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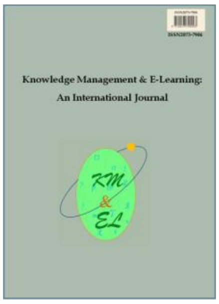

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Evaluation of an informatics educational intervention to enhance informatics competence among baccalaureate nursing students

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Abstract: Concerns around quality of care and patient safety have been key drivers behind the increased interest in improving informatics competencies among health care providers. The purpose of this study was to develop an informatics educational intervention for baccalaureate nursing students and compare outcomes associated with vodcasting and face-to-face methods for delivering this material. Following a pilot test, we used a three-group posttest only design to test the effect of the intervention on knowledge gain, confidence and attitude outcomes toward the electronic health record. Forty-two individuals participated in this study. Findings showed that the intervention had a large effect on knowledge gain (0.444), but no effect on confidence or attitudes, and that vodcasting was equally effective to face-to-face methods for delivering informatics content. Following refinement of the knowledge gain instrument used in this study, we urge replication of this study in other settings with a larger sample.

Keywords: Nursing informatics competence; Baccalaureate nursing education; Curriculum integration; Vodcasting; Electronic health records; Intervention research

Biographical notes: Manal Kleib, RN, PhD is an Assistant Professor in the Faculty of Nursing at the University of Alberta and a Health Informatics Consultant at Alberta Health Services. She has been involved in several initiatives geared at advancing nursing informatics competency development in Canada. She is the founder of the Nursing Informatics Association of Alberta (NIAA) and currently serves as the association’s Director of Education. Her research interests include nursing and health informatics, informatics competence development and assessment, formal and continuing education in informatics, online learning, program planning and evaluation, and curriculum development. More details can be found at: https://uofa.ualberta.ca/nursing/about/contact-us-and-people/academic-listing/manal-kleib

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1. Introduction

Concerns around quality of care and patient safety have been key drivers behind the increased interest in improving informatics competencies among health care providers (Cronenwett et al., 2007). Yet, many health care professionals do not posses the informatics competence required to competently provide patient care in a digitally enabled work environment. The purpose of this study was to develop an informatics educational intervention for baccalaureate nursing students and compare outcomes associated with vodcasting and face-to-face methods for delivering this material.

2. Review of relevant literature

In nursing, the identification of specific nursing informatics competency expectations at various levels of nursing practice and the integration of informatics content in baccalaureate nursing education (BScN) have been proposed as key strategies for facilitating the development of informatics competence among future nurses (Gassert, 2008; Staggers, Gassert, & Curran, 2001). Several nursing organizations in the United States and Canada have led a number of initiatives to help nurses gain the necessary informatics knowledge and skills that would enable them to work effectively in the digital health care world. In the United States, initiatives such as the Technology Informatics Guiding Educational Reform (TIGER) and the Quality and Safety Education for Nurses (QSEN) have been instrumental in promoting informatics education among nurses (Cronenwett et al., 2007; Technology Informatics Guiding Education Reform (TIGER), 2007). Initiatives in Canada led by the Canadian Association of Schools of Nursing (CASN) and Canada Health Infoway have enabled the development of the Nursing Informatics Entry-to-Practice Competencies for Registered Nurses as well as the development of the Nursing Informatics Teaching Toolkit for nurse educators to help support the integration of these competencies into nursing curricula (Nagle et al., 2012; Canadian Association of Schools of Nursing, 2013).

While these initiatives have helped accelerate the process of informatics competence development, nurse educators and nursing programs continue to experience challenges in systematically integrating informatics in undergraduate nursing education. Challenges such as the limited access to information technology applications in clinical agencies and the lack of faculty knowledge, skills, and motivation to integrate informatics into the curriculum have slowed the integration of informatics into BScN programs (Fetter, 2009; Nagle & Clarke, 2004; Thompson & Skiba, 2008). In addition, most informatics education efforts reported in the literature utilized conventional instructional approaches to address outcomes related to computer or information literacy as opposed to the role of informatics in the context of patient care (Kleib, Zimka, & Olson, 2013). In a national survey of nursing educational programs (Thompson & Skiba, 2008), the authors found that information literacy exercises were the predominant example of informatics integration into nursing courses. They also found informatics competencies related to privacy, confidentiality, security and impact were frequently offered in course work, and that faculty members embraced the notion that online course work was the same thing as informatics. A third finding was that handheld devices used for care planning and clinical information systems were rarely integrated into courses. Fourthly, the authors found that graduate programs were far more likely to integrate nursing informatics content and other learning experiences than undergraduate programs. Clinical exposure to informatics tools was common but highly dependent on resources and cooperation of the clinical facility. With regard to faculty members' competence in informatics, 37% of faculty rated themselves as competent in informatics, with 26% rating themselves as advanced beginners. The majority (82%) indicated that they were self-taught. In responding to this question, there were several instances where faculty members equated being involved in distance learning, online learning and web-based instruction with being prepared in informatics (Thompson & Skiba, 2008).

