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Do Electronic Health Records Help Undergraduate Students Develop Health Informatics Competencies?

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Abstract. In this paper we describe the effects of hands-on exposure to an educational electronic health record (EHR) system upon undergraduate health informatics (HI) student competency development. We undertook a quasi-experimental study (i.e. pre-test, post-test design), where students were given the opportunity to do hands-on work with an educational EHR over a 10 week period. HI student competencies were measured pre and post educational EHR exposure. Several HI student competencies improved significantly following hands-on work with the EHR. As well, students provided more in-depth and higher quality case study answers after working with the educational EHR.

Keywords. health informatics, biomedical informatics, undergraduate, education, electronic health record

Introduction

Worldwide there has been a significant rise in the number of electronic health records (EHRs) that are being implemented in regional health authorities, hospitals, clinics, long term care facilities, and physician offices as national and regional governments invest in modernizing health care. With these investments in the EHR, there has emerged a significant demand for an educated workforce that understands not only the processes that are involved in delivering health care, but the technologies that are used to support health professionals. In this paper we describe our research to date investigating the effects of providing HI students with hands-on exposure to EHRs in the classroom upon competency development [1-2]. This work represents a contribution to the HI literature as it is one of the few studies that focus upon the effects of student exposure to an EHR upon HI professional competency development.

1. Literature Review

Over the past several years, several publications have highlighted the barriers to introducing educational EHRs into health professional classrooms. These barriers

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include a lack of: (a) access to differing types of educational EHRs, (b) trained HI professionals to manage educational EHR systems, (c) faculty developed training materials to be used in the classroom along with the EHR, (d) curriculum integration with the EHR, and (e) faculty who are versed in the subject of health informatics [3-9]. Although there have been a number of efforts aimed at creating and disseminating HI competencies internationally, less work has been conducted in developing methods for instilling those competencies in HI students [6].

2. Methods

2.1. Participants

Students enrolled in a mandatory third year course in the undergraduate HI program were invited to participate in the study by a research assistant who made in-person presentations to students, and an invitation letter was also distributed to students via a class list serve.

2.2. Materials

The researchers developed an EHR educational portal that allows HI students to directly access and work with several industry representative educational EHRs remotely over the WWW in the classroom and at home [3]. As an extension of this work, an educational EHR was integrated into the laboratory component of the course to provide students with hands-on opportunities to learn about the technology. The course has both a lecture and a laboratory component, and consists of two 1.5 hour lectures and one 2 hour lab each week for a full semester (12 weeks in length).

2.3. Procedure

During the laboratory component of the course, students were provided with an opportunity to gain experience with use of the EHR. Students were introduced to the EHR and provided with opportunities to directly work with the EHR (i.e. hands-on use) in the early part of the course (i.e. week 2 of the course). At the beginning of the course, students who decided to participate in the study were asked to complete several questionnaires: (a) a demographic questionnaire, (b) a learning styles questionnaire and (c) a HI competency questionnaire. Demographic data were collected to describe the characteristics of the students. Learning styles data were collected to describe the learning styles of the participants [9]. Competency questionnaire data were collected in order to assess the student's current HI competencies. The HI competency instrument collects data about four differing types of HI competences (i.e. information management, clinical/health sciences, the Canadian health care system, and the management sciences). The instrument is based on Canada's Health Informatics Association (COACH's) core competencies. Students were asked to self-evaluate their HI competency development on a 5-point Likert scale (1=lowest and 5= highest).

Students were also asked to complete a case study prior to working with the EHR (and then 10 weeks after using the EHR). The case studies consisted of a description of a scenario where an EHR was used along with questions. Students were

asked to read a short scenario about how a regional health authority is implementing an EHR. The case study exercise involved asking students to provide a list of statements describing how technology affects and improves regional health authority services. Cases were developed by one HI instructor and were independently evaluated and judged to be equivalent by another instructor. HI instructors were used to judge the quality and equivalence of both cases. After week two of the course, students were provided with opportunities to work with an EHR (i.e. “hands-on work”). “Hands-on work” involved learning about and using differing EHR features and functions in a laboratory setting. This “hands-on” laboratory work was a new feature added to the course. At the end of the course students were asked to complete an HI competency questionnaire and a second case study - ten weeks after working with the EHR in the laboratory setting. The competency questionnaire and case study answers were collected by the research assistant.

3. Results

The results of the analysis of the demographic data, learning styles inventory data, HI competency instrument data, and case study data are presented in this section of the paper. 54% (n= 17/32) students agreed to participate in the study – a high response rate.

3.1. Demographic, Learning Styles and HI Competency Data

Student participants completed a short demographic questionnaire. The majority of participants were female (13/23; 57%), and between the age 20-24 (16/22; 73%). Most participants were in their third year of the HI program (20/22; 91%) and had completed two cooperative education work-terms (14/23; 61%). Following this, students were given a Learning Styles Inventory questionnaire to assess the dominant learning mode preferences in the class (Brown and Cooper, n.d). Brown and Cooper (n.d.) divide learning styles into three categories: cognitive (auditory language, visual language, auditory numerical, visual numerical and tactile/concrete), social (individual learning, and group learning), and expressive (oral expressiveness and written expressiveness). Using the Learning Styles Inventory, students answered a series of 45 questions on a Likert scale of 4 (“most like me”) to 1 (“least like me”). Questions were divided into the learning styles subcategories (listed above) and tallied [10].

