Enhancing Students' Learning Experience through Interdisciplinary Research

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Abstract

This paper describes an approach of enriching computer science & engineering education by engaging students in an interdisciplinary research project. The research project is put forth by a join interdisciplinary research group that consists of students and faculty members from College of Computer Science & Engineering and College of Nursing. One of the goals of this interdisciplinary collaboration is to broaden students' research and education experience, and in the mean time to engage students in solving real world problems that have great impact in our society. This paper presents some of the lessons learned and provides some recommendations of conducting successful interdisciplinary research involving students in the near future.

Keywords: computer science education, learning experience, interdisciplinary research, collaboration, nursing language

1. Introduction

The rapid advancing of science and technologies provides new challenges in engineering education and research. The complex research problems we are facing today require students to have special problem solving skills based on a well-rounded, multidisciplinary education. Computer science and engineering curricula provide students with the solid foundations in computing theory (e.g., data structures, algorithms, and computation theory), and in computer systems (e.g., compliers, computer operating systems, and computer architectures), and advanced topics in computer science and engineering fields. However, to better prepare students to embark upon today's complex application domains, we should expand students' education beyond traditional computer science curriculum, and expand their knowledge into other disciplines.

This paper describes an effort put forth by an interdisciplinary research group of students and faculty members from the Florida Atlantic University College of Computer Science & Engineering and the College of Nursing. The goal is to broaden students' research and education experience, and to engage students with solving real world problems that have great impact in our society.

The next section provides an overview of some of the unique challenges of computer science and engineering education. Section 2 describes a joint research project between College of Engineering and College of Nursing, its background and goals, and the need to engage an interdisciplinary research team. Section 3 presents an interdisciplinary education process of the joint project that involves faculty and students from both College of Engineering and College of Nursing, and describes three acute activities of the process. Section 4 summarizes student learning experiences discussed in this paper, and offers advice on conducting successful interdisciplinary research involving students in the near future.

2. A Joint Research Project of Computer Science and Nursing

To improve Computer Science & Engineering students' learning experience and to engage them in real-world applications, College of Engineering and College of Nursing in Florida Atlantic University initiated a joint project, Nursing Language Project (NLP), which has been carried out for over two years with the support from both colleges. The project created caring-based nursing language research that integrates expressions of nursing practice into electronic reports of healthcare practice with the aims of improving the outcomes of treatment, advocating health promotion,

and illness prevention.

2.1 Project Goals

One of the goals of the project is to develop and test electronic health record (EHR) software to capture and manage distinctive nursing practice. During the past two years of collaboration, the research team has advanced the research work to capture the improvements and outcomes of patients due to the pivotal roles nurses play in healthcare of patients [3][5].

A growing body of nursing literature, including emphases on theory, research and practice, is based on the premise that caring is the essence of nursing ([1] [1] [8] [7] [4]). Nursing provides care for the patient at times when the patient needs it the most. Nurses constantly thrive to ameliorate unhealthy conditions of the patient under treatment. Nurses apply their knowledge to promote strength, empowerment and well being for patients through nursing practice, using an expansive and complex repertoire of knowledge from the field of nursing and adapting information from medicine, psychology, sociology and ethics. In spite of the critical role played by a nurse in improvement of health of the patient, contribution of nurse in health care often remains unnoticed and usually not recorded in the electronic record.

The U.S. government aims to have most health records in use in the United States be electronic within the next few years. Although many efforts have been put forth on electronically capturing medical data and some advancement in nursing informatics in recent years, few of those have significantly computed the nursing values applied to monitor the effect of nursing practice on the patient, and provide electronic health record available to record caring as expressed in nursing practice.

Nursing informatics is a field that integrates nursing science, computer science and information science to manage and communicate data, information, knowledge and wisdom in nursing practice [2]. While other nursing informatics approaches concentrate on various aspects of medical care that nurses perform, this paper focuses on graphically extracting patterns and trends of nursing practice illustrations reflecting distinctive nursing values, hence quantitatively analyzing caring expressions of nursing and giving structure to unstructured data.

This joint research project between College of Engineering and College of Nursing is to create an electronic nursing encounter form, and to develop a knowledge-based classification and decision support software system for nurses that can be used to capture and manage nursing practice and using the language of nursing. The system reduces the paper work for nurses and provides computer-based interface to input and store reports of nurse – patient encounters. The system can also help the training of nursing students in learning knowledge and practice of nursing. This research is one step advanced towards the development and use of a comprehensive electronic health record (EHR) for more efficient and effective healthcare and clinical research.

2.2 Research Team

The nursing language project (NLP) application domain encompasses the knowledge from both computer science and nursing, including both theory and practice from each discipline. To properly carry out interdisciplinary research, the research team sought to develop harmonious collaboration for faculty and students from both colleges. The core team is comprised of, on the nursing side, one nursing faculty, one nursing postdoctoral fellow, and two doctorial nursing students. On the engineering side, there are three faculty members and three masters students on the team. After a challenging beginning due to different domain languages of unique disciplines, over the last two years members from both disciplines have been working in tandem on the project and have produced significant results, including prototype software, peer-reviewed publications and a provisional patent application.

