool until users put effort into learning how to use it	3.33	0.544
- Develop positive attitudes toward a computer	3.24	0.564
- Know where to find resources to resolve computer problems	3.14	0.673

Research Question 4

Is there a bivariate relationship between a nursing student's personal characteristics (age, academic year of matriculation, cumulative grade point average, and length of time spent with computers) and computer competencies?

Pearson's product moment correlation analysis was utilized to examine the bivariate relationships between a nursing student's personal characteristics (age, academic year of matriculation, cumulative grade point average, and length of time spent

with computers) and the dependent variable, computer competencies (Table 12). The results showed a weak positive relationship between age and computer competency ($r = .168, p < .01$), indicating that as age increased, the computer competency of nursing students advanced. Moreover, there were weak positive relationships among computer competency, and both the academic year of matriculation and the length of time spent with computers at statistically significant levels of .01 ($r = .19$) and .05 ($r = 0.161$) respectively. However, the correlation between cumulative grade point average and computer competency was not statistically significant ($r = -.118, p = .051$).

Table 12

Bivariate Correlation Matrix for Personal Characteristics and Computer Competency

Variables	Computer Competency	
	Correlation coefficient(r)	p-value
Age	0.168	0.009**
Academic year of matriculation	0.190	0.004**
Cumulative grade point average	-0.118	0.051
Length of time spent with computers	0.161	0.012*

Note. $*p < .05$. $**p < .01$.

Research Question 5

Do student characteristics such as age, academic year of matriculation, cumulative grade point average, and length of time spent with computers predict computer competencies?

Linear multiple regression analysis was conducted to determine which personal characteristics (age, academic year of matriculation, cumulative grade point average, and length of time spent with computers) can predict computer competencies. Results shown

in Table 14 indicated that, together, the four student characteristics significantly explained 3% of the variance in computer competency. However, no single student characteristic significantly contributed to the model (Table 13).

Table 13

Multiple Regression Analysis for Personal Characteristics on Computer Competencies

	$F = 2.478$	$p = 0.05$*	Adjust $R^2 = 0.03$
Variables	*B*	*t*-value	*p*-value
Age	0.002	0.011	0.992
Academic year of matriculation	0.150	0.886	0.377
Cumulative grade point average	-0.016	-0.192	0.848
Length of time spent with computers	0.118	1.591	0.113

Additional Analysis Results

Additional analysis was conducted to give the researcher a more in-depth understanding of the Computer Competency Questionnaire. Exploratory factor analysis was performed to validate the psychometric applicability construct sub-scales of the Computer Competency Questionnaire. This analysis identifies clusters of items that are highly correlated, and these distinct clusters represent explicit constructs. Logic, theory, and prior empirical evidence guide this stage of analysis. To determine the number of factors, eigenvalues, scree plots, and factor loadings were examined. The size of an eigenvalue depends upon the variance in the data it explains, and most researchers use the number of eigenvalues greater than one to indicate the number of factors (Mertler & Vannatta, 2005). A second criterion for determining the number of factors is the scree test, which involves plotting the eigenvalues against the number of items present. The

number of factors is selected by inspecting the slope and deciding where there is a discontinuity between the steep slope of the larger eigenvalues and the less steep slope of the lower eigenvalues (Kim & Mueller, 1978). Another criterion used to determine the number of factors is factor loadings. It is common to retain primary factor loadings greater than 0.40 with no sizeable secondary loadings (0.30 or higher) on other factors (Fabrigar, Wegener, MacCallum, & Straham, 1999; Ferguson & Cox, 1993). However, some researchers note that retaining primary loadings over 0.30 is acceptable (Child, 2006). The other criterion to determine how well the model fits the data is the coefficients in the factor correlation matrix. Small coefficients show that the emerged factors do not display large correlations with each other and therefore capture distinct content. On the contrary, a coefficient greater than 0.6 shows that the emerged factors are correlated and may capture the same concept (Cooper, 2010; Kline, 1994).

In this study, exploratory factor analysis using principal axis factoring and Oblimin with Kaiser normalization was performed. Each of the original six domains was tested separately. Only the items that made up each domain were used. Then, the items from these six domains were combined to test for factor structure of computer competency. With this factor analysis method, a clean and potentially meaningful model emerged. The original 85 items were reduced to 46; 39 items were excluded, and 15 factors (sub-scales) were singled out and labeled by the researcher. The 15 factors and item loadings are given in Table 14. The new names included rights and privacy protection of data (factor 1), hospital information systems (factor 2), basic computer knowledge (factor 3), multimedia (factor 4), presentation programs (factor 5), word processing (factor 6), advanced computer usage (factor 7), computer networks (factor 8),

nursing information systems (factor 9), limitations of computers (factor 10), attitudes toward computers (factor 11), computer safety (factor 12), personal and social issues (factor 13), advanced medical applications (factor 14), and Internet use (factor 15).

Table 14

Factor Loading for Computer Competency

	Factor				
Items	1	2	3	4	5
75. Know about computers copyrights	.874				
74. Know about the laws regarding protecting personal information in computers	.574				
76. Know the basic technique of encryption	.425				
45. Can use HIS to do nursing work		.881			
46. Can use HIS to store/retrieve and transfer data		.833			
43. Can use nursing information systems		.714			
44. Can maintain nursing information systems		.671			
3. Know the basic components of a hardware system			.772		
4. Know input and output devices of computers			.666		
5. Know the basic components of a software system			.513		
2. Know the common computer terminology			.504		
57. Know how to edit multimedia files				-.970	
56. Know how to create multimedia files				-.957	
38. Can use presentation software					-.864
39. Can use presentation software for patient education					-.728

Table 14 *(continued)*

Factor Loading for Computer Competency

	Factor				
Items	6	7	8	9	10
34. Can use word processing software	.907				
35. Can generate nursing documents by using word processing software	.649				
47. Can use computerized equipment for caring		.600			
48. Understand the data from computerized equipment		.571			
49. Can use software to create web pages		-.534			
50. Can create multimedia files for web pages		-.479			
13. Know basic structures of computer networks			.738		
12. Know basic principles of computer networks			.649		
14. Know today's major network types			.608		
25. Know what a nursing information system is				.818	
26. Know today's major nursing information systems				.810	
65. Know about problems of data integrity					.644
66. Know that users are usually the ones who make mistakes					.578
63. Know reasons for slow response time on computer systems					.566
67. Know that computers do not have good ability to interpret natural language					.564
61. Know that cannot replace the role of nurses					.564
64. Know that computer files need to be backed up					.533
60. Know that computers are not intelligent in themselves					.489

Table 14 *(continued)*

Factor Loading for Computer Competency

	Factor				
Items	11	12	13	14	15
83. Know that the computer will not be a powerful nursing tool until learners put efforts into learning how to use it	.842				
82. Develop positive attitudes toward the computer as a good nursing tool	.448				
79. Know about ergonomics as related to a computer		.612			
77. Know what computer viruses are		.601			
78. Know how to prevent and handle attacks by viruses		.591			
70. Know that a computer can be used as a tool for staffing, scheduling, and quality control			.748		
69. Know that the use of computers may result in manpower shifts within the hospital organization			.723		
30. Know about computer applications in medical decision analysis				.631	
29. Know about applications of robotics and expert systems in nursing				.591	
31. Know there is package software which can be used in nursing				.565	
23. Know there is simulation software for continuing education And training				.393	
20. Can use the World Wide Web to search for information					.870
21. I can send/receive mails and transfer files through networks					.529

As shown in Table 15, correlations among the 15-factor structure showed that none of these factors were correlated or measured the same concept.

Table 15

Factor Correlation Matrix of the 15-Factor Structure

Factor	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	1.000	.195	.259	-.274	-.160	.219	-.013	.082	.208	.097	.250	.155	.085	.224	.151
2	.195	1.000	.046	-.138	-.130	.094	.080	.096	.310	-.069	.215	.016	.147	.287	.081
3	.259	.046	1.000	-.263	-.058	.112	-030	.282	.213	.005	.147	.190	.023	.063	.042
4	-.274	-.138	-.263	1.000	.136	-.147	.153	-.113	-.181	-.029	-.202	-.104	-.163	-.047	-.141
5	-.160	-.130	-.058	.136	1.000	-.275	-.098	-.055	-.104	-.211	-.202	-.202	-.170	.065	-.334
6	.219	.094	.112	-.147	-.275	1.000	.102	.076	.144	.110	.088	.069	.160	.123	.194
7	-.013	.080	-.030	.153	-.098	.102	1.000	-.024	.076	.084	.021	-.003	.068	.007	.033
8	.082	.096	.282	-.113	-.055	.076	-.024	1.000	.177	.109	.119	.186	.054	.106	.094
9	.208	.310	.213	-.181	-.104	.144	.076	.177	1.000	-.027	.143	.076	.123	.292	.003
10	.097	-.069	.005	-.029	-.211	.110	.084	.109	-.027	1.000	.266	.219	.353	.020	.256

Table 15 *(continued)*

Factor Correlation Matrix of the 15-Factor Structure

Factor	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
11	.250	.215	.147	-.202	-.202	.088	.021	.119	.143	.266	1.000	.145	.234	.095	.059
12	.155	.016	.190	-.104	-.202	.069	-.003	.186	.076	.219	.145	1.000	.115	-.019	.174
13	.085	.147	.023	-.163	.-170	.160	.068	.054	.123	.353	.234	.115	1.000	.059	.113
14	.224	.287	.063	-.047	.065	.123	.007	.106	.292	.020	.095	-.019	.059	1.000	-.089
15	.151	.081	.042	-.141	-.334	.194	.033	.094	.003	.256	.059	.174	.113	-.089	1.000

As shown in Table 16, Cronbach's alpha coefficients for the 15-factor structure were between 0.60 and 0.96. Cronbach's alpha coefficients were 0.74 for rights and privacy protection of data, 0.89 for hospital information systems, 0.77 for basic computer knowledge, 0.96 for multimedia, 0.81 for presentation programs, 0.79 for word processing, 0.60 for advanced computer usage, 0.76 for computer networks, 0.79 for nursing information systems, 0.85 for limitations of computers, 0.65 for attitudes toward computers, 0.78 for computer safety, 0.78 for personal and social issues, 0.67 for advanced medical applications, and 0.78 for Internet use.

Table 16

Reliability of Each Domain of the 15-Factor Structure

Factor	Cronbach's alpha coefficient
1. Rights and privacy protection of data	0.74
2. Hospital information systems	0.89
3. Basic computer knowledge	0.77
4. Multimedia	0.96
5. Presentation programs	0.81
6. Word processing	0.79
7. Advanced computer usage	0.60
8. Computer networks	0.76
9. Nursing information systems	0.79
10. Limitations of computers	0.85
11. Attitudes toward computers	0.65
12. Computer safety	0.78
13. Personal and social issues	0.78
14. Advanced medical applications	0.67
15. Internet use	0.78

Summary

The primary purpose of the current study was to explore computer competency of Thai nursing students, and to predict the student characteristics that influence computer competency. The study sample consisted of 195 Thai nursing students who were attending Chiangmai University during August to September of 2011. The findings revealed that nursing students perceived that they had moderate computer competency. The regression analysis indicated that all four student characteristics (age, academic year of matriculation, cumulative grade point average, and length of time spent with computers) together explained 3% of the variation of computer competency. However, taken individually, neither age, academic year of matriculation, cumulative grade point average, nor length of time spent with computers were able to successfully explain computer competency.

CHAPTER V

Discussion

This study aimed to explore the computer competency of Thai nursing students, and to examine the influence of the major variables (age, academic year of matriculation, cumulative grade point average, and length of time spent with computers) on computer competency. A cross-sectional descriptive design with stratified random sampling was used to recruit a sample of 195 nursing students at Chiangmai University. In this chapter, the discussion and interpretation of major research findings, and implications of findings for health policy, nursing education, and nursing research are presented. In addition, limitations of this study and suggestions for future research are discussed.

Based on the literature and the findings in this research study, the researcher has organized this chapter as follows: computer knowledge, skills in computer usage, and attitudes toward computers. Computer knowledge comprises four components: concepts of hardware, software, and networks; principles of computer applications; personal and social issues; and limitations of computers.

Discussion of Major Research Findings

Computer Knowledge of Thai Nursing Students

The findings revealed that nursing students at Chiangmai University self-reported their overall computer competency at a moderate level. When considering each domain, computer knowledge about “concepts of hardware, software, and networks” was moderate as was that of “principles of computer applications.” The students ranked “limitations of computers” and “personal and social issues” at high levels of competency. The findings from these four areas are considered to be good or satisfactory and can be

explained by the fact that nursing students in this study had previous computer education and prior hands-on computer experience. The findings indicated that almost all nursing students had mandatory computer courses before entering the nursing school, and the majority started their first mandatory computer class in elementary school with the mean falling at grade 4. Also, the mean of the number of computer courses taken was six. The long exposure to computer education and computer experience that they received may have enhanced their computer knowledge. Much of the literature suggests that computer experience including time spent with computers and number of computer-related courses corresponds to computer knowledge (Lin et al., 2007; Link & Marz, 2006; Stephan, Frederik, & Rein, 2009).