While educational institutions are increasingly using information and communication technologies to support teaching and learning (Fetter, 2009), the utilization of these tools to support learning about health informatics (HI) and nursing informatics (NI) at the undergraduate level is relatively limited with a focus on computer and/or information literacy skills as opposed to the role of informatics in the context of patient care (Kenny, 2002; Kleib, Zimka, & Olson, 2013). In this information age where information and communication technology (ICT) is already integrated in students' learning experiences in most institutions of higher education, informatics education could build on students' existing ICT skills, if known, and could help students use this existing ICT knowledge in the context of patient care (Jette', Tribble, Gagnon, & Mathieu, 2010). Jette', Tribble, Gagnon, and Mathieu proposed that instead of focusing on basic literacy skills, nursing education programs should target skills that students are less familiar with such as searching electronic scientific databases, assessing health related web sites, and exploring issues such as safeguarding electronic data versus patient rights. Most importantly, Jette', Tribble, Gagnon, and Mathieu proposed that nursing education should focus on application of health informatics systems currently used in health-care facilities (Jette', Tribble, Gagnon, & Mathieu, 2010). From a student perspective, some nursing students have raised concerns about whether the informatics education they receive would be sufficient to prepare them for the reality of clinical practice (Fetter, 2009). When asked for their feedback, students verbalized that their readiness to practice could be enhanced through: improving faculty knowledge, skills attitudes and behaviours related to informatics; standardizing and documenting student and faculty informatics competency expectations; enhancing access to references, software and hardware relevant to informatics; increasing content related to privacy and security of health information; and mandating hardware and software such as laptops and PDAs (Fetter, 2009).

We agree with these observations and believe that an understanding of the link between informatics and patient care is critical for graduates' success and that online learning tools could facilitate the integration of informatics concepts in BScN programs. We also believe that the systematic planning and evaluation of informatics education is essential for realizing the value and benefits of this education. Informatics competent nurses contribute to better patient outcomes and safer patient care through their understanding of the technology as a tool to enhance clinical decision-making and the management of health information. Therefore upon conceptualizing the content of this educational intervention, our goal was to focus less on computer and information literacy skills, but rather introduce topics that would engage learners to think critically about emerging complex technologies and the importance of nurses' involvement and advocacy for safer patient care in digitally enabled work environments.

In this paper, we report on our experience in utilizing online teaching tools to address informatics educational needs among BScN students at the University of Alberta. In the Faculty of Nursing, informatics is considered a key graduate outcome. Content related to this competency is threaded within theory and clinical assignments of some courses. However, a specific course or unit of study about NI or HI is not currently offered. This study contributes to the literature as the first study that has examined the efficacy of vodcasting as a tool for integrating informatics education at the baccalaureate level. Also, this is the fist empirical study to report on the design and implementation of an informatics educational intervention utilizing rigorous research methods to test the effect of the intervention, thus encouraging replication of methods in future studies.

This study was conducted in two stages. In stage one, we developed and pilot tested the informatics educational intervention. In stage two, we evaluated the efficacy of this intervention in increasing knowledge, confidence and attitude outcomes toward the electronic health record (EHR). We specifically focused on the EHR because it is a key HI application that nurses are expected to use in clinical practice. We addressed two key research questions in both phases of the study:

1. Does the educational intervention improve knowledge gain, confidence, and attitudes toward the EHR?
2. Which teaching format improves knowledge gain, confidence, and attitudes toward the EHR?

3. Pilot study phase

3.1. Designing the informatics educational intervention

The intervention developed for this study was comprised of two learning modules that provided foundational knowledge about HI and NI relevant to nursing practice. We utilized a blended objectivist-constructivist pedagogical framework to guide the development of the educational strategies to deliver this education in two formats, a lecture or face-to-face format and a vodcast format (Ally, 2004; Forbes & Hickey, 2008). At the time of the development of the intervention, the Canadian nursing informatics entry-to-practice competencies (Nagle et al., 2012) were under development, therefore we used the competencies required of nurses at a beginning level of practice to identify specific learning outcomes for the intervention, to guide the selection of relevant informatics content to be included, and to develop the knowledge test items to assess learning (Staggers, Gassert, & Curran, 2001). We reviewed a variety of resources including NI and HI textbooks, peer-reviewed journals, professional associations' publications, and organizational and governmental reports to identify relevant content, and then organized the selected content into two modules using a topic outline (Table 1). The first module introduced basic principles about HI and NI and the second module reviewed some tools available through HI applications that could be used to improve patient care. We could not include actual care planning applications or practice exercises on using the EHR, as the required software was not available at our university. Instead, we embedded learning activities in the intervention that offered students the opportunity to develop skills in accessing relevant Web-based resources that could be used to inform evidence-based practice.

Instructional activities in the lecture format included a Power Point presentation, use of video clips, and opportunities for question/answer with the speaker. We invited the nursing clinical informatics coordinator at Alberta Health Services to present the two modules in two lecture sessions. We offered some learning activities and guided exercises that required students to access Internet information tools to apply some of the concepts offered in the session. The duration of each lecture was 60 minutes, 40 minutes for instruction and 20 minutes for learning activities.

Table 1
Topic outline for the informatics learning modules

Module 1: Introduction to Health & Nursing informatics
- Driving forces for health informatics development.
- The Canadian context and experience with health informatics.
- Health informatics and selected subspecialty areas: Health Informatics &Nursing Informatics.
- Relevance of health informatics to nursing practice, education, research, and administration.
- Impact of health informatics and nursing informatics on patient care.
- Informatics competencies at different levels of nursing practice.
Module 2: Health Informatics Tools & Applications in Health Care and Nursing Practice
- Health Informatics Tools and Applications: Electronic medical records, electronic health records, & personal health records, professional order entry systems, clinical decision support systems, personal digital assistants, automatic dispensing of medications and documentation, telehealth, monitoring systems, and key administrative information systems.
- Paper and computerized documentation.
- Standardized nursing language and nursing minimum datasets.
- Informatics and nurses' visibility.