3. Interdisciplinary Education Process

To demonstrate students' engagement of the interdisciplinary research, this section identifies three interrelated aspects of the interdisciplinary education process that have played a pivotal role in the cordial collaboration and productive teamwork. These three aspects include preparing good background knowledge foundation, establishing effective communication, and deploying satisfactory results.

3.1 Preparing Knowledge Foundation

Most of computer science & engineering curricula are science and technology oriented. They focus on some of the basic core courses, such as data structure and algorithms, computer architecture, computer operating systems, and software engineering. Very few courses and training opportunities provide engineering students with the necessity skills to conduct human subject and qualitative research, such as nursing, psychology, sociology and ethics aspect of the research; all essential for working on nursing language project. Preparing students with a good foundation for the research topic is the first step for a successful team project. Towards this goal, in addition to investigating the suitable computer science technologies for the research, some procedures are in place to make sure students have adequate understanding of the nursing domain to which the final computer software application will apply.

- Background reading: Students are required to read some basic nursing theory literature and nursing informatics papers to get familiar with the application domain.
- Field trip to clinics: To develop an efficient and effective electronic nursing encounter form and nursing knowledge software, computer science students should better understanding how nurses conduct daily encounters with patients and how nurses practice caring. Field trips to university's clinics are tremendously helpful to give students first-hand experience and envision how they could apply their computer science & engineering knowledge into healthcare and nursing practice. During the field trips, students observe nursing practice and have close contact with nurses to have responses to their questions.

Coupled with background readings, the field trips have been proven to be very beneficial for engineering students to prepare good foundation to conduct research in the interdisciplinary team.

3.2 Establishing Effective Communication

Language is essential as a mode of communication to preserve and transmit knowledge and culture. The distinct language of a profession gives meaning to terms and expressions as well as knowledge of needs and appropriate responses in a given situations [3]. Different disciplines have unique scholarly and professional vocabularies and technical jargons; so it is with the disciplines of nursing and computer science. Dealing with different domain knowledge and language is a typical engineering problem. Properly capturing complete and consistent user's requirements are known challenges in engineering. When it comes to the need to work in an interdisciplinary research team, and the need to capture user requirements from an application domain with which students are not familiar, speaking different professional languages and vocabularies exacerbates the already difficulty tasks from software education point of view [1].

Very often early in the research project, members of the team spoke in their own professional languages and vocabularies and those members were understood only among themselves. This resulted in situations of lack of sharing and often discussions seemed to be "a Babel of voices", whose situation made any advancement of the research difficult.

To overcome these barriers of understanding engaged in intensive weekly meetings involving all stakeholders. Besides getting help and guidance from nursing faculty, the computer science students now seek help and explanation from a variety of nurse practitioners who are nursing Ph.D students. Metaphors, personal experience, and observation in field trips to clinics are all means to enhance effective communication so that a good and thorough understanding of the stakeholders' requirements is achieved. After overcoming the initial communication hurdles, now the two sides of the team can have seamless conversation and understanding of each other and of cross disciplinary knowledge. This effective communication between the two application domains has generated teamwork at its best with synergy that is very productive and satisfactory.

3.3 Deploy Satisfactory Results

Having adequate domain knowledge is essential to capture users' requirements; proper communication is critical for moving from an interdisciplinary team to a transdisciplinary research effort. Following software engineering principles, the development of the nursing language software is an iterative and incremental process, during which domain knowledge, timely and precise communication play pivotal roles for the success of final products.

During the development and deployment of the nursing language software, engineering students receive frequent feedback from end users, such as nurse practitioners and nursing faculty and students. From nurses-patient encounter data collection, user interface design, to out put format, these constructive feedbacks provide validation to both functional and non-functional requirements of the software systems. Frequent users' input and involvement make the

deployment and adoption of the prototype software easier. Part of the results of this research project has filed provisional patent with the U.S. Patent Office. The usefulness of the software and the impact it has created in healthcare and clinical research in turn encourage engineering students to make the nursing language software better.

4. Summary

This paper describes an experience of engaging engineering students in an interdisciplinary research project, which involves faculty and students from College of Engineering and College of Nursing. One of the purposes of this joint project is to utilize computer science & engineering technology in nursing care and practice, in the meantime, enhancing students' learning experience by applying what they have learned in computer science & engineering to a different application domain and generate impact in healthcare and nursing clinical research. Some of the activities in the interdisciplinary research process have been discussed, including preparing a good research foundation for students, establishing an effective communication between two different application domains, and developing satisfactory results to end users. The ever-changing world of technologies in computer science & engineering field provides unique challenges in engineering education. It requires our students to be renaissance engineers [6] in order to be competitive in the global environment.

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