Although fundamental computer knowledge, such as basic usage of computers, computer networks, computer system operation, Internet use, e-mailing, computer-related social issues, and computer limitations was rated highly in the current study, knowledge related to nursing information (such as what a nursing information system is, software tools used in nursing, and application of computer networks in nursing) was low. The low scores for this nursing information-related knowledge may result from the omission of nursing informatics coursework in the nursing program (Faculty of Nursing, 2009). Therefore, the students may lack exposure or opportunity to learn about nursing informatics in their classrooms. The literature suggests that, unless a nursing student is participating in a dedicated informatics program, there are limited educational opportunities to meet learning needs related to health informatics (Fetter, 2009a; McNeil, Elfrink, Beyea, Pierce, & Bickford, 2006). The findings of the current study require

attention from nursing educators to ensure the integration of nursing informatics into nursing education, research, and practice.

Moreover, although the University Hospital in Thailand associated with Chiangmai university, a practice setting for nursing students, has adopted technology such as electronic hospital information systems, the paper-based information system was still used in parallel because of incomplete electronic integration. In addition, the number of computers in the practice setting was limited. Therefore, for logistical purposes, nursing students were encouraged to continue to work with the paper-based systems (P. Chanin, personal communication nurse, September 8, 2011). This practice reflected the results of research done in the United Kingdom (Bond, 2009), which found that nursing students had not felt at all encouraged to use informatics technology when interacting with professional nurses in a clinical setting. This restriction limited the students' opportunities to use computers in their clinical practice. The British student nurses also thought that time had been a limiting factor, and learning the computer system was a low priority on a busy ward where patient care is the top concern. Similarly, in the current study, the limited number of computers in the practice setting along with a lack of opportunity to utilize electronic systems has dampened the nursing students' enthusiasm about computer knowledge and its usage in clinical settings. This finding may be of significance as nurse educators, researchers, and practitioners collaboratively make future plans for educating the next generation of Thai nurses.

Skills in Computer Usage of Thai Nursing Students

Another domain of computer competency was "skills in computer usage." Nursing students reported their computer skills as moderate. The explanation for this

result could be that the nursing students in the current study had some experience with computers. The findings indicated that the majority of the students had been using a computer for 10 to 12 years; the mean years of computer utilization for students was 9. This finding indicated that the students have been exposed to computers over an extended period. Interestingly, the students reported that they used a computer approximately 4 hours each day. In addition, almost all of the students have their own computers, demonstrating that they have much time and opportunity to access the computer and practice their computer skills, and helping to explain the long hours of computer usage that the students are engaged in daily. This finding can be verified through research from other countries. For example, in Greece, researchers reported that owning a personal computer had a great influence on undergraduate nursing students' computer skills (Deltsidou, Gesouli-Voltyraki, Mastrogiannis, & Noula, 2010).

Although the data suggested that Thai nursing students in the current study spent a lot of time with computers, their computer skills were actually ranked at the lowest domain of computer competency. Several explanations are provided to support this finding. First, Thai nursing students did not have a variety of computer skills. Recall that these students' main purposes for computer use were focused primarily on Internet searching, word processing, Power Point presentation development, and computer games. These data suggested that Thai students have significant computer skills only in these four specific applications. Second, Thai students' skills with computers are perhaps limited in other areas including the use of computational software, such as Statistical Package for the Social Sciences (SPSS) and Statistical Analysis Systems (SAS). This limited use of computers (i.e., to the four specific areas) may have caused students to

report low overall computer skills. Recall that the results of the current study indicated that Thai nursing students spent time on the Internet, but their usage was mainly limited to participating in chat rooms, communicating via email, and playing computer games. Collectively, the Thai students utilized computers for personal social activities that were not directly linked to academic pursuits. That is to say, Thai nursing students utilized computers and the Internet as sources of entertainment. This finding corresponded with a study conducted by Tien and Fu (2006) in Taiwan. These researchers have also reported that undergraduate students use computers not only for fulfilling their academic requirements but also for entertainment, such as Internet friend making, movie watching, and shopping. Importantly, the Taiwanese researchers reported that their undergraduate students spent about 19 hours per week using the computer, of which 5 of these hours were academic related (Tien & Fu, 2006). Therefore, the researcher asserted that nursing students in the region utilized computers mainly for personal communication and entertainment purposes. However, their use of computers for academic learning and for the advancement of patient care is not yet known.

Interestingly, Thai nursing students have some level of understanding about their computer competency regarding applications like word processing software and presentation editing software. Their insights suggested that they were aware of their limited knowledge and skills regarding the use of statistical software such as SPSS. This finding is congruent with a longitudinal study that was conducted over an 8-year period in the United States (McDowell & Ma, 2007). Results from this longitudinal study suggested that undergraduate students reported low competency in using statistical programs. Furthermore, the researcher in this longitudinal study pointed out that the

students' sense of computer competence with the statistical program did not change over the 8-year period. Several explanations should be considered regarding this finding. First, the nursing students are not expected to utilize statistical programs in their clinical and research training during their four years of nursing education. Second, perhaps the future employers of nursing students have not yet articulated any expected competency related to the use of statistical software packages. It should be noted that Thai students and other nursing students in different parts of the world report similar statistical program utilization limitations (see McDowell & Ma, 2007). They do not think that they are competent with the statistical software packages. Specifically, in the nursing program at Chiangmai University, a *Nursing Research* course is taught in academic year 4 (Faculty of Nursing, 2009). This course may be the first time that nursing students will be exposed to the statistical program. In most instances, the nursing students are taught how to utilize SPSS. Furthermore, at Chiangmai University, undergraduate students may not have sufficient opportunity to utilize the statistical software outside of the course context. Currently, at the university, research programs that are conducted by faculty members seldom include undergraduate nursing students as research assistants (J. Mesukko, personal communication nursing faculty, October 10, 2011).

Another interesting observation was reported. The highest rated item in the computer skills domain was the students' use of the World Wide Web to search for information. However, their proficiency with information retrieval systems, such as Medline or PubMed, was rather low. Again, this finding was related to the basic purposes for which the students utilized their computers including participation in chat rooms, communication via email, free surfing on commercial websites, and computer game

playing. The students utilized their computers primarily for personal communications and entertainment; the use of computers for academic learning and skills acquisition does not seem to yet be a part of the students' awareness for advancement of their learning. This finding is consistent with many studies which suggest that nursing students lack skills needed for scholarly and scientific usage (Dee & Stanley, 2005; Deltsidou et al., 2010; Elder & Koehn, 2009; McDowell & Ma, 2007). This finding should be of concern to all nurses in international communities. In the United States, the results of the national survey of more than 700 nurse administrators suggested that a critical skill for novice nurses is computer proficiency for a variety of research- and practice-related activities (McCannon & O'Neal, 2003).

Another notable finding from the current study disclosed that nursing students' skills related to nursing informatics was low, which implies that recent nursing graduates have limited skills in storing, retrieving, and transferring patient-related data. In addition, they lacked the skills to use the hospital information system to do nursing work. This lack of nursing information-related skill was not surprising because, as has already been mentioned, the results of the current study reveal that nursing students were not very knowledgeable about nursing informatics. Limitations on the numbers of computers in practice settings, lack of encouragement from nurses, and incomplete electronic hospital information systems are some of the barriers that need to be systematically addressed.

Thai Nursing Students' Attitudes toward Computers

The other domain of computer competency was "attitudes toward computers." Nursing students at Chiangmai University showed positive attitudes toward computers. The mean score of computer competency in the attitudes toward computers in each item

was at a high level. This finding is consistent with research from other international communities. In the United States, Maag (2006) found that nursing students attending universities had positive attitudes toward computers. Also, a study from Sweden reported that nursing students believed that their computer skills were sufficient for their current or future work as registered nurses (Ragneskog & Gardnert, 2006). The findings from the Swedish study are interesting because the researchers reported that nursing students believe that they have the computer competency that will be needed in their future work. Specifically, the researchers reported that the majority of students felt competent in their overall ability to operate computers. They were skilled in word processing and felt competent in accessing online library databases, such as CINAHL and PubMed. In addition, a recent study in South Africa reported that nursing students had good attitudes toward computers (Nkosi, Asah, & Pillay, 2011).

Throughout the world community, computers and information technology are being used in almost every aspect of nursing education. Nursing practice has also incorporated the necessity for computer knowledge and skills. The current study suggests that nursing students at Chiangmai University have positive attitudes toward computers, which is viewed as an antecedent to behavior or intention to acquire knowledge and skills needed for informatics (Ajzen & Fishbein, 1980; Saparniene, Merkys, & Saparnis, 2005). If nursing students have positive attitudes toward computers or are comfortable with computers and information technology, they will manifest the essential elements for learning through the use of computer skills and proficiency. Research suggests that computers can be utilized to strengthen and advance nursing knowledge across a variety of content areas (Fetter, 2009a; McGonigle & Mastrian, 2012). Computers also make

learning linkages possible between the classroom and the health care setting. A past study supported that students with a positive attitude toward computers demonstrate higher computer knowledge and skill levels, whereas persons expressing a negative attitude toward computers were of lower computer knowledge and skill levels (Saparniene et al., 2005).

Relationship between Nursing Students' Characteristics and Computer Competency

Age and computer competency. The current findings revealed that age had a positive relationship with computer competency ($r = 0.17$, $p < .01$), indicating that older nursing students have more computer competency than do younger nursing students. This finding is consistent with two studies from neighboring countries. Researchers reported that age had a positive relationship with the computer literacy of Taiwanese and South Korean nurses (Hsu et al., 2009; Lin et al., 2007). Also, a national study in the United States revealed that older nursing students had better computer competency than younger nursing students (Maag, 2006).

However, it was surprising that age distributed a very low positive correlation to computer competency. One possible explanation for this low correlation could be that all students' ages in the current study were similar. The age range from freshmen to seniors was about 18 to 23 years old. As such, this similar age group may not have many differences in social and cultural backgrounds. For example, it is likely that these young nursing students had equal opportunities to approach computer education through elementary to high school with similar curricula across the nation. Two other studies from different parts of the world revealed similar results. This low correlation between age and computer competency is consistent with a study in another discipline, agriculture

education in the United States, which found that age had a negligible correlation with computer knowledge among agricultural students (Johnson, Ferguson, & Lester, 2000). Similarly, a study in the United Kingdom found no relationship between nursing students' age and computer skills (Bond, 2004). Bond also suggested that it was access to computers, not age, that was the major variable that influences computer competency among nurses.

The current study supports the findings of the United States and the United Kingdom studies because age did not significantly influence computer competency. The findings were not surprising due to the small correlation between age and computer competency, suggesting that age alone may not be sufficient to account for computer competency among nursing students in Thailand. Among the Thai nursing student group, it is again emphasized that there was little variability in their age range (18 to 23), which may have led to a non-significant effect of age.

Academic year of matriculation and computer competency. The current research findings revealed that academic year of matriculation had a positive relationship with computer competency ($r = 0.19$, $p < .01$), indicating that nursing students who are in a higher academic year have more computer competency than do nursing students who are in a lower academic year. This finding is consistent with a study in Greece which showed that senior nursing students had better computer skills than junior nursing students (Deltsidou et al., 2010). No other studies were identified by the researcher that included nursing students. Findings from other disciplines support the association between academic year and computer competency. Johnson, Ferguson, and Lester (2001) found that senior students enrolled in introductory university agriculture courses had higher

scores on a computer examination and a greater level of overall computer self-efficacy than did freshmen. Also, a survey of medical students in the United States confirmed that students' class years were correlated with self-reported computer knowledge (Morewitz et al., 2004). Another study at Mississippi State University revealed that there was a small difference between undergraduate college students' attitudes and their collegiate classification. Senior students who had enrolled in a computer literacy course expressed significantly more positive attitudes toward computers than did sophomore and junior students (Taghavi, 2006).

It was not surprising to discover that academic year of matriculation had a positive correlation with computer competency. Moreover, the statistical analysis in the study showed that among the four students' characteristics, academic year was the strongest independent variable for nursing students' computer competency. A possible explanation for this finding is that as nursing students advance in their education, they earn more academic credits. Perhaps this trend reflects more opportunities to obtain computer exposure. Recall that computer competency is becoming a necessary skill in academic institutions in Thailand and across the world. As Thai nursing students' academic years advanced, their opportunities to use computers at the nursing school and university dormitory increased.

However, it was unexpected that academic year was not able to predict nursing students' computer competency. One possible explanation of the absence of significant effect could be that although academic year was the independent variable that had the strongest relationship with computer competency, this relationship was still statistically

low. Thus, academic year alone may not have a major influence. Other factors such as computer experience may play a more important role than academic year alone.

Cumulative grade point average and computer competency. In this study, a significant relationship between grade point average and computer competency was not found. To our knowledge, this is the first time that the relationship between grade point average and computer competency among undergraduate nursing students was systematically researched and reported in the scientific literature. This finding was congruent with a study in southwestern Ohio, in which researchers reported that the correlation between computer use and grade point average of 10^{th}-grade students was not found to be significant (Hunley, et al., 2005). However, the current findings contrast with past studies. For example, Johnson and colleagues (2000) found that grade point average had a moderate positive correlation with computer knowledge of students who enrolled in a university agriculture course. In 2004, another study in Boston reported a low positive relationship between grade point average and computer skills of high school students (Mccane, 2004). Also, a recent study indicated that Turkish high school students' grade point averages were positively related to computer course grades (Baloğlu, Abbassi, & Cevik, 2009).

