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What is Your Informatics Skills Level? --The Reliability of an Informatics Competency Measurement Tool

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Abstract: To determine the reliability of the nursing informatics self- assessment tool which was developed and extended from Kaminski's assessment tool among health care students. It was hypothesized that there would be no significant difference in participant responses for a test/retest survey completed by nursing students.

INTRODUCTION

Effective use of technology among health care providers is critical to patient care quality (Havens, Vasey, Gittell, & Lin, 2010). Today, Registered Nurses (RNs) compose the largest professional group in the health care field, with approximately 2. 6 million of those were actively employed in 2009 in the USA (Bureau of Labor Statistics, 2009).One of the primary roles of RNs is communication that is facilitated through the use of technology. Technology facilitates the transfer of information among patients and health care providers that takes place every single day. Communication can be complicated and overwhelming to capture and process. According to Vawdrey, about 65,000 electronic documents were created and used among two medical center campuses within four months between November 2007 and February 2008 to communicate about patient care. Nurses contributed to approximately 33.3% of the electronic documents (Vawdrey, 2008). Therefore, it is crucial for nurses to have good technology skills to support communication. Good communications will not only improve the quality of care among each unit (Havens, Vasey, Gittell, & Lin, 2010), it will also reduce medical errors and improve patient safety (Dingley, Daugherty, Derieg, & Persing, 2008). The purpose of this study is to determine the reliability of nursing informatics self- assessment tool among health care students. It was hypothesized that there would be no significant difference in selection participant responses for a test/retest survey completed by nursing students.

Nursing communication occurs in many different forms such as oral, written, pictorial, video, and recorded speech (Communication in Nursing, 2003). Currently, communication processing is augmented by technologies such as clinical documentation systems, monitoring systems and others (Demiris, Oliver, & Wittenberg-Lyles, 2011). The transfer of communication (information) using clinical information systems requires certain technologic skills. For example, nurses are required to have the skills to access, locate, retrieve, process information so that the best decisions can be made to influence patient care and outcomes (Eley, Fallon, Soar, Buikstra, & Hegney, 2009).

Technologies are increasingly present in the workforce environment and used to facilitate communication. However, simply using technology without a demonstration of competency does not ensure that information is effectively captured, stored, used, and transferred, and this can impact patient outcome. These are some of the important components of communication. In order to provide effective communication and use of information among nurses and other health care providers, informatics competencies (use and processing of information) for nurses are crucial (Eley et al., 2009).

The nursing informatics competencies means that nurses have adequate computer literacy and information management skills (McGonigle & Mastrian, 2012). For example, knowing how to use e-mail, manage Windows applications, search databases, and the ability to operate institution specific nursing software used for charting and medication administration are all part of informatics competencies (Barton, 2005). However, not all nurses possess adequate skills. Patients' health outcomes are at risk when health care providers do not possess the technologic skills

required for work environment (Dufault et al., 2010). Additionally, due to the lack of informatics competencies, redundant assessments or laboratory exams frequently occur in healthcare. These redundancies increase the burden and cost for patients and healthcare providers. Furthermore, where nurses cannot transfer information or use information tools correctly, medical errors occur (Institute of Medicine, 2000). Therefore, it is extremely important to identify the nurses' informatics skills toward the technologies that facilitate information processing, communication and its exchange.

BACKGROUND

According to Ackoff, nursing informatics can be examined in terms of theory surrounding data, information, knowledge, and wisdom (1989). Nursing practice begins with the use of data. In our society, more often than not, we are using technology to capture the data.

Data must be contextualized in order to become information. Otherwise data have no value (Ackoff, 1989). For example, simply having a list of blood pressure readings has little value without knowing the larger contexts about when the blood pressures were taken and who these blood pressures belong to. Furthermore, nurses need to have the knowledge to understand and be able to use the information. Information without the knowledge to interpret it is not valuable and of little use. Technology can provide direct access to additional knowledge databases to support their practice and facilitate better decision making. Having wisdom is necessary to know when and how to use the knowledge and information (Graves & Corcoran, 1989). Additionally, wisdom depends on the access to data, information and knowledge. It is important for nurses to access and to have ability to use knowledge bases and technologies related to health care system in order to use information to perform the best patient care.

Technology is ubiquitous across health care facilities (Vawdrey, 2008). Some technologies record and transfer data from monitors to healthcare record, other times they assist health care providers in their efforts to administer medications safely (Wulff, Cummings, Marck &Yurtseven, 2011). The technologies used in the delivery of information are varied and are not limited simply to computers. Many technologies such as Mobile Internet Devices (Smartphone, Personal digital assistant), USB device, and flash drive are frequently used in health care and require the user to have additional skills to use them (Sewell & Thede, 2010).