We delivered the same content in a vodcasting format. Vodcasting is a type of mobile learning technology that allows recording of classroom lectures as video files, making them accessible to students from a computer or a mobile device (Forbes & Hickey, 2008). Various approaches can be used to prepare vodcasts. Using a digital recorder and a microphone, a professor can record a classroom lecture and once done, upload the recorded file on a distribution system such as Black Board (Forbes & Hickey, 2008). With advanced recording technologies, it is possible to synchronize Power Point slides and various animations with a lecture. Vodcasting requires quality digital media to produce desired resolution. Each of the two learning modules was recorded as a 40-minute vodcast presentation with voice over Power Point. Similar learning activities and guided exercises that required students to access Internet information tools to apply some of the concepts offered in these vodcast sessions were offered. In addition, the online environment allowed students to navigate website resources through a pre-selected list of evidence-based resources (Fig. 1). The required time for completing the two-vodcast sessions and the online activities was approximately 2 hours.

We used a combination of online learning community tools (ViviTechnologies) developed at the Centre for Health Evidence, University of Alberta to set up the learning environment of the vodcast. The recorded vodcasts were tested for clarity and resolution quality, and then posted on the Homer Gateway Learning Community Website, a learning resource at Faculty of Medicine and Dentistry (FOMD), University of Alberta: https://homer.med.ualberta.ca/gateway/default.asp. Students were able to access the learning material using a unique ID and password either from home or using a computer station on campus.

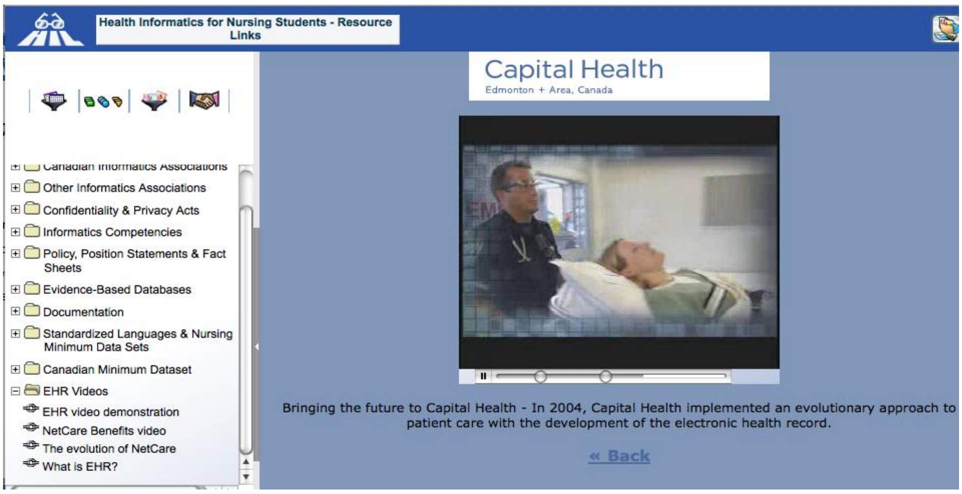

Fig. 1. Screen shot of the vodcast learning environment

3.2. Pilot testing of the informatics educational intervention

3.2.1. Methods

We used a non-equivalent control group with a pre/post design to pilot test the intervention and determine feasibility issues prior to conducting a full-scale study. In addition to the main two study questions listed above, we addressed a number of related questions including: What is the participation rate in each format? What factors influence students' decisions to participate in the study? What is the effect size for each teaching format? What is the projected sample size for phase two of the study? Do study instruments appear to be internally consistent? The primary outcome was gain in knowledge about informatics as offered in this study. The secondary outcome 'self-reported confidence' was measured using the Generic Computer Self-Efficacy Scale. This scale is based on social cognitive theory and is concerned with judgment about future performance of a task, not past accomplishments in relation to computer use (Compeau & Higgins, 1995). The scale assesses three dimensions of computer self-efficacy: magnitude, strength, and generalizability. Magnitude of computer self-efficacy refers to "the level of capability expected of the individual, i.e. individuals with a high computer self-efficacy magnitude might be expected to perceive themselves as able to accomplish more difficult tasks than those with lower judgment of self-efficacy. The level of confidence an individual perceives when performing a task reflects the strength of his/her computer self-efficacy. Generalizability reflects the "degree to which the judgment is limited to a particular domain of activity" as opposed to being comfortable in using a variety of different computer systems and applications in different settings. In this study, we employed the confidence subscale of this instrument (10 items), which requires the individual to imagine that he/she were given a new software package that they have never used before, but it is intended to make their work better, and indicate their perceptions of confidence on a scale of 1-10, where 1 indicates "not at all confident," "5 indicates moderately confident," and "10 indicates totally confident." The internal consistency of the scale (Cronbach's alpha) was 0.8. Attitudes represent a disposition or tendency to respond positively or negatively toward something (idea, object, person, situation). We assessed the secondary outcome 'attitudes toward the EHR' using a five-item Likert-type scale that measures nurses' disposition toward the EHR drawn from the *Usability Assessment Survey* (Moody, Slocumb, Berg, & Jackson, 2004) developed by Moody, Slocumb, Berg, and Jackson. The scale scores are summed for a total score, which may range from 5 to 25. A high score on the scale indicates positive acceptance or disposition toward use of the EHR, and a low score indicates a negative disposition toward the EHR. The Cronbach's alpha of the scale was moderately high, 0.7. To assess knowledge gain, we developed a set of multiple-choice test items based on the learning objectives specified for each module, with five questions to test the information in module 1 and four questions for module 2.