The reason for a lack of correlation between grade point average and computer competency in the current study could possibly be due to the small range of grade point average scores among the studied participants. This observation suggested that the nursing students who were recruited for this study were similar in intellectual ability and knowledge acquisition. Most of the grade point averages of students fell between two ranks, 3.01 - 3.50 and 3.51 - 4.00, indicating little variation. This small variability of

grade point average among the students might explain why the relationship between grade point average and computer competency was not detected in this study.

Another possible explanation for the absence of a significant relationship could be that grade point average is just one indicator that reflects undergraduate academic achievement. It may not, however, be the most important variable that determines computer knowledge and skills acquisition. The data did not identify other variables such as computer self-efficacy, individual computer experience, frequency of computer use, number of computer courses completed, and total academic credits attained. In addition, although CMU School of Nursing integrated an elective university-wide computer course into the undergraduate nursing program in 2009, only 17% (n = 35) of participants reported having completed this computer course. Therefore, the students' grade point averages cannot be explained by exposure to computer courses for two reasons. First, the course has been available to students for less than two years. Second, only 17% of participants reported having successfully completed this university-wide computer course. Faculty at CMU School of Nursing should continue to track students' interest in this or similar courses, and then determine the impact that they have on students' acquisition of computer knowledge and skills.

Length of time spent with computers and computer competency. The current research findings revealed that length of time spent with computers, which was measured in years, had a positive relationship with computer competency ($r = 0.16$, $p < .05$), indicating that nursing students who had spent more time using computers have better computer competency than do nursing students who had spent less time with computers. This finding is congruent with the reports from other studies, which supported the

hypothesis that as length of time spent with computers increased, so did students' level of computer competency (Lin et al., 2007; McKee, 2007; van Braak, 2004; Yang, Yu, Lin, & Hsu, 2004). These studies suggest that length of time spent with computers is one of the essential components for high computer competency.

However, the low correlation between length of time spent with computers and computer competency in this current study ($r = 0.16$) was unexpected. One possible explanation for this result could be that length of time spent with computers was measured as quantity of time. It did not, however, address the variable of quality of computer experience during this time. Researchers, such as Yaghmaie (2007), suggest that an individual with only a few years of computer experience may report high quality, whereas others who have had years of experience could possibly report lower quality. Therefore, time spent with computers, as a single factor, may not produce a high correlation with computer competency. That is to say, this study suggested that students utilized their computers as a form of entertainment, communication, relaxation, and shopping. Their use of computers for the acquisition of knowledge and skills in nursing was not always their major purpose for computer use. In related research, there are other essential components of computer experience that are associated with computer competency; for example, the purpose of computer usage, the number of computer courses, frequency of computer use, access to personal computers both at home and at school, and Internet connection (Becker & Schmidt, 2003; Bond, 2004; Hsu et al., 2009; Lin et al., 2007; Stephan et al., 2009).

In the current study, nursing students reported an early exposure to formal education in computer technology. Most took their first computer courses when they

were in elementary school. In addition, the majority of the students reported that they had completed an average of six computer courses during their elementary to high school years. Further, they reported currently using computers almost 4 hours each day. In addition, almost all nursing students had their own personal computers; they had access to computers and the Internet provided by CMU School of Nursing 24 hours a day. These opportunities for computer experiences including formal computer education, prior hands-on computer courses, frequency of computer use, computer ownership, and Internet access, may be other factors that contributed to computer competency.

The lack of a significant effect related to length of time spent with computers was unexpected. The finding could possibly be due to the small relationship between length of time spent with computers and computer competency. Thus, length of time spent with computers alone may not be sufficient to be a representative variable of computer experience, and may not have a major influence on computer competency. This research suggests that other variables mentioned earlier, such as purposes of computer usage, quality of computer usage, frequency of computer use, computer ownership, and the number of computer training courses taken, may play a more important role than length of time spent with computers alone.

Discussion of Additional Analysis Results

After all data analyses were completed, the researcher determined that an exploratory factor analysis of the Computer Competency Questionnaire would provide additional insight into and knowledge about how this instrument behaves with Thai students. This independent analysis is reported in the final section of Chapter 4.

Exploratory factor analysis was conducted for the Computer Competency Questionnaire to gain more in-depth knowledge about its psychometric properties. The 15-factor structure emerged in this study. It was the cleanest model for the Computer Competency Questionnaire because it had both strong primary factor loadings and no secondary factor loadings. Moreover, there were no correlations between factors, implying that each factor measures a unique concept (Table 15). Interestingly, this 15-factor structure is not much different from the six domains of the original questionnaire developed by Hsu and colleagues. The difference is that the 15-factor structure gives more detail about computer knowledge and skills in computer usage. For example, Hsu's skills in the computer usage domain were extracted to five domains (skills in word processing, presentation program, multimedia, internet use, and hospital information system) with 14 items rather than the original 27. In addition, the reduced number of items in the 15-factor structure makes the questionnaire more concise and easy to administer.

This additional analysis does provide the researcher and the reader with a more in-depth understanding about the questionnaire and its potential utility in research. The findings would guide future and educational interventions aimed at enhancing computer competency of nursing students. However, this 15-factor structure can be confirmed only if additional factor analyses are obtained with a larger sample that represents diverse populations. Additional research will be needed before this 15-factor structure can be used in a definitive manner.

Study Limitations

The present study had a number of limitations that should to be acknowledged. First, the undergraduate student sample was predominantly from the northern region of Thailand. Thus, results of the study may only be generalized to northern public university students; it may not be generalizable to all public university students in Thailand. The student characteristics and backgrounds might differ from those in other regions in the country. Further research is needed, especially for public universities located in the other main regions of Thailand: central, northeast, east, and south.

The second limitation was related to the nature of the self-administered questionnaire. In this study, all data were based on students' self-reports, which may have been affected by insufficient recall and the social desirability effect. The students may have forgotten some of their experiences with computers or others may have had a tendency to overestimate or underestimate their computer competency. These response biases may limit the accuracy of information in the study.

Third, instruments are culture-sensitive, so that an instrument developed as this one was in Taiwan and South Korea might not be sensitive to the same concepts/variables among nursing students in other cultures. The Computer Competency Questionnaire used in this study was originally developed by East Asian educators. Specifically, Taiwanese and South Korean researchers developed this instrument in English; it was then translated from English to Thai for the use of this research. Although for the purpose of this study, the Computer Competency Questionnaire was translated into Thai by bilingual experts and content validity was approved, researchers need to be aware of problems related to interpretation and cultural appropriateness.

Study Implications

Health Policy Implications

The current findings revealed that the computer competency of Thai nursing students was deficient even though it is one of the required skills of the 21st century nursing workforce. Their computer competency, especially in nursing informatics skills, was not sufficient to work efficiently in an environment that increasingly relies on information technology. These findings raise awareness of nursing students' inadequate preparation to policymakers and related stakeholders. The significance of the findings is in their ability to enable these leaders to enforce nursing informatics-related policy on a national level as an umbrella for all nursing education. Research literature suggests that nursing students' computer competency will continue to be an expectation in the nursing workforce. In addition, the Thai Nursing Council, the organization that takes responsibility for and authority over the nursing profession and nursing education, is evaluating the current and future roles of computer technology as a mechanism for the delivery of knowledge, skills, clinical data, and other communication essentials in healthcare systems. That is to say, the Thai nursing council is considering nursing informatics as a core competency for baccalaureate nursing students. This emerging policy will help to ensure that all Thai nursing graduates across the nation will have basic competency levels in computer technology.

Nursing Education Implications

Although nursing students need to be able to utilize computer technology effectively to promote their educational advancement, support their professional practice, and provide a higher quality of nursing care, the lack of nursing students' computer

competency was obvious in the present study. Thus, education and training regarding informatics is vital for these students. To increase nursing students' computer competency, nursing informatics courses should be integrated into the nursing curriculum for undergraduate nursing programs as the initial step. Specifically, nursing informatics should be a free-standing mandatory course, neither embedded in other classes nor separated out as an elective course, as is common today. Such a course will better prepare nursing students to meet electronic health care demands when they become professional nurses and assume a variety of roles in a healthcare system.

In addition, computer competency should be a requirement for nursing students. According to Maag (2006), nursing students in the United States must demonstrate technology skills and basic computer knowledge upon admission to schools of nursing. Based on Maag's findings, nursing schools in Thailand might consider systematically assessing entering students' computer competency. A pre-entrant computer assessment and a final comprehensive informatics assessment should be developed and given to freshmen and seniors, respectively. These data could provide nursing faculty accurate information about Thai nursing students' computer competency, and additional information about the knowledge and skills that they have gained during their matriculation at CMU School of Nursing. These assessments will provide a foundation for determining educational needs for all nursing students while in a formal program and after completion of the degree.

Additionally, incorporating nursing informatics into the curriculum requires the collaborative efforts of nursing faculty because they are the key effective users of computer technology in nursing education (Ragneskog & Gerdnert, 2006). Nurse leaders

will, therefore, need to make sure that certified nursing informatics educators or faculty members are available to students as role models and teachers. Informatics workshops and training, funding, and time for the development of skills need to be provided to nursing faculty for enhancing computer competency.

Nursing Research Implications

This study provided a direction and focus for future nursing research. Although the findings from this study provided empirical evidence to understand the phenomenon of nursing students' computer competency and suggested the integration of nursing informatics into nursing curricula, there is a lack of clarity among nursing faculty about the scope, depth, and essential elements that should be required for informatics contents in the curriculum. Future nursing research should explore the scope and content of nursing informatics courses, and how to effectively integrate this content into nursing curricula. Also, interventions or strategies aimed at enhancing students' computer experience and students' computer competency should be systematically conducted and reported to faculty and students.

Furthermore, the results of this study showed a low value of coefficient of determination, indicating that the four overall student characteristics (age, academic year of matriculation, grade point average, and length of time spent with computers) are not good predictors of computer competency because they explain little variation in computer competency. Therefore, perhaps others influencing factors for computer competency should be identified to better understand the phenomena and increase the potential for developing approaches that are useful for students. Importantly, expanding future research to a longitudinal study and including more independent variables in the study

may be useful for examining changes in computer competency and clarifying the effect of students' characteristics or other major study variables over time. Such data could be utilized to develop specific academic programs across the four academic years that would yield expertise in selected predetermined student outcomes.

Recommendations for Future Research

This study should be replicated using a larger sample of nursing students in order to gain more variations, and recruit samples throughout the five regions of Thailand to have a more representative population so as to increase the generalizability of the results. In addition, this study focused on computer competency among nursing students only. There should be a further study with various populations, such as faculty and registered nurses, to compare their perceptions and get a better understanding of computer competency in the nursing profession.

Additionally, some literature suggests that self-reported assessments may not be as reliable as other forms of evaluation, such as performance measures and hands-on documentation (Ballantine, Larres, & Oyelere, 2007; Elder & Koehn, 2009). It is not known whether self-reported computer literacy is a valid measure of a subject's actual computer competency. A past study indicated that undergraduate students were not able to accurately report their computer literacy (Ivanitskaya, O'Boyle & Casey, 2006; Merritt, Smith, & Di Renzo, 2005). Students may overestimate or underestimate themselves regarding their computer competency. Some studies reported that undergraduate students have a tendency to significantly overestimate their computer competency (Ballantine et al., 2007; Elder & Koehn, 2009; Larres, Ballantine, & Whittington, 2003). Future research might indicate that this study be replicated in two phases. Phase one could be

Thai students' self-reported computer competency, and phase two could be actual computer competency performance assessments. Correlations or comparisons between the scores of the two phrases would be very instructive for Thai faculty and scientists.

Furthermore, focus groups or qualitative designs should be conducted to gain additional insights into the perceptions of nursing students' computer competency. It would also be useful to conduct focus groups with nurses in practice and health policy settings to determine their perceptions and attitudes about computer usage in nursing in general, and then specific role functions in particular.

Conclusion

This study was conducted to explore the computer competency of Thai nursing students and examine the relationships among students' characteristics and computer competency. Also, the predictors of computer competency were examined. An up-to-date profile of nursing students' computer competency was reported. The findings indicated that Thai undergraduate nursing students had moderate computer competencies. When considering each domain, "skills in computer usage" was ranked as the lowest domain, whereas "attitudes toward computers" was the highest. The results showed that age, academic year of matriculation, and length of time spent with computers had a positive correlation with computer competency. However, none of them, including cumulative grade point average, were significant predictors of computer competency.

The findings of the study are important and should help stimulate a national curriculum movement by implementing nursing informatics into nursing curricula. Also, a number of implications for education, research, and health policy were discussed.