In 1988, a Commission of Nursing was created by the Secretary of Health and Human Services. The commission supported the use of the computers to improve efficiency for nurses. As a result of multiple efforts, there is an increase of presence and the use of computers in health care (Sewell & Thede, 2010). Nurses believe technologies can reduce burden related to the workflows of documentation, medication administration, and securing equipment and supplies (Bolton, Gassert, & Cipriano, 2008). Some nurses believe using technologies can save their time compare with using paper documentations (Bolton et al., 2008). Therefore nurses could use the time been saved to provide more direct patient care. Some nurses believe that the use of technologies can effectively decrease their workload, and enhance communication (Bolton et al., 2008). Along with the use of information and computer technologies by the nurses, the term "nursing informatics" was developed. The term "nurse informatics" was first used in the MED-INFO conference in Tokyo by Scholes and Barber in 1980 (Sewell & Thede, 2010).

In 1992, American Nurses Association (ANA) identified nursing informatics as a subspecialty of nursing (Sewell & Thede, 2010). Before the creation of the subspecialty, many nurses entered the nursing informatics field without any formal training. They practiced their skills and knowledge during the time of work. Now, this subspecialty is formally recognized via experienced education, and examination, communicating in board certification (McGonigle & Mastrian, 2012). The additional education improves the quality of nursing informatics and prepares nurses to be successful in their positions (McGonigle & Mastrian, 2012).

What Nursing Informatics is and Why it is Important to Nurses

The term "nursing informatics" means much more than its literal translation: "nursing" and "information". According to the definition provided by American Nursing Association, nursing informatics is "a specialty that integrates nursing science, computer science, and information science to manage and communicate data, information, knowledge, and wisdom in nursing practice." (American Nursing Association, 2008).

Nursing informatics incorporates information technologies with the skills of nurses in health care. It consists of using computer and information technologies, users, and information used during practice (Sewell & Thede, 2010). Nursing informatics also involves cognitive science, which focuses on the design of technologies and

the way nurses think and use technologies. It includes mind, intelligence, and behavior from information development perspective (McGonigle & Mastrian, 2012). Cognitive science helps bridge the gap between modern technologies and clinical practice (Falan & Han, 2011). For example, cognitive science is used to make sure that system and its components can be used and organized in a way that is useful to nurses. It uses modern technologies to help store and provide informations to assist nurses with decision-making (McGonigle & Mastrian, 2012).

For nurses, informatics competency means that certain skills in the use of technology and information management are evident. Most nurses use information technologies in the performance of their daily work (American Nurse Association, 2008). Nursing informatics competencies play a significant role in the use of technology to improve health care delivery from the aspects of quality, efficiency, and safety on a daily bases (Falan & Han, 2011). For instance, nurses perform activities using Health Information Technologies. They review and update nursing care plans and medications on the Electronic Health Record (EHR) every day (Demiris, Oliver & Wittenberg-Lyles, 2011). Competent use of technology impacts many areas of health care delivery from patient assessment to clinical documentation (Warm & Thomas, 2011). By using technologies, accessing patient information can become faster and easier (Bolton, Gassert, & Cipriano, 2008). Additionally, nurses use technologies to conduct research and education. It can help nurses to perform the highest possible quality patient care (American Nurse Association, 2008). Understanding the importance of nursing informatics skills will allow the patients to receive the best possible care (Warm & Thomas, 2011).

Nursing informatics skills are recognized as essential for nursing practice in multiple official documentations including Technology Informatics Guiding Education Reform (TIGER) and *The Essentials of Baccalaureate Education for Professional Nursing Practice* (American Association of Colleges of Nursing, 2008).

Technology Informatics Guiding Education Reform (TIGER) is an organization to enable nurses to use informatics tools to make health care more effective and safer in the future. It recommends that all the practicing nurses and graduating nursing students develop skills related to nursing informatics including concepts of information and communication technology, using the computer and managing files, word processing, spreadsheets, using databases, presentation, web browsing and communication (Technology Informatics Guiding Education Reform, 2009).

The Essentials of Baccalaureate Education for Professional Nursing Practice provides curricular elements and frameworks in order to assist with nursing education directions, recommends informatics competencies as necessary (American Association of Colleges of Nursing, 2008). According to the document, "Graduates must have basic competence in technical skills, which includes the use of computers, as well as the application of patient care technologies such as monitors, data gathering devices, and other technological supports for patient care interventions" (American Association of Colleges of Nursing, 2008, p. 17).

