INTEGRATING PROFESSIONALISM INTO CS/CIS CAPSTONE COURSES USING A COLLABORATIVE TEACHING/LEARNING APPROACH

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ABSTRACT

The realized benefits of integrating professionalism into CS and CIS capstone courses through collaborative teaching/learning are outlined. We believe that the lessons we have learned in the process are transferable across academic disciplines.

Keywords: professionalism, collaboration, teaching, learning, CS/CIS

INTRODUCTION

Why and How should professionalism be integrated into CS/CIS curriculums? Let’s begin with the first question: Why? Professionalism in CS/CIS has been the subject of many papers, workshops, conferences and discussions. Just searching for the word ‘professionalism’ on the Association of Computing Machinery (ACM) web site’s (www.acm.org) collection of bibliographic citations and abstracts guide, yields 544 results ranging from the early 1970’s through the present time. Further, Peter Denning (2, p. 15) states “Students aspiring to be professionals look to faculty for a comprehensive, up-to-date view of a world with many fragments, for making sense of rapidly changing technologies, for assistance in framing and answering important questions, and for training in effective professional practices.” The study of professionalism continues to be an important issue in the computing disciplines. According to the Joint Task Force on Computing Curricula 2001 Final Report (7, p. 141), “Although technical issues are obviously central to any computing curriculum, they do not by themselves constitute a complete educational program in the field. Students must also develop an understanding of the social and professional context in which computing is done.” The Joint Task Force goes on to say “Computing Curricula 2001 must include professional practice as an integral component of the undergraduate education” (7, p. 13). It appears that there is general agreement that we need to include professionalism in CS and CIS curriculums. But that leads us to the next and most important question: How? This paper suggests that one way to incorporate professionalism into the computing disciplines is by using a collaborative teaching/learning approach in CS and CIS capstone courses. We are not suggesting, however, that this should be the only place in which undergraduate students receive such instruction. Professionalism should be interwoven throughout the entire CS and CIS curriculums. But we do suggest that the CS and CIS capstone courses provide an excellent opportunity for the student to coalesce what they have learned. Just as the students must apply the technical concepts they have learned throughout their course of study to real-world projects, they must also demonstrate an understanding of the social and professional context in which computing is done. Using this collaborative approach, we combined both the CS and CIS capstone classes to examine professionalism in the computing disciplines. In the next sections, we define what we mean by professionalism and collaborative teaching/learning, discuss the methodology we used for integrating professionalism into the CS and CIS capstone courses and describe the resulting benefits.
for our students and ourselves.

**BACKGROUND AND LITERATURE REVIEW**

What is professionalism? There doesn’t appear to be a consistent or agreed upon definition of professionalism particularly as it relates to the computing discipline. John Quiggin, an Australian economist, states that the primary definition of professionalism is “…that of individual professionalism: the idea that membership of a profession carries with it a set of internalized values that will be reflected in the way in which work is carried out and the ethical standards that are adhered to... (12).” We began by looking at our own definition of professionalism. We started with the goal of our computing disciplines: “…to prepare students for a career in computing by providing a foundation for life-long learning through professional development and/or graduate study” and integrated Quiggin’s definition of individual professionalism. We defined professionalism for our capstone courses by dividing our subject matter into three segments: software engineering and system methods (the way in which work is carried out), ethics (internalized values and ethical standards) and career goals (membership of a profession). We integrated these segments by using a collaborative teaching/learning approach, which allowed for multiple views and open discussions. First, let’s look at collaborative teaching/learning.

**Collaborative Teaching**

There are various terms regarding the shared responsibility and delivery of instruction in classrooms, many of which have been used synonymously such as team teaching, co-teaching, cooperative teaching and collaborative teaching (15). For the purposes of this paper, we define collaborative teaching as two or more educators, working together in a joint intellectual effort, delivering meaningful instruction to groups of students in an academic environment. Most team teaching approaches utilize teachers in the same subject (16); the collaborative approach allows for teachers representing different disciplines. Further, the collaborative approach does not mean that all educators must be together in the same classroom, or even teach the same group of students or even the same project. In this case, collaborative teaching means both, multiple teachers directing class projects between separate classes as well as joint sessions with the separate classes.