APPENDICES

Appendix A

Figure 4. Chiangmai located in the northern region of Thailand

Appendix B

A sample of the letter to the Dean of CMU School of Nursing

May 20, 2011

Faculty of Nursing

Chiangmai University

Thailand, 50300

Dear Dean of the School of Nursing, Chiangmai University

My name is Srimana Niyomkar, a doctoral student at Frances Payne Bolton School of Nursing, Case Western Reserve University, Cleveland, Ohio, USA. I am writing to ask for your assistance in my research study about computer competency of Thai undergraduate nursing students. The information obtained from this study will help clarify the extent of nursing students' computer competency and provide baseline information for ongoing planning to appropriately develop nursing informatics courses to improve nursing students' computer competency. Regarding confidentiality and protection of human subjects, there are no risks involved. This study will use an anonymous questionnaire, and the results will be reported as group data. Moreover, students have the right to withdraw from the study at any time if they feel uncomfortable. Therefore, I, as the researcher, ask for permission to collect data in your school setting. Please feel free to contact me if you have any questions or concerns. I can be reached by email at srimana.niyomkar@case.edu or srimana@nurse.cmu.ac.th or phone: 001-1-216-231-2951. Thank you very much for your consideration. Your assistance is greatly appreciated. I am looking forward to hearing from you.

Sincerely yours,

Srimana Niyomkar, RN, MSN

Frances Payne Bolton School of Nursing

Case Western Reserve University

Cleveland, OH, USA 44106-4904

Appendix C

Instructions for the faculty members

Dear instructor,

One week before research collection, please make the announcement to your students at the end of the class. Please say that Ms. Srimana Niyomkar, a PhD student at the School of Nursing, Case Western Reserve University, is conducting a research study entitled *Computer Competency of Nursing Students in Thailand.* Please tell the students that they have been randomly selected to participate in the study because they are currently enrolled in the 4-year baccalaureate nursing program. However, their participation is voluntary. The PhD student will come to see them next week at the end of the class to administer and collect the questionnaires. The questionnaires will take around 35 minutes to complete. Please inform the students that they are welcome to join the study. Thank you very much.

Sincerely yours,

Srimana Niyomkar
PhD Student, School of Nursing
Case Western Reserve University
Cleveland OH 44106-4904 U.S.A

Appendix D

The Inform Consent Letter

Dear nursing student at Chiangmai University,

My name is Srimana Niyomkar, a doctoral student at Frances Payne Bolton School of Nursing, Case Western Reserve University, Cleveland, Ohio, USA. I am writing to ask for your assistance as a voluntary participant in my study about computer competency of Thai undergraduate nursing students. You will be asked about your background and to self-rate your computer competency. The information obtained from this study will help clarify the extent of nursing students' computer competency and provide baseline information for ongoing planning to appropriately develop nursing informatics courses to improve nursing students' computer competency.

Regarding confidentiality and protection of human subjects, there are no risks involved in the study. Participation in this study is completely voluntary. Your decision whether or not to complete the questionnaires will not affect your study benefits. This study will use an anonymous questionnaire, and the results will be reported as group data. To protect your privacy, please do not put your name or student code on the questionnaires. Return of a completed questionnaire implies consent and voluntary participation. Please keep a copy of the informed consent letter for your records. You have the right to withdraw from the study at any time if you feel uncomfortable. When your questionnaires are completed, please return them immediately to the locked box provided in the back of this classroom. If you are not willing to participate in the study, you do not have to fill out the questionnaires and you are free to leave from the classroom at any time. You can withdraw from the study any time without penalty or loss of

benefits. Also you will be not asked to explain the reason for stopping or withdrawing from the study.

Please feel free to contact me if you have any questions or concerns. I can be reached by email at srimana.niyomkar@case.edu or srimana@nurse.cmu.ac.th or phone: 053-213342. Thank you very much for your participation. Your participation is greatly appreciated.

Sincerely yours,

Srimana Niyomkar
PhD Student, School of Nursing
Case Western Reserve University
Cleveland OH 44106-4904 U.S.A

45/7 Sonsuay 1 Village
Superhighway Road
Chiangmai, 50300 Thailand.

Appendix E

The Instruments
The Demographic Data Questionnaire

Direction: Please fill your background information in the blank box and/or marking (X) in the appropriate boxes that best describes yourself

Demographic Data

1. What is your age?.....
2. What is your gender? ☐ Male ☐ Female
3. Where is your hometown?.....
4. Did you graduate from a public or private high school?

   ☐ Public school ☐ Private school
5. What was your cumulative GPA in high school?

   ☐ 0-0.50

   ☐ 0.51-1.00

   ☐ 1.01-1.50

   ☐ 1.51-2.00

   ☐ 2.01-2.50

   ☐ 2.51-3.00

   ☐ 3.01-3.50

   ☐ 3.51-4.00
6. What is your academic year at the university?

   ☐ Year1 ☐ Year2 ☐ Year3 ☐ Year 4
7. What is your cumulative GPA at the School of Nursing?

   ☐ 0-0.50

   ☐ 0.51-1.00

   ☐ 1.01-1.50

   ☐ 1.51-2.00

   ☐ 2.01-2.50

   ☐ 2.51-3.00

   ☐ 3.01-3.50

   ☐ 3.51-4.00

8. Where do you live?
   - ☐ A dormitory in the main campus
   - ☐ A dormitory in the School of Nursing
   - ☐ Parents' house
   - ☐ Relative' s house
   - ☐ Other (specify)…….
9. What is your parents' income per month?
   - ☐ Less than 5,000 Baht
   - ☐ 5000-10,000 Baht
   - ☐ 10,001-15,000 Baht
   - ☐ 15,001-20,000 Baht
   - ☐ 20,001-25,000 Baht
   - ☐ 25,001-30,000 Baht
   - ☐ More than 30,000 Baht

Computer Experience

10. Do you have your own email address? ☐ Yes ☐ No
11. Do you have your own personal computer? ☐ Yes ☐ No → Go to question # 13
12. If yes, how long have you owned a personal computer?
    - ☐ Less than 1 year
    - ☐ 1 year – 3 years
    - ☐ 3 years – 5 years
    - ☐ 5 years – 7 years
    - ☐ More than 7 years
13. How long have you been using computers?.....Years
14. How often do you use a computer?
    - ☐ Every day
    - ☐ Almost everyday
    - ☐ Several times a week
    - ☐ Several times a month
    - ☐ Almost never
    - ☐ Other (specify)……..

15. What purpose do you use the computer for? (please check all that apply)

☐ Word processing

☐ Power Point graphics

☐ Excel

☐ Statistics

☐ Picture and photo editing

☐ Computer games

☐ Internet/WWW

☐ Programming

☐ Web design

☐ Other (specify)……..

16. What do you primarily use the Internet for? (please check all that apply)

☐ Sending/receiving email

☐ Free surfing on the Net

☐ Purposeful research of information/education

☐ Document download

☐ Participation in chat room

☐ Game playing/ entertainment

☐ Book research and ordering

☐ Shopping

☐ Wasting time

☐ Other (specify)……..

17. Approximately how many hours per day do you use the computer? …...hours/day.
18. Did your primary/secondary school provide mandatory computer-related courses to students?

☐ Yes ☐ No → Go to question # 20

19. If so, what school level did you first start studying computer class in a school?

☐ Elementary school grade.....…..... ☐ High school grade.....……...

20. Was a computer course an elective course in your elementary/high school?

☐ Yes ☐ No

21. How many computer classes have you attended throughout your life time?.....

22. Have you taken any computer course provided by CMU?

☐ Yes ☐ No→ Go to question # 24

23. If so, what course did you take?.....

24. Have you ever participated in computer-based or online courses?

☐ Yes ☐ No

Appendix F

The Computer Competency Questionnaire

Directions: The following questions are about a nursing student's computer competency. Please respond with the number that best describes your opinions about computers.

1= extremely disagree
2=disagree
3=agree
4=extremely agree

Item	1	2	3	4
1. I know today's popular types of computer systems, such as Apple Macintosh and IBM-compatible				
2. I know the common computer terminology, e.g., bit, byte, RAM, ROM, HD.				
3. I know the basic components of a computer's hardware system and their function				
4. I know input and output devices of computers				
5. I know the basic components of a computer's software system and their function				
6. I know the basic usage of a computer, e.g., login/logout a computer, use a mouse				
7. I know the usage of file management functions in computer operating systems				
8. I know how to operate computer systems (e.g., Windows)				
9. I know how to install software drivers for peripherals				
10. I can assemble basic components of computer hardware				
11. I can resolve common error situations				
12. I know basic principles of computer networks				
13. I know basic structures of computer networks				
14. I know today's major network types				
15. I know common network hardware devices, e.g., network adapters, hub, and modem				
16. I know how to setup communication software in computers				
17. I know the difference between analog and digital signals				
18. I know important milestones in the evolution of computer technology				
19. I can use a library information retrieval system to search for references, e.g., Medline				
20. I can use the world wide web (WWW) to search for information				
21. I can send/receive mails and transfer files through networks				
22. I know there are video discs for nurses' continuing education, patients' health education, etc.				

Item	1	2	3	4
23. I know there is simulation software for continuing education and training				
24. I can use computerized self-learning equipment				
25. I know what a nursing information system is				
26. I know what today's major nursing information systems are				
27. I know the significant highlights in the evolution of computer applications in nursing				
28. I know about applications of computer networks and telecommunications in nursing				
29. I know about applications of robotics and expert systems in nursing.				
30. I know about computer applications in medical decision analysis				
31. I know there are package software and software tools which can be used in nursing				
32. I know about common computerized equipment in medicine and health care, such as CT scan and MRI				
33. I know how to apply computers for personal use				
34. I can use word processing software				
35. I can generate nursing documents by using word processing software to, e.g., reports, patient care plan,etc.				
36. I can use a spreadsheet program (e.g., MS Excel)				
37. I can use a spreadsheet program (e.g., MS Excel) as a management tool in nursing				
38. I can use presentation editing software (e.g., MS Power Point)				
39. I can use presentation editing software (e.g., MS Power Point) for preparing lectures or patient education				
40. I can use database software to construct nursing databases				
41. I know what a hospital information system (HIS) is				
42. I know that HIS are useful tools in promoting running efficiency of hospital				
43. I can use nursing information systems				
44. I can maintain nursing information systems				
45. I can use HIS to do nursing work, e.g., nursing records				
46. I can use HIS to store/retrieve and transfer data such as patient information or drug information				
47. I can use common computerized equipment for patient monitoring and care				
48. I understand the output data from computerized equipment for patient monitoring and care				
49. I can use packaged software (e.g., Front Page) to create web pages				
50. I can create multimedia files for web pages				
51. I know how to use statistical software (e.g. SPSS, SAS, etc.)				
52. I can use statistical software for nursing research				

Item	1	2	3	4
53. I know how to manage and store files				
54. I can convert files for different application software				
55. I know how to use common peripherals such as printers and scanners				
56. I know how to create multimedia files				
57. I know how to edit multimedia files				
58. I can use computers as self-learning tools				
59. I know that a computer program has limitations in its design and capability				
60. I know that computers are not intelligent in themselves and must be programmed based on our needs				
61. I know that the computer is only a tool to provide better nursing care. It cannot replace the role of nurses				
62. I know limitations and reliability of computerized patient monitoring systems				
63. I know the reasons for slow response time such as heavy demands on computer systems				
64. I know that computer files need to be backed up				
65. I know about problems of data integrity				
66. I know that computer users are usually the ones who make mistakes				
67. I know that computers in use today do not have good enough ability to interpret natural language				
68. I know the importance of computer technology to us and our society				
69. I know that the use of computers may result in manpower shifts within the hospital organization				
70. I know that the computer can be used as a tool for staffing, scheduling, quality control, etc.				
71. I know that the use of the computer might result in dehumanization of patient care				
72. I am concerned about how data is collected and used				
73. I know the importance of confidentiality when processing computerized data and medical records				
74. I know about the laws regarding protecting personal information in computers				
75. I know about the copyrights regarding computer programs and electronic files.				
76. I know the basic technique of encryption and access control				
77. I know what computer viruses are				
78. I know how to prevent and handle attacks by viruses				

Item	1	2	3	4
79. I know about ergonomics as related to the design of the computer screen, location of computer devices to minimize harm from computers				
80. I am afraid of using computers				
81. I know that females can be computer literate, just like males are				
82. I develop positive attitudes toward the computer as a good nursing tool				
83. I know that the computer will not be a powerful nursing tool until users put effort into learning how to use it				
84. I develop positive attitude toward lifelong learning and am happy to take on-the-job training				
85. I know where to find resources to resolve computer problems				

Appendix G

Demographic Data Questionnaire (Thai Version)

แบบสอบถามประเมินตนเองด้านสมรรถนะทางคอมพิวเตอร์ของนักศึกษาพยาบาล

ส่วนที่ 1: แบบสอบถามข้อมูลส่วนบุคคล

คำชี้แจง: โปรดกรอกข้อมูลเกี่ยวกับตัวของท่านเองลงในช่องว่าง หรือทำเครื่องหมาย (√) ในช่อง □ ที่ตรงกับท่าน

ข้อมูลส่วนบุคคล

1. อายุ.....ปี
2. เพศ ☐ ชาย ☐ หญิง
3. ภูมิลำเนา.....
4. จบการศึกษาชั้นมัธยมจาก ☐ โรงเรียนรัฐบาล ☐ โรงเรียนเอกชน
5. เกรดเฉลี่ยรวมจากชั้นมัธยมศึกษาตอนปลาย
   - ☐ 0-0.50
   - ☐ 0.51-1.00
   - ☐ 1.01-1.50
   - ☐ 1.51-2.00
   - ☐ 2.01-2.50
   - ☐ 2.51-3.00
   - ☐ 3.01-3.50
   - ☐ 3.51-4.00
6. ชั้นปีที่ศึกษาในปัจจุบัน ☐ ปี1 ☐ ปี2 ☐ ปี3 ☐ ปี 4

7. ปัจจุบันได้เกรดสะสมเฉลี่ยรวม

☐ 0-0.50

☐ 0.51-1.00

☐ 1.01-1.50

☐ 1.51-2.00

☐ 2.01-2.50

☐ 2.51-3.00

☐ 3.01-3.50

☐ 3.51-4.00

8. ปัจจุบันพักอาศัยอยู่ที่

☐ หอพักฝั่งสวนสัก (ในมหาวิทยาลัยเชียงใหม่)

☐ หอพักในคณะพยาบาลศาสตร์

☐ บ้านบิดามารดา

☐ บ้านญาติ

☐ อื่นๆ (โปรดระบุ)…….....