Tools to Measure Informatics Competencies

There are different informatics competencies assessment tools including Staggers' four level measurement tool (Staggers, Gassert, & Curran, 2002), Kaminski's self assessment tool (Nursing-informatics.com, 2010-2012) and Schleyer, Burch and Schoessler's five level measurement tool (Schleyer, Burch & Schoessler, 2011), and other assessment tools developed by TIGER (Technology Informatics Guiding Education Reform, 2009), Public Healthcare (O'Carroll, Yasnoff, Ward, Ripp & Martin, 2002), and AACN (American Association of College of Nursing, 2008) (See similarities and differences in Appendix A).

Staggers et al (2002) developed a four level measurement tool (Beginning Nurse, Experienced Nurse, Informatics Specialist, and Informatics Innovator) to classify nursing informatics competencies according to nurses' ability of manipulate different technologies and information input. The competencies for first level, beginning nurses, are basic computer skills such as the ability to search for patient, access data, and documentation. Informatics Specialists which categorized as level three need to have a higher level of computer skills. For example, informatics specialists need to know how to manage projects with project management software (Staggers et al., 2002).

Kaminski created a self assessment tool to help assess nurses' informatics competencies levels that are further subcategorized to 3 groups: Technical competency, Utility competency, and Leadership competency (Nursing-informatics.com, 2010-2012). Under each of the category, Kaminski identified different skills. For example, under technical competency, Kaminski named 17 computer applications such as word processing, keyboarding, and spreadsheets (Nursing-informatics.com, 2010-2012).

Schleyer, Burch and Schoessler (2011) divide nurses into five categories: novice, advanced beginner, competent, Proficient and expert. Each category consists of informatics competencies that nurses should be able to

perform during practice (Schleyer, Burch & Schoessler, 2011). This five level measurement tool was integrated with Stagger's four level measurement tool with ANA's 2001 Scope and Standards of Nursing Informatics Practice (Schleyer et al., 2011).

TIGER (2009) developed a Nursing Informatics Competencies Model which includes three components: basic computer competencies, information literacy, and information management. TIGER has identified a set of competencies for each component. The competencies were maintained by standard development organizations and evaluated by certain standards. For instance, the standard setting organization for Information Literacy component was American Library Association. Five recommendations under information literacy were made. For example, the first recommendation was that all practicing nurses and gradating nursing students need to have the ability to determine the nature and extent of the information needed (Technology Informatics Guiding Education Reform, 2009).

O'Carroll and the Public health informatics competencies working group (2002) developed a conceptual framework for public healthcare members. Three general classes of public health informatics competencies were mentioned including the use of information, the use of information technology, and development, deployment, and maintenance of information systems (O'Carroll et al., 2002).

AACN (American Association of Colleges of Nursing) emphasizes that nurses have the competences in technical skills, includes the use of computers, the application of patient care technologies such as monitors, data gathering devices, and other technological supports for patient care interventions (American Association of College of Nursing, 2008).

However, the tools they are using to determine informatics skills are either measured by yes or no questions (Staggers et al., 2002), (Nursing-informatics.com, 2010-2012), (Schleyer et al., 2011), or simply name the competencies that nurses need to have (Technology Informatics Guiding Education Reform, 2009), (O'Carroll et al., 2002), (American Association of College of Nursing, 2008). Nurses or nursing students may have difficulties to assess their nursing informatics competencies or cannot determine which part of informatics competencies they need to improve.

METHODS

This study examined the responses of students with different levels of education to determine their self-reported informatics competencies using a repeated measures design. Their responses were classified to five levels of proficiency; no experience, beginner, competent, proficient, and expert as used by Benner (1982). The next section discusses the preliminary work for the study, its design sample selection, measurement tools, and procedures for data collection and analysis.

Preliminary work

A great deal of literature exists on the importance of informatics competencies (Eley et al., 2009; Dufault et al., 2010; Institute of Medicine, 2000). In fact as previously discussed, several different authors have expressed multiple approaches to understanding informatics (Nursing-informatics.com, 2010-2012; Staggers et al., 2002; Schleyer et al., 2011; Technology Informatics Guiding Education Reform, 2009; Essentials of baccalaureate education for professional nursing practice, 2008; O'Carroll et al., 2002). The assessment tools, however, are inconsistent and somewhat vague. Kaminski has demonstrated the greatest depth in developing a self-reported informatics competency dichotomous (yes or no) list of skills. After conversation with Kaminski and permission to use her tool for this preliminary study, Falan (Personal Communication, 2010) modified the scale from a dichotomous scale to a five level scale as addressed above. This study is a preliminary report of the findings using this tool to help gain a better understanding of students' perceived informatics knowledge.