3.2.2. Procedures

The primary outcomes were initially specified as knowledge gain (the difference between pre and post mean scores on knowledge of EHR test), attitudes toward EHR, and perceived confidence regarding use of the EHR. Additional data included participants' age, learning styles, and any previous education in informatics. Learning styles were assessed by one question asking students to indicate which learning approach they preferred (auditory, visual, or by doing). Previous education in informatics was assessed by asking respondents to indicate whether they had little to no education in informatics, moderate, or quite a bit, of informatics education. We did not assess basic computer literacy skills because students already utilize computers in their learning on daily basis. We predicted significant improvements in the post intervention mean scores on all outcome measures regardless of the teaching format. The null hypothesis was: "There is no significant difference between pre and post intervention mean scores of knowledge, attitudes, and confidence between students taking the vodcast and those receiving an in-class lecture." Following administrative approval from the Faculty of Nursing and ethics clearance from the Health Ethics Board at the University of Alberta to conduct the pilot study, a convenience sample was drawn from fourth-year baccalaureate-nursing students in the fall term of the academic year 2010-2011. We used questionnaires to collect data before and after the intervention. We applied a paired-samples t-test to compare pre and post intervention mean scores on knowledge gain, confidence, and attitudes toward the EHR.

3.2.3. Results of pilot study

In spite of the low participation rate (Lecture n=22), (Vodcast n=9), overall, findings showed that there was an interest in learning about informatics among students. The lack of incentive to participate and students' workload may have negatively impacted participation in the pilot study. Students in the online and lecture components differed in learning styles and demographic characteristics, which made it difficult to compare the results. There was a statistically significant improvement between pre and post intervention mean scores on all outcome measures for the lecture format but not for the online format. Effect size for each of the dependent variables was calculated as: attitudes (0.74), knowledge related to informatics (0.9), and confidence (0.54). The reliability of the knowledge test was very low, possibly due to low number of test items used during this phase. Cronbach's alpha for the confidence scale was 0.9, and 0.6 for the attitudes toward the EHR scale.

3.2.4. Implications for the main study

Due to lack of a control group in the pilot design and the short time span between completion of the pre-test and the post-test, it was difficult to know whether the scores on the posttest were related to knowledge gained from completing the pretest or the intervention. Therefore, in planning for the main study, we selected a three-group posttest only design with random assignment to control for known and unknown confounders (Shadish, Cook, & Campbell, 2002). Given the low participation rates, we obtained additional ethics approval to include students from all years of the BScN programs at the University of Alberta and the BScN program at the MacEwan University. With regard to the educational intervention, in the face-to-face instructional format, we combined the two modules in a 2-hour session. Instructional activities included case studies and guided exercises that required students to access Internet information tools to apply some of the concepts offered in the session. In the vodcast format, we divided the two learning modules into four learning units; each unit was recorded as a 20-30 minute vodcast presentation with voice over Power Point, and included a set of self-directed exercises that students could complete as they studied each unit. The sessions were offered through the Homer Learning Community, a learning resource at the Faculty of Medicine and Dentistry.

To enhance internal consistency of the knowledge test, we combined test items for both modules and added 10 more new questions based on the learning objectives for the modules, in order to enhance internal consistency of the knowledge test. In addition to the method of instruction, participants' age, learning styles, and previous education in informatics, we included university, program of study, and year of study in the program as additional independent variables, in order to test their effects on the intervention in the main study.

4. Main study phase

4.1. Methods

We used a three-group (vodcast, face-to-face, and control) posttest only randomized controlled design to examine the same research questions used in the pilot study. This design provided better control of threats to internal validity that were encountered during the pilot phase of the study (Shadish, Cook, & Campbell, 2002). Random assignment of participants to study groups ensured that the groups were similar/equivalent at the start of the experiment. The use of a control group facilitated comparisons between those who received the educational intervention in two forms of instructions with those who had not received any education. Both measures enabled isolation of treatment effect; thus more confidence that any differences in the posttest measurement between groups were attributed to the intervention. Using the random assignment controlled for unidentified factors that may affect study outcomes and for selection bias. Use of the post-test only design controlled for any possible testing effects associated with completing study instruments prior to the intervention (Shadish, Cook, & Campbell, 2002). Due to internal consistency issue of the knowledge test impacting accurate assessment of effect size during the pilot phase, we used the effect size of the confidence outcome (0.54) to estimate required sample size. Based on an effect size of 0.54 and setting the power at 0.8, and the possibility of type I error (alpha) at 0.5, we estimated that 51 participants would be needed in each group (N=153). Individual students in each group were specified as the unit of analysis in this study. All students in four undergraduate programs at the University of Alberta, (Collaborative, Bilingual, After Degree Program (ADP), and the Honors program) and the undergraduate program at Grant MacEwan University were invited to participate. We examined two null hypotheses: (1) The intervention has no effect on knowledge gain, confidence and attitudes toward the EHR, and (2) the teaching format has no effect on knowledge gain, confidence, and attitudes toward the EHR. The alternative hypotheses stated: "Those who receive the intervention through either teaching format, vodcast or face-to-face, will have better knowledge gain, confidence, and more positive attitudes toward the EHR than those who do not receive the intervention (control group), and "the difference between the mean scores of the vodcast format and the face-to-face format will not be significantly different."