9. รายได้รวมของบิดามารดาต่อเดือน

☐ น้อยกว่า 5,000 บาท

☐ 5000-10,000 บาท

☐ 10,001-15,000 บาท

☐ 15,001-20,000 บาท

☐ 20,001-25,000 บาท

☐ 25,001-30,000 บาท

☐ มากกว่า 30,000 บาท

ประสบการณ์การใช้คอมพิวเตอร์

10. นักศึกษามีที่อยู่จดหมายอิเล็กทรอนิคส์ (email address) ☐ มี ☐ ไม่มี

11. นักศึกษามีคอมพิวเตอร์ส่วนตัวเป็นของตัวเอง ☐ มี ☐ ไม่มี ⟶ ข้ามไปข้อ 13

12. ระยะเวลาที่มีคอมพิวเตอร์เป็นของตนเอง

☐ น้อยกว่า 1 ปี

☐ 1 ปี – 3 ปี

☐ 3 – 5 ปี

☐ 5 – 7 ปี

☐ มากกว่า 7 ปี

13. นักศึกษาใช้คอมพิวเตอร์มากี่ปีแล้ว .....ปี

14. นักศึกษาใช้คอมพิวเตอร์บ่อยแค่ไหน

☐ ทุกวัน

☐ เกือบทุกวัน

☐ หลายครั้งต่อสัปดาห์

☐ หลายครั้งต่อเดือน

☐ แทบไม่ค่อยได้ใช้

☐ อื่นๆ (โปรดระบุ)…….....

15. วัตถุประสงค์ที่ใช้คอมพิวเตอร์ หรือ โปรแกรมคอมพิวเตอร์ที่ใช้บ่อย (ตอบได้มากกว่า 1 ข้อ)

☐ โปรแกรมที่ช่วยในการพิมพ์งานและสร้างเอกสาร (Word processing)

☐ โปรแกรมที่ใช้ช่วยงานด้านการนำเสนอข้อมูล (Power Point graphic)

☐ โปรแกรมประเภทตารางการคำนวณ (Excel)

☐ โปรแกรมสถิติ (Statistics)

☐ โปรแกรมตกแต่งรูปภาพ (Picture and Photo editing)

☐ เกมส์คอมพิวเตอร์ (Computer games)

☐ โปรแกรมอินเตอร์เน็ต (Internet / WWW)

☐ การเขียนโปรแกรม (Programming)

☐ การออกแบบเว็บไซต์ (Web Design)

☐ อื่นๆ (โปรดระบุ)…….....

16. สาเหตุหลักที่ใช้อินเตอร์เน็ต (ตอบได้มากกว่า 1 ข้อ)

☐ รับ-ส่ง จดหมายอิเล็กทรอนิคส์

☐ เล่นอินเตอร์เน็ตหรือท่องโลกแห่งเวปไซด์

☐ เพื่อการศึกษา ค้นหาข้อมูลทางวิชาการ

☐ โอนย้ายไฟล์หรือข้อมูล (Document download)

☐ สนทนาออนไลน์ (chat room)

☐ เล่นเกมส์

☐ ค้นหาหนังสือ หรือสั่งซื้อหนังสือ

☐ ซื้อของ (Shopping)

☐ ฆ่าเวลา

☐ อื่นๆ (โปรดระบุ)….....……..

17. โดยเฉลี่ยแล้ว นักศึกษาใช้คอมพิวเตอร์วันละกี่ชั่วโมง ……..ชั่วโมง/วัน

18. คอมพิวเตอร์เป็นวิชาบังคับในโรงเรียนประถม/มัธยมของท่าน

☐ ใช่ ☐ ไม่ใช่ ⟶ ข้ามไปข้อ 20

19. ระดับชั้นที่ได้เรียนคอมพิวเตอร์ครั้งแรกในโรงเรียน

☐ ประถมศึกษาปีที่……. ☐ มัธยมศึกษาปีที่…….

20. คอมพิวเตอร์เป็นวิชาเลือกในโรงเรียนประถม/มัธยมของคุณ

☐ ใช่ ☐ ไม่ใช่

21. ตั้งแต่เด็กจนถึงปัจจุบัน เคยเรียนวิชาที่เกี่ยวกับคอมพิวเตอร์มาทั้งหมดกี่รายวิชา.....

22. เคยเรียนรายวิชาคอมพิวเตอร์ที่จัดสอนโดยมหาวิทยาลัยเชียงใหม่

☐ เคย ☐ ไม่เคย ⟶ ข้ามไปข้อ 24

23. รายวิชาที่ลงเรียนเป็นรายวิชาเกี่ยวกับเรื่อง.....

24. เคยเรียนรายวิชาต่างๆผ่านระบบออนไลน์หรือไม่ ☐ เคย ☐ ไม่เคย

Appendix H

The Computer Competency Questionnaire (Thai Version)

แบบประเมินตนเองด้านสมรรถนะทางคอมพิวเตอร์ของนักศึกษาพยาบาล

คำชี้แจง: คำถามต่อไปนี้จะเกี่ยวข้องกับการประเมินตนเองด้านสมรรถนะทางคอมพิวเตอร์ของนักศึกษาพยาบาล เมื่อท่านได้ประเมินตนเองแล้วโปรดทำเครื่องหมาย (√) ในช่องที่ตรงกับความคิดเห็นของท่านตามความเป็นจริง

ท่านเห็นด้วยกับข้อความต่อไปนี้มากน้อยเพียงใด	**ไม่เห็นด้วยอย่างยิ่ง**	**ไม่เห็นด้วย**	**เห็นด้วย**	**เห็นด้วยอย่างยิ่ง**
1. ฉันรู้จักระบบคอมพิวเตอร์ที่เป็นที่นิยมใช้ในปัจจุบัน เช่น แอปเปิ้ลแมคอินทอช และ ไอบีเอ็ม				
2. ฉันรู้จักคำศัพท์พื้นฐานของคอมพิวเตอร์ที่ใช้กันทั่วไป เช่น บิต ไบต์ แรม รอม และฮาร์ดดิสก์				
3. ฉันรู้จักส่วนประกอบพื้นฐานและหน้าที่ของระบบฮาร์ดแวร์คอมพิวเตอร์				
4. ฉันรู้จักอุปกรณ์รับและแสดงผลของคอมพิวเตอร์				
5. ฉันรู้จักส่วนประกอบพื้นฐานและหน้าที่ของระบบซอฟต์แวร์คอมพิวเตอร์				
6. ฉันรู้จักวิธีใช้งานพื้นฐานของคอมพิวเตอร์ เช่น การลงบันทึกการเข้า/การออกคอมพิวเตอร์ (ล็อคอิน/ล็อคเอาท์), การใช้เมาส์				
7. ฉันรู้จักวิธีใช้ระบบการจัดการแฟ้มข้อมูล				
8. ฉันรู้จักวิธีใช้ระบบปฏิบัติการคอมพิวเตอร์ (เช่น วินโดว์)				
9. ฉันรู้จักวิธีติดตั้งโปรแกรมไดรฟเวอร์สำหรับอุปกรณ์ต่อพ่วง เช่น ปริ้นท์เตอร์				
10.ฉันสามารถประกอบอุปกรณ์คอมพิวเตอร์พื้นฐานได้ เช่น จอภาพ เมาส์ แป้นพิมพ์				

ท่านเห็นด้วยกับข้อความต่อไปนี้มากน้อยเพียงใด	ไม่เห็นด้วยอย่างยิ่ง	ไม่เห็นด้วย	เห็นด้วย	เห็นด้วยอย่างยิ่ง
11.ฉันสามารถแก้ปัญหาง่ายๆที่เกิดขึ้นกับคอมพิวเตอร์ได้				
12.ฉันรู้จักหลักการพื้นฐานของเครือข่ายคอมพิวเตอร์				
13.ฉันรู้จักโครงสร้างพื้นฐานของเครือข่ายคอมพิวเตอร์				
14.ฉันรู้จักชนิดของเครือข่ายคอมพิวเตอร์ที่สำคัญในปัจจุบัน				
15.ฉันรู้จักอุปกรณ์เชื่อมต่อเครือข่ายคอมพิวเตอร์ เช่น เน็ตเวิร์กอะแดปเตอร์, ฮับ, และ โมเด็ม				
16.ฉันรู้จักวิธีติดตั้งโปรแกรมสื่อสาร (คอมมิวนิเคชั่นซอฟต์แวร์) เช่น MSN, Skype				
17.ฉันรู้จักความแตกต่างระหว่างสัญญาณอะนาล็อคกับดิจิตอล				
18.ฉันรู้จักเหตุการณ์สำคัญที่เกิดขึ้นในวิวัฒนาการของเทคโนโลยีคอมพิวเตอร์				
19.ฉันสามารถใช้ระบบการสืบค้นข้อมูลสารสนเทศของห้องสมุด เช่น เม็ดไลน์ เพื่อค้นหาเอกสารอ้างอิงได้				
20.ฉันสามารถใช้เว็บไซต์เพื่อค้นหาข้อมูลได้				
21.ฉันสามารถรับ/ส่ง จดหมายอิเล็คโทรนิกส์และย้ายไฟล์ผ่านเครือข่ายได้				
22.ฉันรู้ว่ามีแผ่นวีดีโอสำหรับการศึกษาต่อเนื่องของพยาบาล และการให้สุขศึกษาแก่ผู้ป่วย				
23.ฉันรู้ว่ามีโปรแกรมการจำลองสถานการณ์ (สิมูเลชั่นซอฟต์แวร์) เพื่อการศึกษาและฝึกอบรมต่อเนื่องสำหรับพยาบาล				
24.ฉันสามารถใช้อุปกรณ์คอมพิวเตอร์เพื่อส่งเสริมการเรียนรู้ด้วยตนเอง				
25.ฉันรู้ว่าระบบสารสนเทศทางการพยาบาลคืออะไร				

ท่านเห็นด้วยกับข้อความต่อไปนี้มากน้อยเพียงใด	ไม่เห็นด้วยอย่างยิ่ง	ไม่เห็นด้วย	เห็นด้วย	เห็นด้วยอย่างยิ่ง
26.ฉันรู้จักระบบสารสนเทศทางการพยาบาลที่สำคัญๆในปัจจุบัน				
27.ฉันรู้จักเหตุการณ์สำคัญที่เกิดขึ้นในวิวัฒนาการของการประยุกต์ใช้คอมพิวเตอร์ในวงการพยาบาล				
28.ฉันรู้จักการใช้งานของระบบเครือข่ายคอมพิวเตอร์และการติดต่อทางไกลในการพยาบาล				
29.ฉันรู้จักระบบหุ่นยนต์อัจฉริยะที่ใช้ในงานพยาบาล				
30.ฉันรู้เกี่ยวกับการใช้คอมพิวเตอร์ที่ช่วยวิเคราะห์การตัดสินใจทางการแพทย์				
31.ฉันรู้ว่ามีชุดโปรแกรมสำเร็จรูปที่ใช้ในการพยาบาล				
32.ฉันรู้จักอุปกรณ์ดิจิตอลทั่วไปที่ใช้ในทางการแพทย์ เช่น เครื่องซีทีสแกน และ เอ็มอาร์ไอ				
33.ฉันรู้วิธีใช้คอมพิวเตอร์ส่วนบุคคล				
34.ฉันสามารถใช้โปรแกรมสำเร็จรูปเวิร์ดโปรเซสซิ่ง				
35.ฉันสามารถสร้างเอกสารทางการพยาบาล เช่น รายงานกรณีศึกษาและการวางแผนการพยาบาลแก่ผู้ป่วย โดยใช้โปรแกรมสำเร็จรูปเวิร์ดโปรเซสซิ่ง				
36.ฉันสามารถใช้โปรแกรมตารางจัดการ (spreadsheet program) เช่น ไมโครซอฟท์เอ็กเซล				
37.ฉันสามารถใช้โปรแกรมตารางจัดการ เช่น ไมโครซอฟท์เอ็กเซล เป็นเครื่องมือในการบริหารจัดการข้อมูลทางการพยาบาล				
38.ฉันสามารถใช้โปรแกรมการนำเสนอข้อมูล เช่น ไมโครซอฟท์พาวเวอร์พอยท์				
39.ฉันสามารถใช้โปรแกรมการนำเสนอข้อมูล เช่น ไมโครซอฟท์พาวเวอร์พอยท์ เพื่อใช้สำหรับการเตรียมการสอนหรือให้ความรู้แก่ผู้ป่วย				