As outlined earlier, participants were asked to complete a HI Competency Instrument both before and after receiving hands-on exposure to the educational EHR (i.e. 10 weeks of using and working with the EHR in the laboratory component of the course). The competency instrument was used to collect data about four competency areas based on Canada’s Health Informatics Association (COACH’s) core competencies: information management, clinical/health sciences, the Canadian health care system, and management sciences. Participants self-rated their HI competencies higher after 10 weeks of hands-on exposure to the EHR on 10 out of the 18 (56%) competencies at the 0.05 level. Specifically, participants rated significantly higher on 3 of the 6 (50%) questions pertaining to information management, 3 of the 6 (50%) questions related to clinical and health sciences, and 1 of the 2 (50%) questions about management related HI competencies. Meanwhile, participants scored significantly higher on 3 out of the 4 (75%) measures relating to the Canadian health care system. In summary, participants had significantly higher ratings ($p < 0.05$) on 10

out of the 18 (56%) HI competency measures after having hands-on exposure to the EHR.

3.2 Case Study Data

Anonymized student solutions to the case studies were judged for their quality by two HI researchers who have industry experience. As well, case study data was provided in random order to our experts who judged the quality of the EHR design solutions. In HI, experts from the field are often used to develop and validate the representativeness of study materials to ensure the ecological validity or real-world representativeness of tasks participants are asked to perform [5].

The quality of the solutions to the case studies were scored on a five point Likert Scale (where 1 = poor and 5 = excellent) by two graduate level HI experts. As part of this process, the experts commented on the strengths and weaknesses of each of the solutions. The experts were blind to the students who solved the case studies and whether the case study was completed before or after receiving the lectures only or “hands-on work” with the EHRs (to prevent bias in reviewing the student solutions). The evaluators are familiar with the professional competencies, and evaluating the quality of EHR solutions. The first case study (prior to hands-on use of the EHR) was completed by 17 participants. Meanwhile, the second case study (after EHR use) was completed by 22 participants. Student participants’ scores remained the same (i.e. a 0.23 difference on a 5 point Likert scale). Both the case study given before the EHR intervention (Case Study 1) and the case study given after (Case Study 2) had a median of 4; however, the mode in Case Study 1 (i.e. 5) was higher than that of Case Study 2 (i.e. 4). Tests for differences were conducted for the case study scores. No statistically significant differences were found for the quality of the case scores.

The researchers also determined the number of unique data elements (i.e. number of points brought up by students) that were present in the responses to both cases (pre and post implementation). The mean number of data elements per participant was higher in Case Study 1 (6.35) compared to Case Study 2 (5.5). However, both the median and mode are higher in Case Study 2 (median = 6; mode = 6) compared to Case Study 1 (median = 5; mode = 5). Overall, the mean number of data elements was higher in Case Study 1, meanwhile the mode and median were higher in Case Study 2.

Student answers to the cases were also qualitatively analyzed for key themes related to the COACH core competencies. 17 themes emerged from the data. All of the themes were common across both case study solutions (i.e. they appeared in both). However, the frequency of the majority of key themes increased by 53% from Case Study 1 to Case Study 2. For example, more students for Case Study 2 identified how EHRs reduce medical errors and redundancy, and increase efficiency as important themes. As well, the frequency of themes surrounding record availability and patient management also increased from Case Study 1 to Case Study 2. Other important themes that were more prevalent after hands-on exposure to the EHR included DSS, public health, privacy, and better interface designs.

Alternatively, there was a decrease in the frequencies for the following six (6/17; 35%) themes: interoperability, records being available, information exchange, storage, patients having access to information, and information organization/data management. Meanwhile, participants noted cost savings, and comprehensive medical data equally in both case studies (2/17; 12%). Overall, the majority of themes that emerged in this

study increased from the baseline administration of Case Study 1, to the administration of Case Study 2 (after gaining hands-on experience using an EHR).

4. Discussion and Conclusion

This research is one of the few studies that specifically focuses on how HI undergraduate students (rather than nursing or medical students) acquire health IT competencies in a four year baccalaureate program. The study also shows that hands-on exposure to an EHR as a new addition to a course can lead to statistically significant improvements in student competency development in 10 health professional competency areas (as described by COACH). With the introduction of hands-on exposure to the EHR, students now have the opportunity to use an EHR in a laboratory setting, experience its features, functions and workflows as well as observe how data is inputted and retrieved. This EHR also allows students to see how the technology acts as a data collection tool for healthcare administrators so that the data can be extracted and used in quality improvement (thereby improving the healthcare system overall). Lastly, students became more sensitive to the ability of the EHRs to reduce medical errors and redundancy of information while improving healthcare organizational efficiency (as evidenced by the answers to the case studies). A limitation of this study is its pre/post test design. We were unable to randomize the students to an intervention or control group due to the limited number of students in the class. Future research needs to explore the effects of introducing hands-on usage of educational EHRs upon undergraduate and graduate (i.e. Masters, Doctoral) student basic and advanced HI competencies throughout a typical HI curriculum. As well, there is potential to use clinical simulations in conjunction with EHRs as a method for teaching students about technology. Such research would help academics with tracking of student competency development and lead to studies where differing types of teaching techniques and course content could be studied to identify those teaching strategies and approaches that best support student competency development.

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