4.2. Procedures

We collected data electronically over the fall and winter terms of the academic year 2011/2012. Two research assistants helped with data collection and management. Recruitment strategies included a print poster and study information sheet, word of mouth, and e-mail announcements about the study. We created a unique Web page for each group (vodcast, face-to face, and control) on the Homer Gateway server at the FOMD and an online registration Website. The registration site facilitated navigation of study information online as well as registration and random assignment to study groups. Once students clicked on the registration link, they were able to navigate the website immediately, and provide demographic information. After this step, the registration portal randomly assigned the students to one of three groups. Those assigned to the vodcast group were able to access the learning module immediately and were given one-week period to complete the modules beginning on the date of their registration. Although the link was open for one week, we imposed restrictions on time spent on completion of the learning material so that instructional time for vodcast and face-to-face groups was equivalent. Students in the face-to-face learning sessions were invited to attend a lecture in either the morning or afternoon. The lecture sessions were scheduled during the week as well as during weekends. Students randomized to this group were able to view and choose from a list of session dates that best worked for them. The lectures were held in a computer lab, which facilitated students' completion of the instruments on knowledge gain, confidence and attitudes online immediately after their instructional session was completed. Students who were in the control group completed the instruments on knowledge gain, confidence, and attitudes immediately after they registered. After completion of the data collection for the study, we provided the control group access to the learning materials.

Participants were informed that participation in this study was voluntary and had no impact on their grades in their academic program. Each participant was given a $10 coffee gift card in appreciation of his or her time. Students who completed the learning material did not receive credit for any course requirements, but were given a certificate indicating completion of the study modules. A written informed consent procedure was not required because consent was implied by the students' choice to access the study registration Website and sign up for a learning session.

4.3. Data analysis

Background/demographic data provided by each subject were summarized using descriptive statistics. ANOVA was used to determine whether there were any significant differences between the means of the three groups on each of the three outcomes of interest (knowledge gain, confidence, and attitudes) (Pallant, 2007). Post Hoc Analysis was performed to determine which groups differed from each other. A correlation matrix was created using Spearman's Rho measure of association to investigate the correlations between the primary outcome variable and possible covariates: group assignment, university, program, year of study in the program, previous education in informatics, age, and learning style. The variables that showed moderate to strong correlations were included in a regression model.

4.4. Results of the main study

4.4.1. Response rate and demographic characteristics of the sample

During the initial data collection (fall, 2011) only 4 students registered for the study. In the second run of data collection in winter term, 2012, participation improved to 60 individuals who were randomly assigned to the three study groups (Vodcast n= 17, Face-to-Face n= 21, and Control n=22). Complete data sets were available for 42 students (n=9 in the Vodcast group, n=13 Face-to-Face group, and n=20 in the control group). Results reported here are based on data from the winter 2012 term. The majority of participants (81%) were from University of Alberta whereas (19%) were from MacEwan University. University of Alberta participants were mainly from the 4-year Collaborative BScN program and the After Degree Program (97.4%) and a small proportion were from the Bilingual program (2.6%). Participation was highest among second and third year students (39% and 29.3 % respectively) with less participation among first (12.2%) and fourth year (19.5%) students. The majority of participants were 20 – 39 years of age (92.8%). With regard to learning style, the majority of participants indicated that they learned best by doing (75.6%) as compared to those with visual (14.6%) or auditory (9.8%) learning styles. About two thirds of the sample (59.5%) indicated that they had none to little education in informatics, whereas (40.5%) indicated they had moderate to good education in informatics.

4.4.2. Results of descriptive analyses related to confidence and attitudes

Responses on the confidence scale were scored as follows: Not confident (scores of 1, 2, 3, or 4), moderately confident (5, 6, or 7), and totally confident (8, 9, or 10). An average score was used to measure responses on the confidence scale ($M = 7.16$, $SD = 1.40$). Frequency statistics describing respondents' self-reported level of confidence in relation to using the EHR showed that participants' perceptions of confidence toward using an unfamiliar software, in this case the EHR, were highest if someone showed them how to use it first (83.4%), or if they had used similar software in the past to do the same job (88.1%). A large percentage of participants thought that they would feel more confident if they could call someone for help if needed (71.4%), or if someone helped them get started (71.4%). More than half of the participants felt that they would feel more confident if they had the software manuals for reference (57.1%), if they had seen someone else using the software before trying it themselves (57.2%), if they had access to a built-in facility for assistance (54.8%), or if they had sufficient time to complete the job for which the software was provided (54.7%). Participants felt least confident if they had never used a package similar to the EHR before (2.4%), and when they thought that there was no one available to provide assistance (9.6%).

Scores on the attitude scale were summed to yield a total attitude score. Total scores ranged from 12 -25 (M = 18.98, SD = 3.460). Overall, the majority of participants held positive attitudes toward the EHR (64.3%) and its potential for improving patient care in time (76.2%). A small percentage (35.7%) perceived the threat to privacy to be lower for electronic health records compared to paper records. Over two thirds (76.2%) believed that the EHR would lead to improved patient care.

4.4.3. Results related to study question 1

There were no significant differences in confidence (p = 0.951) or attitude (p = 0.600) scores among the three groups, but the ANOVA comparing knowledge gain between groups was statistically significant (F (2, 38) = 15.201, p = .001). These results support the alternate hypothesis that those students who received the educational intervention gained more knowledge about informatics compared to those who did not receive the intervention. The effect size of the knowledge outcome in this study was 0.444, which corresponds to a large effect size. In other words, the independent variable "group assignment" predicted 44.4% (η^2 = 0.444) of the variability in the knowledge gain variable (Pallant, 2007).