After Institutional Review Board approval for the study was secured, the survey was given to students in health care curriculum as part of an assignment. Each student had the option to allow the results to be used for research. Those who did not want their responses used for research were removed by a graduate student. All students received course credit for completing the survey regardless of their desire to allow the responses to be used for research. The purpose of the survey was explained to the students and any questions students had about the survey were answered. A link to the survey was made available to 25 students in Informatics course that was open to all students in the university. The survey was completed electronically at the beginning of the course and again 2

weeks later. The survey consisted of five sessions. First section introduced how many questions the survey included, how long the survey takes and the confidentiality of the survey. Second section included background questions such as gender, race and how long have been practicing as a nurse. The third, fourth and fifth sections evaluated technical competencies, including user level, modifier level and innovator level competencies.

Sample and Criteria

The sample size was 25 students in nursing school. A convenience sample was used in this study. The education level of the sample population was students in an informatics course at Western Michigan University. Each participant was enrolled in the informatics course and no restrictions on age, gender, or ethnicity were used. Any student in the course was given the opportunity to complete the survey.Students were excluded from the study if they were not currently enrolled in the informatics course at Western Michigan University.

Recruitment

All students were required to complete the survey as part of a course assignment and were informed via the syllabus and grading criteria. Students were not required to share their responses for research. The professor of the course was not aware of which students allowed permission to use their responses for research. This was controlled by the graduate assistant. The graduate assistant recorded course grades for completed surveys, removed names from all surveys and deleted responses from those who did not wish to have their responses used for research. This is a pilot study.

RESULTS

The survey was completed by a total of 25 participants. All participants completed the same survey twice. 22 (78%) of them were females. One person (4%) was black and 24 people (96%) were white. All 25 subjects chose 'Not Hispanic or Latino' as their ethnicity. The mean age was 25.8 with oldest 45 and youngest 20. Among the participants, 44% (N = 11) identified themselves as 'juniors'. 13 of them (52%) were seniors and 1 person (4%) was a graduate student. Two students (8%) were not in nursing program but currently in another program. More details please see Table 2 and Table 3.

Years in nursing program	Number of students	Percentage
Not in nursing, currently in another program	2	8%
1 year	2	8%
2 years	9	36%
3 years	10	40%
4 years	2	8%
5 or more years	0	0%
Total	25	100%

Table 2. Number of people and percentage based on years in nursing program

Highest academic degree	Number of students	Percentage
No degree	16	64%
Associate's	4	16%
Bachelor's	4	16%
Master's	1	4%
Total	25	100%

Table 3. Number of people and percentage based on their highest academic degree

During the data analysis, a total of four values were found missing in the data after data cleansing. The missed values were filled with the mode of other 24 values within the same category. For example, in question 15: uses computer applications to document client care, subject 17 had a missing value in the second survey. The other 24 subjects' responses were analyzed and the mode was used to fill in the missing value.

T-test analyzing method was used to compare the results of test reference. The responses of the repeated measures were compared for each subject. In order to determine the stability of the tool, it was hypothesized that there would be not change from time 1 versus time 2 in the subject responses.

Among the 14 questions of the section 'overall experience', besides presentation graphics p value = 0.016, expert data systems p value = 0.022, telecommunication devices p value = 0.10, nursing information systems p value = 0.50, p values of other competencies are all bigger than 0.05 which means the results were not significant different among those questions (Table 4). Among the 43 competencies of the section 'technical competencies', 26 of them had a p value that was bigger than 0.05 which means the results were not significant different. 17 of them had a p value that was less than 0.05. One was less than 0.01 (Table 5). Among the 23 competencies of the section 'modifier level competencies', 15 of them had a p value that was bigger than 0.05. Three of them had a p value that was less than 0.01. (Table 6). In the section "Innovator level competencies", 19 out of 24 questions had a p value that was bigger than 0.05, two of them were less than 0.01 (Table 7).