ท่านเห็นด้วยกับข้อความต่อไปนี้มากน้อยเพียงใด	ไม่เห็นด้วยอย่างยิ่ง	ไม่เห็นด้วย	เห็นด้วย	เห็นด้วยอย่างยิ่ง
40.ฉันสามารถใช้โปรแกรมฐานข้อมูล เพื่อสร้างฐานข้อมูลทางการพยาบาล				
41.ฉันรู้ว่าระบบสารสนเทศโรงพยาบาล (Hospital information system) คืออะไร				
42.ฉันรู้ว่าระบบสารสนเทศโรงพยาบาลเป็นเครื่องมือที่มีประโยชน์ในการส่งเสริมประสิทธิภาพการบริหารโรงพยาบาล				
43.ฉันสามารถใช้ระบบสารสนเทศทางการพยาบาลได้				
44.ฉันสามารถดูแลระบบสารสนเทศทางการพยาบาลได้				
45.ฉันสามารถใช้ระบบสารสนเทศโรงพยาบาล เช่น บันทึกทางการพยาบาล เพื่อทำงานที่เกี่ยวข้องกับพยาบาลได้				
46.ฉันสามารถใช้ระบบสารสนเทศโรงพยาบาล เพื่อเก็บ/ค้นหา หรือย้ายข้อมูล เช่น ข้อมูลผู้ป่วย หรือ ข้อมูลเกี่ยวกับยา				
47.ฉันสามารถใช้อุปกรณ์ดิจิตอลสำหรับเฝ้าระวัง/ประเมินอาการ และดูแลผู้ป่วยได้				
48.ฉันเข้าใจข้อมูลแสดงผลที่ได้จากอุปกรณ์ดิจิตอลสำหรับเฝ้าระวัง/ประเมินอาการ และดูแลผู้ป่วย				
49.ฉันสามารถใช้ชุดโปรแกรมสำเร็จรูป เช่น โปรแกรมฟรอนท์เพจ เพื่อสร้างเว็บเพจ				
50.ฉันสามารถสร้างไฟล์มัลติมีเดียสำหรับเว็บเพจ				
51.ฉันสามารถใช้โปรแกรมสำเร็จรูปทางสถิติ เช่น เอสพีเอสเอส, เอสเอเอส เป็นต้น				
52.ฉันสามารถใช้โปรแกรมทางสถิติในการทำวิจัยทางการพยาบาล				
53.ฉันรู้จักวิธีจัดการและจัดเก็บไฟล์				

ท่านเห็นด้วยกับข้อความต่อไปนี้มากน้อยเพียงใด	ไม่เห็นด้วยอย่างยิ่ง	ไม่เห็นด้วย	เห็นด้วย	เห็นด้วยอย่างยิ่ง
54.ฉันสามารถแปลงไฟล์ได้ เช่นแปลงไฟล์จากสกุล .doc เป็นสกุล .pdf ได้				
55.ฉันสามารถใช้อุปกรณ์ต่อพ่วง เช่น ปริ้นท์เตอร์ และสแกนเนอร์				
56.ฉันสามารถสร้างไฟล์มัลติมีเดีย				
57.ฉันสามารถแก้ไขไฟล์มัลติมีเดีย				
58.ฉันสามารถใช้คอมพิวเตอร์เพื่อเป็นเครื่องมือช่วยในการเรียนรู้ด้วยตัวเอง				
59.ฉันรู้ว่าโปรแกรมคอมพิวเตอร์มีข้อจำกัดในการทำงาน				
60.ฉันรู้ว่าคอมพิวเตอร์ไม่ได้ฉลาดด้วยตัวเอง แต่มันถูกควบคุมด้วยโปรแกรมเพื่อให้ทำงานตามความต้องการของมนุษย์				
61.ฉันรู้ว่าคอมพิวเตอร์เป็นเพียงเครื่องมือที่ช่วยให้การดูแลผู้ป่วยให้มีประสิทธิภาพมากขึ้น แต่มันไม่สามารถแทนที่บทบาทของพยาบาลได้				
62.ฉันรู้ว่าอุปกรณ์ดิจิตอลที่ใช้ในการเฝ้าระวัง/ประเมินอาการผู้ป่วยมีข้อจำกัด เราไม่สามารถเชื่อถือข้อมูลที่ได้จากอุปกรณ์เหล่านี้เพียงทางเดียว				
63.ฉันรู้สาเหตุว่าทำไมบางครั้งคอมพิวเตอร์มีการทำงานที่ล่าช้า เช่น อาจเนื่องจากมีคำสั่งเป็นจำนวนมากเข้ามายังระบบคอมพิวเตอร์ในเวลาเดียวกัน				
64.ฉันรู้ว่าจำเป็นต้องทำการสำรองข้อมูลในคอมพิวเตอร์				
65. ฉันตระหนักว่าข้อมูลที่ได้รับอาจมีความมีความผิดพลาดได้ เช่น มีการกรอกข้อมูลผิดพลาด, แผ่นข้อมูลเสียหาย				

ท่านเห็นด้วยกับข้อความต่อไปนี้มากน้อยเพียงใด	ไม่เห็นด้วยอย่างยิ่ง	ไม่เห็นด้วย	เห็นด้วย	เห็นด้วยอย่างยิ่ง
66.ฉันรู้ว่าบ่อยครั้งความผิดพลาดในงานคอมพิวเตอร์เกิดจากตัวผู้ใช้คอมพิวเตอร์เอง				
67.ฉันรู้ว่าคอมพิวเตอร์ที่ใช้ในปัจจุบัน ยังไม่มีความสามารถที่ดีพอที่จะแปลหรือเข้าใจภาษามนุษย์ มันยังคงต้องใช้ภาษาคอมพิวเตอร์ในการสั่งงาน				
68.ฉันรู้ถึงความสำคัญของเทคโนโลยีคอมพิวเตอร์ที่มีต่อผู้คนในสังคมปัจจุบัน				
69.ฉันรู้ว่าการใช้คอมพิวเตอร์อาจจะส่งผลต่อการเปลี่ยนแปลงการใช้แรงงานคนในโรงพยาบาล				
70.ฉันรู้ว่าคอมพิวเตอร์สามารถใช้เป็นเครื่องมือสำหรับการจัดเวรทำงานของพนักงาน การจัดตารางเวลา และการควบคุมคุณภาพ เป็นต้น				
71.ฉันรู้ว่าการใช้คอมพิวเตอร์อาจทำให้การดูแลผู้ป่วยด้วยหัวใจแห่งความเป็นมนุษย์ลดลง				
72.ฉันตระหนักถึงวิธีใช้และจัดเก็บข้อมูลให้ปลอดภัยและเหมาะสม				
73.ฉันรู้ถึงความสำคัญของการเก็บรักษาความลับเมื่อทำการเก็บข้อมูลเวชระเบียนและบันทึกทางการแพทย์ลงในคอมพิวเตอร์				
74.ฉันรู้เรื่องกฎหมายที่เกี่ยวข้องกับการป้องกันข้อมูลส่วนบุคคลที่เก็บไว้ในคอมพิวเตอร์				
75.ฉันรู้เกี่ยวกับลิขสิทธิ์ของโปรแกรมคอมพิวเตอร์และเอกสารข้อมูลทางอิเล็กทรอนิกส์				
76.ฉันรู้เทคนิคพื้นฐานของการเข้ารหัสข้อมูลและการควบคุมสิทธิการเข้าถึงข้อมูล				
77.ฉันรู้ว่าไวรัสคอมพิวเตอร์คืออะไร				
78.ฉันรู้วิธีป้องกันและการจัดการกับไวรัสคอมพิวเตอร์				

ท่านเห็นด้วยกับข้อความต่อไปนี้มากน้อยเพียงใด	ไม่เห็นด้วยอย่างยิ่ง	ไม่เห็นด้วย	เห็นด้วย	เห็นด้วยอย่างยิ่ง
79.ฉันรู้วิธีจัดวางอุปกรณ์คอมพิวเตอร์ต่างๆให้อยู่ในตำแหน่งที่เหมาะสม และปลอดภัยต่อการใช้งาน				
80.ฉันกลัว/ไม่กล้าใช้คอมพิวเตอร์				
81.ฉันรู้ว่าผู้หญิงสามารถที่จะมีความรู้และมีทักษะทางคอมพิวเตอร์ได้ดีเช่นเดียวกับผู้ชาย				
82.ฉันมีทัศนะคติที่ดีต่อคอมพิวเตอร์ในฐานะที่เป็นเครื่องมือทางการพยาบาลที่ดี				
83. ฉันรู้ว่าคอมพิวเตอร์จะไม่ใช่เครื่องมือทางการพยาบาลที่มีประสิทธิภาพจนกว่าผู้ใช้พยายามเรียนรู้ที่จะใช้มัน				
84.ฉันมีทัศนะคติที่ดีต่อการเรียนรู้ตลอดชีวิตและมีความยินดีที่จะได้รับการฝึกอบรมคอมพิวเตอร์ในระหว่างการทำงาน				
85.ฉันรู้ว่าจะสามารถหาแหล่งข้อมูลเพื่อแก้ปัญหาคอมพิวเตอร์ได้ที่ไหน				

References

Adomavicius, G., & Gupta, A. (Eds.). (2009). *Business computing* (1st ed.). Bingley, UK: Emerald.

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting behavior*. New Jersey: Prentice Hall.

Ali, N. S., Hodson-Carlton, K., & Ryan, M. (2002). Web-based professional education for advanced practice nursing: A consumer guide for program selection. *The Journal of Continuing Education in Nursing, 33*, 33-38.

Amarasingham, R., Plantinga, L., Diener-West, M., Gaskin, D. J., & Powe, N. R. (2009). Clinical information technologies and inpatient outcomes: A multiple hospital study. *Archives of Internal Medicine, 169*(2), 108-114.

American Nurses Association. (2001). *Scope and standards of nursing informatics practice*. Washington, DC: American Nurses Publishing.

American Nurses Association. (2008). *Nursing informatics: Scope and standards of practice*. Silver Spring, MD: American Nurses Publishing.

Atack, L. (2003). Becoming a web-based learner: Registered nurses' experiences. *Journal of Advanced Nursing, 44*(3), 289-297.

Bakken, S. (2001). An informatics infrastructure is essential for evidenced-based practice. *Journal of the American Medical Informatics Association, 8*(3), 199-201.

Ballantine, J., Larres, P. M., & Oyelere, P. (2007). Computer usage and the validity of self-assessed computer competence among first year business students. *Computers & Education, 49*, 976-990.

Baloğlu, M., Abbassi, A., & Cevik, V. (2009). The predictors of success in computer

courses among high school students. *Psychological Reports, 104*(3), 725-736.

Barnard, A., Nash, R., & O'Brien, M. (2005). Information literacy: Developing lifelong skills through nursing education. *Journal of Nursing Education, 44*(11), 505-510.

Baromarajonani College of Nursing. (2009). *Bachelor of nursing science programme*. Retrieved December 2, 2010, from http://www.bcnc.ac.th/History/administer_bcnc1.php

Beckers, J. J., & Schmidt, H. G. (2003). Computer experience and computer anxiety. *Computers in Human Behavior, 19*, 785-797.

Bertalanffy, L. V. (1986). *General system theory: Foundations, development, applications*. New York: George Braziller.

Beyene, J., Sam, J., & Haynes, R. B. (2005). Effects of computerized clinical decision support systems on practitioner performance and patient outcomes: A systematic review. *The Journal of the American Medical Association, 293*(10), 1223-1238.

Bond, C. S. (2006). Nurses on the net. *Studies in Health Technology and Informatics, 122*, 211-214.

Bond, C. S. (2009). Nurses, computers and pre-registration education. *Nurse Education Today, 29*(7), 731-734.

Bloom, B. S. (Ed.). (1974). *Taxonomy of educational objectives*. New York: David McKay.

Borton, J. (2003). *Thailand's novel education policy.* Retrieved July, 27, 2010 from http://www.atimes.com/atimes/Southeast_Asia/EI24Ae03.html

Brown, T. A. (2006). *Confirmatory factor analysis for applied research.* New York : Guilford Press.

Bryson, D. M. (1991). The computer-literate nurse. *Computers in Nursing, 9*, 100-107.

Burger, A., & Blignaut, P. (2004). A computer literacy course may initially be detrimental to students' attitudes toward computers. *ACM International Conference Proceeding Series, 75*, 10-14.

Burns, N., & Grove, S. K. (2007). *Understanding nursing research: Building an evidence-based practice* (4th ed.). St. Louis, MO: Saunders Elsevier.

Cartwright, J. C., & Menkens, R. (2002). Student perspective on transitioning to new technologies for distance learning. *Computers, Informatics, Nursing, 20,* 143-149.

Carty, B., & Rosenfield, P. (1998). From computer technology to information technology: Findings from a national study of nursing informatics. *Computers in Nursing, 11*, 122-126.

Chaudhry, B., Wang, J., Wu, S., Maglione, M., Mojica, W., Roth, E., et al. (2006). Systematic review: Impact of health information technology on quality, efficiency, and costs of medical care. *Annals of Internal Medicine, 144*(10), 742-752.

Chen, D., & Stroup, W. (1993). General systems theory: Toward a conceptual framework for science and technology education for all. *Journal of Science Education and Technology, 2*(3), 447-459.