In preparation for the planned regression analysis, Spearman's Rho was used to examine associations among the independent variables and knowledge (see Table 2). Variables that were significantly correlated with knowledge (group assignment, and program) were included as independent variables in the regression equation for knowledge gain. Although the correlation between age and knowledge gain was small in this study, we also included it as an independent variable in the regression equation based on the results of other researchers. The hypothesis for the regression model was that none of these independent variables would be significant predictors of knowledge gain.

Table 2
Spearman's Rho correlations between variables and knowledge gain

Variable	Knowledge
Knowledge	1.000
Group	**-.640****
University	-.149
Program	**.462****
Year of Study	.216
Prev. Ed. Informatics	.195
Age	.095
Learning Style	.031

*** P< 0.01*

Because the sample size was small, we report the results of the Adjusted R Square value as opposed to the R Square Change to provide a better estimate of the true population value (Pallant, 2007). The model explained 49.1% of the variance in knowledge gain, F (6, 34) = 7.434, p <0.001. "Group assignment" significantly contributed to variance in knowledge gain (β=-0.686, p<0.001), while the program ($\beta_{program}$ =0.244, p<0.062), and age (β_{age} =0.232, p <0.073) did not significantly contribute to variance in knowledge gain. Therefore, we accepted the alternate hypothesis that group assignment would predict knowledge gain.

4.4.4. Results related to study question 2

Post hoc Scheffe testing was used to compare mean scores in knowledge gain among the three groups of participants. The vodcast group had higher knowledge gain scores (*M* =14.33, SD = 2.5) compared to the face-to-face group (*M* = 14.08, SD = 1.49), but the scores of these two groups were not significantly different (p>0.963). Both groups that received the educational intervention had knowledge gain scores that were significantly higher than that of the control group (*M* =10.47, SD = 2.34, p >0.001). These findings suggest that both teaching formats are equally effective for teaching informatics. Therefore, we accepted the null hypothesis that teaching format had no effect on knowledge gain.

4.4.5. Results related to internal consistency of study instruments and power

In the main study, Cronbach's alpha for the confidence scale was 0.925. For the Attitudes toward the EHR scale, Cronbach's alpha was 0.76. Both statistics fall within acceptable ranges for this test, as reported in previous studies. The internal consistency of the knowledge test was measured using the Cronbach's Coefficient Alpha, and the Kuder-Richardson 20 (KR-20) internal consistency reliability measures because the knowledge test had dichotomous/binary data, i.e. correct vs. incorrect. The Cronbach's Coefficient Alpha, based on a sample of 41 students in this study, was 0.51. The K-R20 yielded a result of 0.52. One test item (question 31) was excluded in this analysis because all respondents answered this question correctly. Both statistics fall below the ranges reported in the literature for acceptable reliability of a measuring instrument. The low internal consistency suggests that the items within the scale may measure more than one construct.

We recalculated the power of this study based on the effect sizes obtained for knowledge gain, confidence, and attitudes toward the EHR. Using the approach outlined by Cohen and setting power at 0.8, and alpha at 0.05, the sample size required per group to detect a change in knowledge gain, with an effect size of (0.44) was 52 (Cohen, 1992). The effect size for confidence was 0.003 and 0.026 for attitudes toward EHR. Given these effect sizes for confidence and attitudes toward EHR, the power for a three group ANOVA was 0.40. These findings suggest that the sample was too small to detect any differences in confidence and attitudes toward EHR that may have existed.

5. Discussion

In this section we provide a discussion of main study findings including response rate, findings related to the two research questions, a discussion of key limitations and some implications for future research, nursing education and practice.

5.1. Response rate

In spite of successive recruitment attempts in this study, the response rate was quite low. Students had busy study schedules and personal and family responsibilities which may have limited the time available for participation in this study. Low participation rates could also be attributed to a lack of interest among students to learn about informatics. In both universities in this study, formal education about informatics is not offered, which may have contributed to a perception among students that information about informatics was not relevant to future nursing practice. Although this study coincided with events taking place to implement EHRs in clinical settings in which the students were working, the low participation rate suggests that students were either unaware of these events, or that they did not see how these events related to nurses' work. Low response rate could also be attributed to lack of incentives to encourage students to take part in research activities. A small incentive was provided in this study, but it may not have been sufficient to encourage participation.

5.2. Improving knowledge, confidence and attitudes about health informatics and nursing informatics

Enhancing informatics competence among nurses is a key priority in nursing education (American Association of Colleges of Nursing, 2008; College and Association of Registered Nurses of Alberta, 2006). Nurses who are able to utilize informatics tools and applications competently not only contribute to improved patient outcomes but also to the overall significance of nursing practice and knowledge development (Canadian Nurses Association, 2006). Adding an evaluation perspective to the existing descriptive body of literature about informatics education at the BScN level increased understanding about the effect of informatics educational interventions in enhancing informatics competence among BScN students. In this study, a significant difference with a very large effect size was found in relation to knowledge gain about informatics. Students who received the informatics intervention had better knowledge gain than those who did not received the intervention (control group); these findings suggest that the provision of informatics education at the BScN level is therefore warranted.