Competency	**t**	**p**
Word Processing	-.527	.603
Keyboarding	.272	.788
Spreadsheets	-.811	.425
Presentation Graphics	-2.585	**.016***
Databases (simple to complex)	-1.809	.083
Desktop Publishing	-1.661	.110
World Wide Web	.527	.603
E-mail programs	-1.000	.327
Expert data systems	-2.449	**.022***
Multimedia	-1.809	.083
Telecommunication devices	-2.791	**.010****
Nursing Information Systems	-2.064	.050
Hospital Information Systems	-1.599	.123
Peripherals (printers, CD-ROMS, DVD)	1.072	.294

These competencies are an expansion of Kaminski's Self Assessment tool (Nursing-informatics.com, 2010-2012).
** Significant at .05 confidence interval **Significant at .01 confidence interval*

Table 4. ***Paired t-test survey results N = 25***

	t	***p***
uses word processing applications	-1.541	.136
demonstrates keyboarding skills	-1.549	.134
uses spreadsheet applications	-1.414	.170
uses telecommunication devices to communicate with other systems	-1.953	.063
uses e-mail systems to communicate with other health care professionals	.176	.862
uses presentation applications to create slides, displays, overheads	-1.769	.090
uses multimedia presentations	-2.400	**.024***
uses internet resources to locate client support groups, online resources	-1.681	.106
uses sources of data that relate to nursing practice and care	-1.365	.185
accesses, enters and retrieves data related to client care via available hospital or nursing information systems	.253	.802
uses database management programs to develop and access databases and tables	-1.000	.327
uses database applications to enter and retrieve data and information	-.618	.543
conducts online and database literature searches	-1.297	.207
uses decision support systems, expert systems and other aids for clinical decision	-.647	.524
uses computer applications to document client care	-1.549	.134
uses computer applications to plan client care, including discharge planning	-1.541	.136
uses computer applications to enter client data (demographic, vital signs,	-.901	.376
uses information management systems for client education	-1.072	.294
uses technology based client monitoring systems	-2.064	.050
operates peripheral devices (bedside and hand held)	-.926	.364
uses operating systems	-2.493	**.020***
uses computer peripheral devices (CD ROMs, DVD, zip drives)	-1.619	.119
uses computer technology safely	-2.388	**.025***
navigates in Windows environment effectively	-1.769	.090
demonstrates basic technology skills (load paper, change toner, unjam printers, print)	-1.769	0.090
applies technology support to provide evidenced based practice	-1.809	.083
synthesizes data from more than one source and applies to practice	-1.769	.090
demonstrates awareness of and ability to access data and information from multiple sources	-2.377	**.026***
uses decision support systems in practice	1.163	.256
accesses pertinent literature resources and incorporates into practice and professional development	-1.225	.233
creates and accesses research and other documents electronically	-1.155	.260
participates in the design and development of information systems for nursing practice	-1.549	.134
develops inventive ways to access data and interact with information systems	-2.138	**.043***
participates in the design and develop design and development of new applications	-1.445	.161
participates in developing new methods for data and information organization	-2.221	**.036***
collaborates with information technology consultants and other members of information system development team	-.253	.802
collaborates, negotiates with and directs information technology vendors	-1.365	.185
proficiency in diverse computer application programs	.000	1.000
manipulates and enhances nursing data sets	-1.732	.096
organizes and directs applications of shared data sets	-.901	.376
develops data gathering tools and processes for literature search access for nurses	-2.551	**.018***
develop charting and documentation templates for use in nursing practice	-1.769	.090
design and development of evidenced based practice documentation and processing within practice area	-2.823	**.009****

Expansion of Kaminski's Self Assessment tool (Nursing-informatics.com, 2010-2012).

* Significant at .05 confidence interval **Significant at .01 confidence interval

Table 5. ***Paired t-test survey results N = 25***

Competency	***t***	***p***
applies technology support to provide evidenced based practice	-1.809	.083
synthesizes data from more than one source and applies to practice	-1.659	.110
demonstrates awareness of and ability to access data and information from multiple sources	-.618	.543
uses decision support systems in practice	.000	1.000
accesses pertinent literature resources and incorporates into practice and professional	-.827	.417
creates and accesses research and other documents electronically	-.972	.341
understands basic and complex concepts and processes of various computer systems and how they relate to practice	-2.092	**.047***
accesses and utilizes multiple information sources for gathering evidence for clinical decision	-4.243	.000
upholds ethical standards related to data security, confidentiality and clients' right to privacy	-.204	.840
evaluates internet based nursing and health materials for quality, accountability, reliability and	-1.541	.136
coordinate information flow with multidisciplinary team using information systems	-.768	.450
analyzes patient information needs, accesses technology resources to meet needs and evaluate	-1.155	.260
awareness of role of nursing informatics in the context of health informatics and information	-4.042	**.000****
participates in policy and procedural development related to nursing informatics	-2.138	**.043***
participates in system change processes and utility analysis	-2.221	**.036***
participates in evaluation of information systems in practice settings	-1.661	.110
analyzes ergonomic integrity of work station, bed side and portable technology apparatus in	-2.193	**.038***
articipates in design of data collection tools for practice decision making and record keeping	-1.541	.136
participates in quality management initiatives related to patient and nursing data in practice	-2.982	**.006****
awareness of the impact of implementing technology to facilitate nursing practice	-2.138	**.043***
evaluates security effectiveness and parameters of system for protecting client information and ensuring confidentiality	-1.297	.207
participates in change to improve the use of informatics within nursing practice	-1.899	.070
encourages other nurses to develop comfort and competency in technology use in practice	-1.549	.134