Chiangmai University. (2010). *About Chiangmai University*. Retrieved July, 27, 2010 from http://www.cmu.ac.th/about_eng.php?menu=50

Child, D. (2006). *The essentials of factor analysis* (3rd ed). New York: Continuum.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, N J.: Lawrence Erlbaum.

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

Cole, I. J., & Kelsey, A. (2003). Computer and information literacy in post-qualifying education. *Nurse Education in Practice, 4*, 190-199.

Cooper, C. (2010). *Individual differences and personality* (3rd ed). London: Hodder Education.

Cork, R. D., Detmer, W. M., & Friedman, C. P. (1998). Development and initial validation of an instrument to measure physicians' use of, knowledge about, and attitudes toward computers. *Journal of the American Medical Informatics Association, 5*(2), 164-176.

Corty, E. W. (2007). *Using and interpreting statistics: A practical text for the health behavioral and social sciences*. St. Louis, MO: Mosby.

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

Curran, C. R. (2003). Informatics competencies for nurse practitioners. *AACN Clinical Issues,*14(3), 320-30.

Curtis, E., Hicks, P., & Redmond, R. (2002). Nursing student's experience and attitudes to computers: A survey of a cohort of students on a bachelor in nursing studies course. *Information Technology in Nursing, 14*(2), 7-17.

Custodio, R., Gard, A. M., & Graham, G. (2009). Health information technology:

Addressing health disparity by improving quality, increasing access, and developing workforce. *Journal of Health Care for the Poor and Underserved, 20*, 301-307.

Daft, R. L., & Lane, P. (2010). *Management* (10th ed.). Mason, OH: South Western Cengage Learning.

Dambrot, F., Silling, S., & Zook, A. (1988). Psychology of computer use: Sex differences in the prediction of course grades in a computer language course. *Perceptual and Motor Skills*, *66*, 627-636.

Dee, C., & Stanley, E. E. (2005). Information-seeking behavior of nursing students and clinical nurses: Implications for health sciences librarians. *Journal of the Medical Library Association, 93*(2), 213-222.

Deltsidou, A., Gesouli- Voltyraki, E., Mastrogiannis, D., & Noula, M. (2010). Undergraduate nursing students' computer skills assessment: A study in Greece. *Health Science Journal, 4*(3), 182-188.

Demiris, G., & Zierler, B. (2010). Integrating problem-based learning in a nursing informatics curriculum. *Nurse Education Today, 30*, 175–179.

Dulong, D., & Gassert, C. (2008). Technology informatics guiding education reform: TIGER Phase 2: achieving the vision. *CIN: Computers, Informatics, Nursing, 26*(1), 59-61.

Elder, B. L., & Koehn, M. L. (2009). Assessment tool for nursing student computer competencies. *Nursing Education Perspectives, 30*(3), 148-152.

Fabrigar, L. R., Wegener, D. T., MacCallum, R. C., & Straham, E. J. (1999). Evaluating

the use of exploratory factor analysis in psychological research. *Psychological Methods,* 4: 272-299.

Faculty of Nursing. (2008). *Handbook for undergraduate students*. Chiangmai, Thailand: Chiangmai University.

Faculty of Nursing. (2009). *Manual for students: Undergraduate nursing program*. Chiangmai, Thailand: Chiangmai University.

Faculty of Nursing. (2010a). *About faculty of nursing*. Retrieved October, 2, 2010, from http://www.nurse.cmu.ac.th/webeng/faculty%20of%20nursing.htm

Faculty of Nursing. (2010b). *Nursing program.* Retrieved October, 2, 2010, from http://www.nurse.cmu.ac.th/webeng/programs.htm

Faculty of Nursing. (2010c). *Academic service: Nursing program*. Chiangmai, Thailand: Faculty of Nursing Chiangmai University.

Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). *G*Power 3: A flexible statistical power analysis program for the social behavioral, and biomedical sciences. *Behavioral Research Methods, 39*, 175-191.

Ferguson, E., & Cox, T. (1993). Exploratory factor analysis: A users' guide. I*nternational Journal of Selection and Assessment, 1*(2), 84-94.

Fetter, M. S. (2009a). Improving information technology competencies: Implications for psychiatric mental health nursing. *Issues in Mental Health Nursing, 30*(3), 3-13.

Fetter, M. S. (2009b). Curriculum strategies to improve baccalaureate nursing information technology outcomes. *Journal of Nursing Education, 48*(2): 78-85.

Field, A. (2005). *Discovering statistics using SPSS* (2nd ed.). London: SAGE.

Gupta, G. K. (2006). Computer literacy: Essential in today's computer-centric world. *The SIGCSE Bulletin, 38*(2), 115-119.

Gassert, C. A., & McDowell, D. (1995). Evaluating graduate and undergraduate nursing students' computer skills to determine the need to continue teaching computer literacy. *Medinfo, 8*, 1370.

Graveley, E. A., Lust, B. L., & Fullerton, J. T. (1999). Undergraduate computer literacy evaluation and intervention. *Computers in Nursing, 17*(4), 166-170.

Halamka, J. D. (2010). Making the most of federal health information technology regulations. *Health Affairs, 29*(4), 596-600.

Hanson, B. G. (1995). *General systems theory beginning with wholes.* Washington D.C.: Taylor & Francis.

Hardy, C., Heeler, P., & Brooks, D. (2006). Are high school graduates technologically ready for post-secondary education? *Journal of Computing Sciences in Colleges, 21*(4), 52-60.

Hebda, T., & Czar, P. (2009). *Handbook of informatics for nurses & health care professionals* (4th ed.). New Jersey: Pearson Prentice Hall.

Hillestad, R., Bigelow, J., Girosi, A. F., Meili, R., Scoville, R., & Taylor, R. (2005). Can electronic medical record systems transform health care? Potential health benefits, savings, and costs. *Health Affairs, 24*(5), 1103-1117.

Hilton, A., & Skrutkowski, M. (2002). Translating instruments into other languages: Development and testing processes. *Cancer Nursing, 25*(1), 1-7.

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

Hollander, S. (1999). Assessing and enhancing medical students' computer skills: A two-year experience. *Bulletin of the Medical Association Association, 87*(1), 67-73.

Honey, M. (2004). Flexible learning for post graduate nurses: A basis for planning. *Nurse Education Today, 24*(4), 319-325.

Hsiao, H. C., & Lin, Y. C. (2005). *Factors affecting computer literacy of college students in Taiwan*. Retrieved October, 2, 2010, from http://conference.nie.edu.sg/paper/Converted%20Pdf/ab00369.pdf

Hsu, H. M., Hou, Y. H., Chang, I. C., & Yen, D. C. (2009). Factors influencing computer literacy of Taiwan and South Korea nurses. *Journal of Medical Systems, 33*, 133-139.

Hsu, H. M., Hsiao, H. W., Huang, I. J., & Lin, I. C. (2006). Factors associated with computer literacy among nurses. *Studies in Health Technology and Informatics, 122*, 190-193.

Hulick, F., & Valentine, D. (2008). Computer competency of incoming college students: Yet more bad news. *Proceedings of the Information Systems Education Conference*, Phoenix, AZ, USA, 25, 1-7.

Hunley, S. A., Evans, J. H, Delgado-Hachey, M., Krise, J., Rich, T., & Schell, C. (2005). Adolescent computer use and academic achievement. *Adolescence, 40*(158), 307-318.

Inan, F. A., & Lowther, D. L. (2010). Factors affecting technology integration in K-12 classrooms: A path model. *Educational Technology Research and Development, 58*(2), 137-154.

Institute of Medicine. (2000). *To err is human: Building a safer health system*.

Washington, DC: National Academy Press.

Ivanitskaya, L., O'Boyle, I., & Casey, A. M. (2006). Health information literacy and competencies of information age students: results from the interactive online Research Readiness Self-Assessment (RRSA). *Journal of Medical Internet Research, 8*(2), e6.

Jacko, J., Sears, A., *&* Sorensen, S. J. (2001). Framework for usability: Healthcare professionals and the Internet, *Ergonomics*, *44*(11), 989-1007.

Jiang, W. W., Chen, W., & Chen, Y. C. (2004). Important computer competencies for the nursing profession. *The Journal of Nursing Research, 12*(3), 213-226.

Johnson, D. M., Ferguson, J. A., & Lester, M. L. (1999). Computer experiences, self-efficacy and knowledge of students enrolled in introductory university agriculture courses. *Journal of Agricultural Education, 40*(2), 28-37.

Johnson, D. M., Ferguson, J. A., & Lester, M. L. (2000). Students enrolled in selected upper-division agriculture courses: An examination of computer experiences, self-efficacy and knowledge. *Journal of Agricultural Education, 41*(4), 62-72.

Johnson, D. M., Ferguson, J. A., & Lester, M. L. (2001). Computer experiences, self-efficacy and knowledge of freshman and senior agriculture students. *Journal of Southern Agricultural Education Research, 51*(1), 304-315.

Joint Commission Resources. (2010). *Final rules supporting 'meaningful use' of electronic health records announced.* Retrieved November, 10, 2010 from http://www.jcrinc.com/Blog/2010/7/23/Final-Rules-Supporting-%E2%80%98Meaningful-Use%E2%80%99-of-Electronic-Health-Records-Announced/

Jones, R. (2009). The role of health kiosks in 2009: Literature and informant review. *International Journal of Environmental Research and Public Health, 6*, 1818-1855.

Kaewsaiha, T. (1999). *Learning technology: To reach the unreached in Thailand*. Bangkok, Thailand: Thai Education Commission.

Kay, R. H. (1993). A practical research tool for assessing ability to use computers: The computer ability survey (CAS). *Journal of Research on Computing in Education, 26*(1), 16-28.

Kenny, A. (2002). Online learning: Enhancing nurse education. *Journal of Advanced Nursing, 38*(2), 127-135.

Kijsanayotin, B., & Speedie, S. (2006). Are health centers in Thailand ready for health information technology? A national survey. *Annual Symposium Proceeding Archives: American Medical Informatics Association,* Washington DC, USA*,* 2006: 424-428.

Kim, J-O., & Mueller, C. W. (1978). *Factor analysis: Statistical methods and practical issues.* Beverley Hills, California: Sage.

Kirkley, D., Johnson, P., & Anderson, M. A. (2004). Technology support of nursing excellence: The magnet connection. *Nursing Economics, 22*(2), 94-98.

Kirshbaum, M. (2004). Are we ready for the electronic patient record? Attitudes and perceptions of staff from two NHS trust hospitals. *Health Informatics Journal, 10*(4). 265-276.

Kline, P. (1994). *An easy guide to factor analysis.* London: Routledge.

Ku, Y. L., Sheu, S., & Kuo, S. M. (2007). Efficacy of integrating information literacy

education into a woman's health course on information literacy for RN-BSN students. *Journal of Nursing Research, 15*(1), 67-76.

Kudyba, S. P. (Ed.). (2010). *Healthcare informatics: Improving efficiency and productivity***.** Boca Raton, FL: CRC Press.

Larres, P. M., Ballantine, J. A., & Whittington, M. (2003). Evaluating the validity of self-assessment: Measuring computer literacy among entry-level undergraduates within accounting degree programmes at two UK universities. *Accounting Education, 12*(2), 97-112.

Lee, A. S. (1999). Computer competencies of high school seniors in the state of Utah. *Dissertation Abstract International, 60*(4), 1090A. (UMI No. AAT 9926515). Retrieved September 5, 2010, from dissertations and theses database.

Liaw, S. (2002). An Internet survey for perceptions of computers and the World Wide Web: Relationship, prediction, and difference. *Computers in Human Behavior, 18*, 17-35.

Lin, J. S., Lin, K. C., Jiang, W. W., & Lee, T. T. (2007). An exploration of nursing informatics competency and satisfaction related to network education. *Journal of Nursing Research, 15*(1), 54-65.

Link, T. M., & Marz, R. (2006). Computer literacy and attitudes towards e-learning among first year medical students. *BMC Medical Education, 6*, 34.

Little, D. R., Zapp, J. A., Mullins, H. C., Zuckerman, A. E., Teasdale, S., & Johnson, K. B. (2003). Moving toward a United States strategic plan in primary care informatics: A white paper of the primary care informatics working group,

American Medical Informatics Association. *Informatics in Primary Care, 11*(2), 89-94.

Maag, M. M. (2006). Nursing students' attitudes toward technology: A national study. *Nurse Educator, 31*(3), 112-118.

Mahidol University. (2010). Bachelor of nursing science program. Retrieved October, 2, 2010, from http://www.ns.mahidol.ac.th/english/degrees_BNS_th_en.html

McBride, S. H., & Nagle, L. M. (1996). Attitudes toward computers: A test of construct validity. *Computer in Nursing, 14*(3), 164-170.

McCanne, L. (2004). The relationship among computer literacy, computer access, and achievement in high school students. *Dissertation Abstracts International, 65*(3), 901A. (UMI No. AAT 3124860). Retrieved September 5, 2010, from dissertations and theses database.

McCannon, M., & O'Neal, P. V. (2003). Results of a national survey indicating information technology skills needed by nurses at time of entry into the work force. *Journal of Nursing Education, 42*(8), 337-340.

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

McGonigle, D., & Mastrian, K. (2009). *Nursing informatics and the foundation of knowledge*. Boston: Jones and Bartlett Publishers.