The process of competence development in informatics requires more than a gain in knowledge (Beiter, Sorscher, Henderson, & Talen, 2008). Addressing the knowledge aspects of informatics competence on its own is not likely to result in a change in behavior or attitudes among those receiving this education. In this study, the lack of opportunities to do "hands-on" practice on the EHR may have limited improvements in the confidence and attitude outcomes. Although no significant improvements in confidence or attitudes were found, the descriptive analyses suggest that students' perceptions of confidence are more likely to increase with support, mentorship, and "hands-on" practice prior to actual use of health technology. This finding is in agreement with similar research by others (Borycki, Kushniruk, Armstrong, Joe, & Otto, 2010).

5.3. Choosing the best format for providing informatics educational interventions

Although no difference between vodcast and face-to-face teaching was found in this study, others have reported increased efficacy of online learning when compared with conventional or face-to-face teaching methods (Bloomfield, Roberts, & While, 2010; Cook et al., 2008). Evidence generated in this study showed that learning through vodcast technology was as effective as face-to-face instruction about informatics. The vodcasting technology proved to be a convenient and cost-effective tool for recording content related to informatics and making it available to nursing students at any time and from anywhere. Tools within the online environment provided an opportunity for students to navigate among sites containing important information related to evidence-based practice and a wide array of resources relevant to HI and NI. These web-based resources were selected to facilitate self-directed learning and students' construction of knowledge about informatics.

While higher education institutions are increasingly investing in advanced learning technologies, such as learning management systems and simulation technology, to advance educational goals and meet the needs of millennial generations of students, the use of technologies for informatics education at the BScN level remains limited (Kleib, Zimka, & Olson, 2013). Considering challenges in making informatics education available at the undergraduate level, these findings give nursing programs more confidence in the potential of online learning tools and the actual value of providing informatics education (Fetter, 2009; Nagle & Clarke, 2004; Thompson & Skiba, 2008). Nonetheless, because this is the first study about vodcasting specifically applied to learning about health informatics and nursing informatics content at the BScN level, caution should be exercised in interpreting and generalizing these findings.

In this study, computer literacy skills and previous use of computer-based educational applications were not assessed because students were already using advanced on-line packages in their education. It has been proposed in the literature that use of technology for learning purposes enhances overall confidence in using computers or other technological devices such as mobile learning tools (Kenny, 2002; Kuiper, 2010). Other authors have argued that while the construct of self-efficacy had been shown to be fairly stable in assessing academic achievement in face-to-face learning environment, research on its role within online learning environments remains inconclusive, especially with emerging new technologies (Burkhard & Roldan, 2009; Hodges, 2007). Research among undergraduate-nursing students shows that higher perceptions of self-efficacy were associated with the use of computer-assisted instruction such as online learning packages or human patient simulator technology in the delivery of health teaching or providing nursing care (Madorin & Iwasiw, 1999; McMullan, Jones, & Lea, 2011). However, does being tech-savvy and confident in using online learning tools translate into a similar perception of confidence when using complex health care technology? The influence of generic computer self-efficacy and the general use of computers on the use of complex health technologies such as the EHR are unclear. Researchers have shown, though, that positive experiences with technology influence attitudes of users, and that experiences associated with positive attitudes contribute to increasing perceptions of self-efficacy related to future behavior, in areas such as adoption and use of technology (Compeau & Higgins, 1995; Kinzie, Delcourt, & Powers, 1994).

6. Limitations

The main limitation in this study was related to the low response rate, which affected the power of the study. Another limitation was related to the low internal consistency of the knowledge scale, which we developed for this study. The test had items pertaining to several objectives and this may have reduced the internal consistency. Future research could examine whether developing separate tools for each knowledge objective enhances the internal consistency of the scale. Lastly, pilot results suggested that the limited time between the pretest and the posttest may have resulted in a testing effect, and thus a posttest only control group design was used. A longer interval between the pretest and the posttest may have reduced the risk of a testing effect. In this case, we could have included a pretest assessment, which would have increased the strength of the experiment.

7. Implications

Informatics education should be comprehensive and relevant to nursing practice with the goal of engaging student nurses in thinking about technological application in a more critical way as opposed to just learning how to operate the technology. Nursing programs and nurse educators could explore online tools for teaching informatics especially when faculty resources are scarce. Advocating for teaching resources that would enhance the quality of informatics education, such as an EHR simulator could help to maximize the link between theory and practice and may help to improve confidence and self-efficacy in relation to NI and HI. Providing opportunities for hands-on-practice through structured clinical experiences in practice settings that have different modalities of informatics applications, e.g. EHR, telehealth, etc. is much needed (Borycki et al., 2010). Likewise, clinical agencies should offer shadowing experiences with nurses or HI/NI specialists whereby nursing students could take part in the planning, design, implementation, and evaluation of informatics projects in the clinical setting (Travis et al., 1991).

This study contributes significantly to the body of knowledge as the first empirical study that utilized a rigorous research method to test the efficacy of an informatics educational intervention at the BScN level. Nonetheless, given limitations associated with the small sample size, a replication of this study is needed with a larger sample and in other settings, in order to enhance the generalizability of results. Follow-up studies with participants in this study would shed some light on whether the knowledge provided helped them engage more easily with health care technology following graduation. Lastly, because most existing measurement tools have been developed in reference to computers in general, there is a need for new measures that reflect evolving advancements in HI and NI.

8. Conclusion

A systematic approach for the planning, implementation, and evaluation of informatics education in BScN programs is very important. This study demonstrated the effectiveness of an educational intervention in increasing knowledge about informatics among BScN students. It also demonstrated that this education could be delivered with similar outcomes via vodcast and face-to-face teaching methods. Further research is recommended to allow for greater generalizability of these findings to other educational settings in Canada.