These competencies are an expansion of Kaminski's Self Assessment tool (Nursing-informatics.com, 2010-2012)

* Significant at .05 confidence interval **Significant at .01 confidence interval

Table 6. ***Paired t-test survey results N = 25***

Competency	***t***	***p***
participates in the design and development of information systems for nursing practice	-2.064	.050
develops inventive ways to access data and interact with information systems	-1.163	.256
participates in the design and develop design and development of new applications for nursing	-1.281	.212
participates in developing new methods for data and information organization	-1.163	.256
collaborates with information technology consultants and other members of information system development team	-.000	1.000
collaborates, negotiates with and directs information technology vendors	-1.445	.161
proficiency in diverse computer application programs	-1.809	.083
manipulates and enhances nursing data sets	-1.414	.170
organizes and directs applications of shared data sets	-.253	.802
develops data gathering tools and processes for literature search access for nurses	-1.281	.212
develop charting and documentation templates for use in nursing practice	-2.281	**.032***
design and development of evidenced based practice documentation and processing within	-1.549	.134
participates in needs assessment, system selection, implementation and maintenance of information systems for practice	-.327	.746
ensures inclusion of nursing data and information in design of planned information systems	-2.281	**.032***
recognizes factors and issues related to human - computer interface interactions	-1.899	.070
independently seeks learning initiatives to stay abreast of technological developments	-1.899	.070
synthesizes data and information for knowledge generation within practice	-3.381	**.002****
understands and helps to determine data structures used to organize patient information	-2.874	**.008****
develops and participates in quality assurance programs using information systems	-1.809	.083
participates in patient instructional program development	-2.000	.057
participates in ergonomic design of work stations, bed side access stations and portable appartus	-1.281	.212
awareness of societal and technological trends, issues and new developments and applies these	-.625	.538
demonstrates proficient awareness of legal and ethical issues related to client data, information,	-1.661	.110
design and implement project management initiatives related to information technology for	-.569	.574

Expansion of Kaminski's Self Assessment tool (Nursing-informatics.com, 2010-2012).
* Significant at .05 confidence interval **Significant at .01 confidence interval

Table 7. ***Paired t-test survey results N = 25***

DISCUSSIONS

For competencies with p values bigger than 0.05, the results were not significantly different. It means these questions were answered constantly reliable. For competencies with p values significantly different ($p<0.05$), the means for the test/retest responses were analyzed. Results showed that for the same question, the means of the retest survey was higher than the means of the first test (Table 8). However, the values did not jump into other categories very much. The lowest level of the Likert scale as 'no experience' was given 1 point and the highest level as 'expert' was given 5 point (as mentioned in section II Method). For instance, on competency 'Presentation graphics', the mean of the first time of survey taken was 2.68, and the mean for the second time of survey taken was 2.96 and it was still falling into the 2-3 interval. This showed the reliability of the surveys as well.

Competency	**Mean for first time of survey taken**	**Mean for second time of survey**
Presentation graphics	2.68	2.96
Expert data systems	1.88	2.28
Telecommunication devices	2.40	2.96
Uses multimedia presentations	2.68	3.12
Uses operating systems	2.16	2.64
Uses computer technology safety	3.24	3.72
Demonstrates awareness of and ability to access data and information from multiple sources	2.68	3.04
Develops inventive ways to access data and interact with information systems	1.36	1.68
Participates in developing new methods for data and information organization	1.28	1.64
Develops data gathering tools and processes for literature search access for nurses	1.32	1.64
Design and development of evidenced based practice documentation and processing within	1.32	1.68*
Understands basic and complex concepts and processes of various computer systems and how they relate to practice	2.08	2.44
Accesses and utilizes multiple information sources for gathering evidence for clinical	1.92	2.52*
Awareness of role of nursing informatics in the context of health informatics and	2.08	2.80*
Participates in policy and procedural development related to nursing informatics	1.48	1.80
Participates in system change processes and utility analysis	1.44	1.80
Analyzes ergonomic integrity of work station, bed side and portable technology apparatus in	1.64	2.08
Participates in quality management initiatives related to patient and nursing data in practice	1.52	2.04*
Awareness of the impact of implementing technology to facilitate nursing practice	2.32	2.64
Develop charting and documentation templates for use in nursing practice	1.36	1.64
Ensures inclusion of nursing data and information in design of planned information systems	1.40	1.68
Synthesizes data and information for knowledge generation within practice	1.72	2.16*
Understands and helps to determine data structures used to organize patient information	1.60	1.92*