McGonigle, D., & Mastrian, K. G. (Eds.). (2012). *Nursing informatics and the foundation of knowledge* (2nd ed.). Burlington, MA: Jones & Bartlett Learning.

McKee, T. (2007). Computer literacy of final year baccalaureate nursing students. *Dissertation Abstracts International, 46*(6), 144A. (UMI No. AAT MR38285). Retrieved September 5, 2010, from dissertations and theses database.

McNeil, B. J., & Sodom, S. K. (2000). Nursing informatics education in the United States: Proposed undergraduate curriculum. *Health Informatics Journal*, *6*(1), 32-38.

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

McNeil, B. J., Elfrink, V. L., Pierce, S., & Beyea, S. C. (2004). Preparing students nurses, faculty and clinicians for 21st informatics practice: Findings from a national survey of nursing education programs in the United States. *Studies in Health Technology and Informatics, 107,* 903-907.

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

Medicare Payment Advisory Commission (MEDPAC). (2004). *Report to the Congress: Information technology in health care.* Washington, DC: MedPAC.

Merritt, K., Smith, K. D., & Di Renzo, J. C. (2005). An investigation of self-reported computer literacy: Is it reliable? *Issues in information systems, 6*(1), 289-295.

Mertler, C. A. & Vannatta, R. A. (2005*). Advanced and multivariate statistical methods: Practical application and interpretation* (3rd ed.). Glendale, CA: Pyrczak.

Miller, J. C. (2009). *Computer science innovative in Thailand*. Proceedings of the fifth international workshop on computing education research workshop, International Computing Education Research Workshop, 63-74.

Miller, M. (2010). *Absolute beginner's guide to computer basics* (5th ed.). Indianapolis: Que.

Miller, R. H. (2005). The value of electronic health records in solo or small group practice. *Health Affair, 24*(5), 1127-1137.

Ministry of Education. (2008). *Indicators and core learning: Occupation and technology*. Bangkok, Thailand: Choomnoomsahagorngankaset Press.

Ministry of Public Health. (2008). *Action plan*. Retrieved October 20, 2010 from http://ict.moph.go.th/project/eva/51/%E0%B8%A7%E0%B8%B4%E0%B8%AA%E0%B8%B1%E0%B8%A2%E0%B8%97%E0%B8%B1%E0%B8%A8%E0%B8%99%E0%B9%8C%E0%B9%81%E0%B8%9C%E0%B8%99%E0%B8%9B%E0%B8%8F%E0%B8%B4%E0%B8%9A%E0%B8%B1%E0%B8%95%E0%B8%B4%E0%B8%A3%E0%B8%B2%E0%B8%8A%E0%B8%81%E0%B8%B2%E0%B8%A3%E0%B8%9B%E0%B8%B5%E0%B8%87%E0%B8%9A%E0%B8%9B%E0%B8%A3%E0%B8%B0%E0%B8%A1%E0%B8%B2%E0%B8%9351.pdf

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

Morewitz, S. J., Shaw, G. P., Clark, J., & Mullins, S. (2004). A survey of podiatric students' computer literacy. *Journal of the American Podiatric Medical Association, 94*(4), 375-381.

National Advisory Council on Nurse Education and Practice (NACNEP). (1997). *A*

national agenda for nursing education and practice. Rockville, MD: U.S. Department of Health and Human Services, Health Resources and Services Administration.

National League for Nursing. (2008a). *National League for Nursing issues call for faculty development and curricular initiatives in informatics*. Retrieved December 2, 2010, from http://www.nln.org/newsreleases/informatics_release_052908.htm

National League for Nursing. (2008b). *Preparing the next generation of nurse to practice a technology-rich environment: An informatics agenda*. Retrieved December 2, 2010, from http://www.nln.org/aboutnln/positionstatements/informatics_052808.pdf

National Statistical Office. (2011). *Summary of families' socioeconomic survey for the first 6 months of 2011*. Retrieved October, 2, 2011, from http://service.nso.go.th/nso/nsopublish/themes/files/socioSum54.pdf

Nkosi, Z. Z., Asah, F., & Pillay, P. (2011). Post-basic nursing students' access to and attitudes toward the use of information technology in practice: A descriptive analysis. *Journal of Nursing Management, 19*, 876-882.

Norton, B. (1998). Selecting learning experiences to achieve curriculum outcomes. In D. Billings & J. Halstead (Eds.), *Teaching in nursing: A guide to faculty* (pp. 151-178). Philadelphia: WB Saunders.

O'Connor, P. J., Crain, A. L., Rush, W. A., Sperl-Hillen, J. M., Gutenkauf, J. J., & Duncan, J. E. (2005). Impact of an electronic medical record on diabetes quality of care. *Annals of Family Medicine*, *3*(4), 300-306.

Office of the National Economic and Social Development Board. (2008). *National*

income of Thailand. Retrieved October, 1, 2010 from http://www.nesdb.go.th/Default.aspx?tabid=94

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

Prachusilpa, S. (2007). *Nursing informatics* (1st ed.). Bangkok: Chulalongkorn Press.

Pendleton, B. F., Schrop, S. L., Ritter, C., Kinion, E. S., McCord, G., Cray, J. J., et al. (2010). Underserved patients' choice of kiosk-based preventive health information. *Family Medicine, 42*(7), 488-495.

Pett, M. A., Lackey, N. R., & Sullivan, J.J. (2003). *Making sense of factor analysis: The use of factor analysis for instrument development in health care research*. Thousand Oaks, CA.: Sage.

Polasek, O., Mavrinac, M., Jovic, A., Boban, A. D., Biocina-Lukenda, D., Glivetic, T., Vasilj, I., & Petrovecki, M. (2010). Undergraduate grade point average is a poor predictor of scientific productivity later in career. *Collegium Antropologicum, 34*(1), 1-5.

Polit, D. F., & Beck, C. T. (2008). *Nursing research: Principles and methods* (7th ed.). Philadelphia: Lippincott.

Potosky, D., & Bobko, P. (1998). The computer understanding and experience scale: A self-report measure of computer experience. *Computers in Human Behavior, 14*(2), 337-348.

Prachusilpa, S. (2007). *Nursing informatics* (1st ed.). Bangkok, Thailand: Chulalongkorn Press.

Priselac, T. M. (2003). Information technology's role in improving practice environments

and patient safety. *Nursing Outlook, 51*(3), S11-S13.

Ragneskog, H., & Gerdnert, L. (2006). Competence in nursing informatics among nursing students and staff at a nursing institute in Sweden. *Health Information and Libraries Journal, 23*, 126-132.

Raja, E. E. J., Mahal, R., & Masih, V. B. (2004). An exploratory study to assess the computer knowledge, attitude and skill among nurses in health care setting of a selected hospital, Ludhiana, Punjab, India. *Studies in Health Technology and Informatics, 107*, 1304-1307.

Reilly, D. E., & Oermann, M. H. (1990). *Behavioral objectives: Evaluation in nursing* (3rd ed.). New York: National League for Nursing.

Rosenberg, R. S. (2004). *The social impact of computers* (3rd ed.). Amsterdam, Netherlands: Elsevier Academic Press.

Roy, C. (2008). *The Roy adaptation model* (3rd ed.). New Jersey: Pearson.

Rozell, E. J., & Gardner, W. L. (2000). Cognitive, motivation, and affective processes associated with computer-related performance: A path analysis. *Computers in Human Behavior, 16,* 199-222.

Saba, V. K. (2001). Nursing informatics: Yesterday, today and tomorrow. *International Nursing Review*, 48, 177-187.

Saba, V. K., & McCormick, K. A. (2006). *Essentials of nursing informatics* (4th ed.). New York: McGraw-Hill.

Saba, V. K., & Riley, J.B. (1997). A look at nursing informatics. *International Journal of Medical Informatics, 44*, 57-60.

Saparniene, D., Merkys, G., & Saparnis, G. (2005). Students' attitudes towards computer:

Statistical types and their relationship with computer: *The European Conference on Educational Research,* University College Dublin, Ireland. Retrieved from http://www.eric.ed.gov/

Saranto, K., & Leino-Kilpi, H. (1997). Computer literacy in nursing: Developing the information technology syllabus in nursing education. *Journal of Advanced Nursing, 25*(2), 377-385.

Scarpa, R., Smeltzer, S. C., & Jasion, B. (1992). Attitudes of nurses toward computerization: A replication. *Computers in Nursing, 10*(2), 72-80.

Shorten, A., Wallace, M. C., & Crookes, P. A. (2001). Developing information literacy: A key to evidence-based nursing. *International Nursing Review, 48*(2), 86-92.

Shute, V. J. (1992). *Learning processes and learning outcomes.* (Report No. AL-TP-1992-0015). Brooks Air Force Base, TX: Air Force Systems Command.

Smedley, A. (2005). The importance of informatics competencies in nursing: An Australian perspective. *CIN: Computer, Informatics, Nursing, 23*(2), 106-110.

Smith, B., Caputi, P., Crittenden, N., Jayasuriya, R., & Rawstorne, P. (1999). A review of computer experience. *Computers in Human Behavior, 15*, 227-242.

Staggers, N., Gassert, C. A., & Curran, C. (2001). Informatics competencies for nurses at four levels of practice. *Journal of Nursing Education, 40*(7), 303-316.

Stein, M., & Deese, D. (2004). Addressing the next decade of nursing challenges. *Nursing Economics, 22*(5), 273-279.

Stephan, P., Frederik, T., & Rein, D. (2009). Perceived computer literacy among different types of (under)graduate students: Findings of a survey. *Proceedings of ICERI 2009*, Madrid, Spain, 4910-4921.

Stromberg, A., Dahlstrom, U., & Fridlund, B. (2006). Computer-based education for patients with chronic heart failure: A randomized, controlled, multicentre trial of the effects on knowledge, compliance and quality of life. *Patient Education and Counseling, 64*, 128-135.

Suanpang, P. & Petocz, P. (2006). E-learning in Thailand: An analysis and case study. *International Journal on E-Learning, 5*(3), 415-438.

Swartz, N. (2004). A prescription for electronic health records. *The Information Management Journal, 38*, 20-26.

Sun, B. C., Knapp, H., Shamouelian, A., Golden, J., Goetz, M. B., & Asch, S. M. (2010). Effect of an education kiosk on patient knowledge about rapid HIV screening. *Journal of Telemedicine and Telecare, 16*(3), 158-161.

Taghavi, S. E. (2006). The effects of age, access to a computer, and college status on computer attitudes. *Journal of Information Technology Impact, 6*(1), 1-8.

Tai-Sheng, F., Yi-Ching, L., & Niess, M. (1998). Predicting academic achievement of college computer science majors. *Journal of Research on Computing in Education, 31*, 155-173.

Tang, P. C., & Lansky, D. (2005). The missing link: Bridging the patient-provider health information gap. *Health Affairs, 24*(5), 1281-1289.

Technology Informatics Guiding Educational Reform. (2007). *The TIGER initiative: Evidence and informatics transforming nursing 3-year action steps toward a 10-year vision.* Retrieved June 15, 2010 from http://www.tigersummit.com/uploads/TIGERInitiative_Report2007_Color.pdf

Technology Informatics Guiding Educational Reform. (2008*). The TIGER initiative:*

Collaborating to integrate evidence and informatics into nursing practice and education: An executive summary. Retrieved June 15, 2010 from http://www.tigersummit.com/uploads/TIGER_Collaborative_Exec_Summary_040509.pdf

Thomas, H. (2006). *Computers and productivity: How firms make a general purpose technology work.* Mannheim, Germany: Physica-Verlag.

Thuvasethkul, C., & Koanantakool, T. (2002). *National policy in Thailand*. Retrieved October 2, 2010, from http://www.nectec.or.th/users/htk/publish/20020302-National-ICT-Policy-v16-word.pdf

Tien, F. F., & Fu, T. T. (2006). The correlates of the digital divide and their impact on college student learning. *Computers & Education, 50*(1), 421-436.

van Braak J. (2004). Domains and determinants of university students' self-perceived computer competence. *Computers & Education 43*, 299-312.

Velleman, P., & Welsch, R. (1981). Efficient computing of regression diagnostics. *The American Statistician, 35*(4), 234-242.

Volrathongchai, K., Abbott, P., & Phuphaibul, R. (1999). Nursing informatics: Improving nursing in Thailand. *Rama Nurses Journal, 5*(3), 263-272.

Ward, R., Stevens, C., Brentnall, P., & Briddon, J. (2008). The attitudes of health care staff to information technology: A comprehensive review of the research literature. *Health Information and Libraries Journal, 25*(2), 81-97.

Weaver, C. A., Delaney, C. W., Weber, P., & Carr, R. L. (2006). *Nursing and informatics for the 21st century: An international look at practice, trends and the future*. Chicago: HIMSS.

Willmer, M. (2007). How nursing leadership and management interventions could facilitate the effective use of ICT by student nurses. *Journal of Nursing Management, 15*, 207-213.

Yaghmaie, F. (2007). Development of a scale for measuring user computer experience. *Journal of Research in Nursing, 12*(2), 185-190.

Yang, K. F., Yu, S., Lin, M. S., & Hsu, C. L. (2004). Study of basic competence among public health nurses in Taiwan. *The Journal of Nursing Research, 12*(1), 1-10.