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References

Ally, M. (2004). Foundations of educational theory for online learning. In T. Anderson & F. Elloumi (Eds.), *Theory and practice of online learning* (pp. 3–31) (2nd ed.). Athabasca University.

American Association of Colleges of Nursing. (2008). *The essentials of baccalaureate education for professional nursing practice*. Retrieved from http://www.aacn.nche.edu/education-resources/BaccEssentials08.pdf

Beiter, P. A., Sorscher, J., Henderson, C. J., & Talen, M. (2008). Do electronic medical record (EMR) demonstrations change attitudes, knowledge, skills or needs? *Informatics in Primary Care, 16*(3), 221–227.

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

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

Burkhard, R., & Roldan, M. (2009). Task context and computer self-efficacy in the era of web 2.0 tools. *Journal of Online Learning and Teaching, 5*(1), 155–165.

Canadian Association of Schools of Nursing. (2013). *Nursing informatics teaching toolkit: Supporting the integration of the CASN nursing informatics competencies into nursing curricula*. Retrieved from http://casn.ca/wp-content/uploads/2014/12/2013ENNursingInformaticsTeachingToolkit.pdf

Canadian Nurses Association. (2006). *Position statement: Nursing information and knowledge management*. Retrieved from http://www.cna-aiic.ca/~/media/cna/page-content/pdf-en/nursing-information-and-knowledge-management_position-statement.pdf?la=en

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

College and Association of Registered Nurses of Alberta. (2006). *Entry-to-practice competencies for the registered nurses profession*. Retrieved from http://www.nurses.ab.ca/content/dam/carna/pdfs/DocumentList/Standards/RN_EntryPracticeCompetencies_May2013.pdf

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

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

Cronenwett, L., Sherwood, G., Barnsteiner, J., Disch, J., Johnson, J., Mitchell, P., Sullivan, D. T., & Warren, J. (2007). Quality and safety education for nurses. *Nursing Outlook, 55*(3), 122–131.

Fetter, M. S. (2009). Graduating nurses' self-evaluation of information technology competencies. *The Journal of Nursing Education, 48*(2), 86–90.

Forbes, M. O., & Hickey, M. T. (2008). Podcasting: Implementation and evaluation in an undergraduate nursing program. *Nurse Educator, 33*(5), 224–227.

Gassert, C. A. (2008). Technology and informatics competencies. *Nursing Clinics of North America, 43*(4), 507–521.

Hodges, C. B. (2007). Self-efficacy in the context of online learning environments: A review of the literature and directions for research. *Performance Improvement Quarterly, 20*(3/4), 7–25. doi: 10.1002/piq.20001

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

Kenny, A. (2002). Online learning: Enhancing nurse education? *Journal of Advanced Nursing, 38*(2), 127–135. doi: 10.1046/j.1365-2648.2002.02156.x

Kinzie, M. B., Delcourt, M. A. B., & Powers, S. M. (1994). Computer technologies: Attitudes and self-efficacy across undergraduate disciplines. *Research in Higher Education, 35*(6), 745–768. doi: 10.1007/BF02497085

Kleib, M., Zimka, O., & Olson, K. (2013). Status of informatics integration in baccalaureate nursing education: A systematic review. *Canadian Journal of Nursing Research, 45*(1), 138–154.

Kuiper, R. (2010). Metacognitive factors that impact student nurse use of point of care technology in clinical settings. *International Journal of Nursing Education Scholarship, 7*(1), 1–16. doi: 10.2202/1548-923X.1866

Madorin, S., & Iwasiw, C. (1999). The effects of computer-assisted instruction on the self-efficacy of baccalaureate nursing students. *Journal of Nursing Education, 38*(6), 282–285.

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

Moody, L. E., Slocumb, E., Berg, B., & Jackson, D. (2004). Electronic health records documentation in nursing: Nurses' perceptions, attitudes, and preferences. *CIN: Computers, Informatics, Nursing, 22*(6), 337–344.

Nagle, L., Borycki, E., Donelle, L., Frisch, N., Hannah, K., Harris, A., Jette', S., & Shaben, T. (2012). *Nursing informatics: Entry to practice competencies for registered nurses*. Canadian Association of Schools of Nursing, Ottowa.

Nagle, L. M., & Clarke, H. F. (2004). Assessing informatics in Canadian schools of nursing. *Studies in Health Technology and Informatics, 107*, 912–915.

Pallant, J. (2007). *SPSS survival manual* (3rd ed.). England: UK: Open University Press.

Shadish, W. R., Cook, T. D., & Campbell, D. T. (2002). *Experimental and quasi-experimental designs for generalized causal inference*. Boston, MA: Houghton Mifflin.

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.

Technology Informatics Guiding Education Reform (TIGER). (2007). *Evidence and informatics transforming nursing: 3-year action steps toward a 10-year vision*. Retrieved from http://www.thetigerinitiative.org/docs/tigerinitiativesummaryreport_001.pdf

Thompson, B. W., & Skiba, D. J. (2008). Informatics in the nursing curriculum: A national survey of nursing informatics requirements in nursing curricula. *Nursing Education Perspectives, 29*(5), 312–317. doi: 10.1016/8755-7223(93) 90084-P

Travis, L. L., Root, A., Hoehn, B., Brennan, P., Fitzpatrick, J. J., Gross, M., & Youngblut, J. (1991). An integrated informatics curriculum in a baccalaureate nursing program. In *Proceedings of the Annual Symposium on Computer Applications in Medical Care* (pp. 278–282).