Expansion of Kaminski's Self Assessment tool (Nursing-informatics.com, 2010-2012).
*: p value < 0.01

Table 8. ***Mean results for competencies with p<0.05 (N=25)***

Several factors can contribute to the significant p values. One of the reasons was that students were still in college while the survey was taken. Learning may still take place during the two week interval. For instance, for competency presentation graphics, students might have learned more skills related to presentation graphics during the test/retest period. The results may be affected by the learning process.

Also after taking the survey, the students might actually pay more attention to the competencies that they were not familiar or never realized before. For example, as a student, s/he might not be aware what "expert data systems" are or whether they have this competency or not. The student might look for answers after s/he first time of taking the survey and gave a more informed answer at his or her second time of taking the survey.

Another reason was possibly because students might realize they actually have more knowledge about certain competencies comparing with how much they think they do after their first exposure to the survey. They might change the answers for their retest.

In order to control the influences on dependent variables, a shorter interval period between the test/retest period could be suggested. For example, students could take the survey one week or three days apart instead of two weeks. Before taking the survey, the students might be able to ask questions pertaining to the competencies the survey mentioned. A broader number of students could also be conducted in this research in order to have a more accurate result.

The means for each section of the survey were also being analyzed for the purpose of being able to see where students' competencies levels fall into (Table 9). Most of the means fall into the 1 to 2 range which were "no experience" and "beginner" (with the exception of user level competencies in the second time of survey taken which was 3.04). This showed that the skill levels fell on the lower side of the scale but they were essentially stable. The table also shows where the educators could focus on during their nursing informatics competency education due to

certain mean values were smaller than others. For instance, the mean values for innovator level competencies were 1.43 and 1.64 which is smaller than other values.

Competency	**Mean for first time of survey taken**	**Mean for second time of survey taken**
Experience	2.82	2.65
User level competencies	2.83	3.04
Modifier level competencies	2.41	2.59
Innovator level competencies	1.43	1.64
Modifier level technical competencies	2.20	2.36
Modifier level utility competencies	2.25	2.51
Modifier level leadership competencies	1.69	2.05
Innovator level technical competencies	1.39	1.56
Innovator level utility competencies	1.68	1.95
Innovator level leadership competencies	1.67	1.83

These competencies are an expansion of Kaminski's Self Assessment tool (Nursing-informatics.com, 2010-2012).

Table 9. ***Mean results for each section (N=25)***

CONCLUSION

Nursing informatics competencies for nurses has become crucial due to the increasing present of technologies in the workforce environment. Inefficient informatics competencies affect nurses' ability of performing optimum health care. This paper conducted the analyzing of a newer developed nursing informatics assessment tool which further expanded from Kaminski's self assessment tool. The study showed the tool was basically reliable. Recommendations related to the study were a one week or three days interval period between the test/retest, which may decrease variability in its means. Also a broader number of students are suggested in this research.

APPENDIX A

Competencies	**similarities**	**Differences**
Communication	Nurses need to know how to communicate and exchange information with each other and how to use technologies to communicate.	Kaminski (Nursing-informatics.com, 2010-2012): Technical competencies Staggers et al (2002): more specific computer skills- **email, internet, telecommunications** • Uses telecommunication devices (e.g., modems or other devices) to communicate with other systems (e.g., access data, upload, download). • Use e-mail (e.g., create, send, respond, use attachments). • Uses the Internet to locate, download items of interest (e.g., patient, nursing resources)**.**
Computer skills	Nurses need to have basic computer skills in order to successfully administer, communicate, and document information.	Kaminski (Nursing-informatics.com, 2010-2012): named specific skills: Word processing, Keyboarding, Spreadsheets, Presentation Graphics, Databases (simple to complex), Desktop Publishing, World Wide Web, E-mail programs, Blogs, Wikis, Social Media, Expert data systems,. Multimedia, Telecommunication devices , Nursing information systems , Hospital information systems, Periphereals (printers, CD-ROMS, DVDs, Mp3s), Palmtops, ipods, ipads Staggers et al (2002):

		named specific knowledge according to different level but didn't identify what skills nurses need to have in order to manipulate these process: • Beginning nurse: administration, communication, data access, documentation, education, monitoring, basic desktop software, systems. • Experienced nurse: administration, communication, data access, monitoring, quality improvement, research. • Informatics specialist: basic desktop software, project management, quality improvement, systems. • Informatics innovator: Simulation. Schleyer, Burch, & Schoessler (2011): Named some examples but didn't list all the skills, more vague: computer literacy skills (included the psychomotor use of the tools (e.g., keyboarding) TIGER (2009): generally identified: Concepts of information and communication technology. Using the computer and managing files. Word processing. Spreadsheets. Using databases. Presentation.web browsing and communication. Public healthcare (O'Carroll, Yasnoff, Ward, Ripp & Martin, 2002): generally identified: Competencies related to the **use of information technology** to increase one's *individual effectiveness* as a public health professional. AACN (Essentials of baccalaureate education for professional nursing practice, 2008): More detailed comparing with TIGER and Public healthcare: competence in technical skills, includes the use of computers, the application of patient care technologies such as monitors, data gathering devices, and other technological supports for patient care interventions. Have competence in the use of information technology systems, including decision-support systems, to gather evidence to guide practice.
Information literacy	Nurses need to recognize when and what information is needed, conduct with critical thinking skills and evidence based practice.	Kaminski (Nursing-informatics.com, 2010-2012): named specific nursing informatics competencies: process of applying evidenced based practice, critical thinking, accountability in the use of selected applications. Staggers et al (2002): named specific knowledge according to different level but didn't identify what skills nurses need to have in order to manipulate these process:. • Beginning nurse: Informatics knowledge: data, impact, privacy/security, systems. • Experienced nurse: Informatics knowledge: data, research, impact, privacy/security, systems. • Informatics specialist: Informatics knowledge: data, education, impact, privacy/security, regulations, systems, usability. • Informatics innovator: Informatics knowledge: education, impact. Schleyer, Burch, & Schoessler (2011)/TIGER (2009)/ Public healthcare (O'Carroll, Yasnoff, Ward, Ripp & Martin, 2002): More generalized: ability to recognize when information is needed and to retrieve, evaluate, and use it appropriately
Information management	Nurses need to use information appropriately applying with accountability. Informatics	Kaminski (Nursing-informatics.com, 2010-2012): named specific informatics competencies: process of applying accountability, client privacy and confidentiality and quality assurance in documentation in the use of selected applications in a comfortable and knowledgeable way Staggers et al (2002): named specific knowledge according to different level

	specialists need to know how the information systems are programmed, maintained, and designed.	but didn't identify what skills nurses need to have in order to manipulate these process: • Experienced nurse: Informatics skills: evaluation, role, system maintenance. • Informatics specialist: Informatics skills: analysis, data/data structures, design, development, evaluation, fiscal management, implementation, management, privacy/security, programming, requirements, role, system, maintenance, system selection, testing, training. • Informatics innovator: Informatics skills: analysis, design, development, evaluation, fiscal management, management. Schleyer, Burch, & Schoessler (2011): Named some examples but didn't list all the skills, more vague: Information management skills were multifaceted, including (but not limited to) applying the data to wisdom concept continuum to support clinical decision making and tell the patient's story; ensuring data integrity, confidentiality, and security; articulating the value of information systems and their links to improved quality, financial, and satisfaction outcomes; and mentoring peers in their acquisition of higher levels of informatics skill acquisition. TIGER (2009): generally covered: A process of 1) collecting data, 2) processing the data, 3) presenting and communicating the processed data as information or knowledge. (datainformation-knowledge continuum). Managed through information systems. Public healthcare (O'Carroll, Yasnoff, Ward, Ripp & Martin, 2002): generally covered: Competencies related to the **development, deployment, and maintenance of information systems** to improve the *effectiveness of the public health enterprise* (e.g., the state or local health department) AACN (Essentials of baccalaureate education for professional nursing practice, 2008): more specific, named skills nurses need to have: information management for patient safety, regulatory requirements through electronic data monitoring systems, ethical and legal issues related to the use of information technology, including copyright, privacy, and confidentiality issues, retrieval information systems, including access, evaluation of data, and application of relevant data to patient care, online literature searches, technological resources for evidence-based practice, web-based learning and online literature searches for self and patient care, technology and information systems safeguards (patient monitoring, equipment, patient identification systems, drug alerts and IV systems, and barcoding), interstate practice regulations (licensure, telehealth), technology for virtual care delivery and monitoring, principles related to nursing workload measurement/resources and information systems, information literacy, electronic health record/physician order entry, decision support tools

Table 1: ***Informatics competencies similarities and differences.***

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