Collaborative teaching in higher education especially across disciplines and between academic institutions is the exception (1) even though research has demonstrated this as a best practice for improving student outcomes (10). This is mainly due to the problems encountered in team teaching such as the use of multiple faculty resources to teach one class, conflicts in teaching style, course presentation and grading, and academic time and energy constraints (4). In our collaborative teaching, we taught and ran our specific classes separately except for one two-hour session per week when our classes would meet jointly. This alleviated some of the problems associated with team teaching, while at the same time allowed for interdisciplinary integration of material.

**Collaborative Learning**

In addition to collaborative teaching, we also used a collaborative learning pedagogy. “Collaborative learning has typically been conceived of as the instructional use of small groups of students working together to maximize their own and each other’s learning (13, p. 184).” There is a wide variability in collaboration learning activities. We used an open-discussion forum, which
centered on the students’ exploration of the topic at hand, not just on the instructors’ presentation or explanation. “Through dialogue learning as shared inquiry evolves by critically exploring the perspectives of others (9, p. 79)”. Collaboration emphasizes holistic learning and identifies four values; touching the affective not just the intellectual level, working with the experiences and situations of the participants, strengthening the cognitive to go beyond mere transmission of subject matter and enhancing the social and relational process (9). Collaborative learning has been shown to promote high level critical thinking, to increase student retention through increased positive social and academic support, to increase authentic learning and assessment, and to promote a variety of positive personal, interpersonal and academic outcomes (6).

In our collaborative teaching/learning approaches, we created learning environments where students were exposed to multiple viewpoints and expertise from instructors both inside and outside their disciplines as well as from their own peers. As suggested by Langenberg (8), the ultimate responsibility for effectively delivering all forms of learning is shifted from the individual faculty member to all members of the computing disciplines.

OVERVIEW

The ideas for using the collaborative teaching/learning approach began in 2003 when the CS and CIS departments undertook assessment and program review of their respective departments. While designing and implementing assessment plans for the CS and CIS majors, the assessment process brought forth many similarities in the objectives and goals for the students in these majors as well as in the curriculum. Primarily, the core courses were the same. The main difference in the majors is the area in which the student desires to apply the core knowledge. The first courses taken by CIS and CS students allow the instructors to introduce and develop the theory of their particular disciplines including basic programming and methodology. The CS students’ second and third year courses include operating systems, programming languages and theory of computation. The CIS students’ second and third year courses include team projects using software engineering, database and system analysis and design approaches. The final portion of the courses taken by both CS and CIS students includes a capstone course. The capstone courses are both essentially project courses in which the students use all CS and CIS faculty as mentors and have similar goals and objectives particularly in the professionalism area. For the CS student, this course involves an individual project that integrates and extends several areas within computer science. For the CIS student, this is a systems projects class in which the students must complete a real world project integrating computer science concepts with the different business functional areas of an organization. The aim of these courses is to allow students to apply the knowledge and skills they have acquired and to extend their knowledge. The goals of course projects are to “prepare students for the working life, making them familiar with the work place by practicing their skills on real-world problems”(11) as well as to “provide students with an insight and a flavour of research methodology that should be useful for those students who continue to study (11).” Jarvinen (5) states that one of the most important things in education is to adjust the teaching methods to the nature of the content. The main objective of our collaborative teaching/learning in the CIS and CS capstone courses is to develop teaching methods and approaches that are more meaningful and interesting for the student. The teachers’ role in these projects changed from that of an instructor to the role of a facilitator of learning and coordinator of learning environments.

METHODOLOGY
We begin in the classroom. For two hours every Tuesday morning, the CS and CIS capstone students, the instructors for the capstone courses, as well as other instructors from the computing disciplines, meet together to discuss issues ranging from systems management and software engineering, to cyber ethics, to career paths. From a systems management and software engineering perspective, the students are required to read and discuss *The Mythical Man-Month* by F. P. Brooks and *The Cathedral and the Bazaar* by Eric Raymond as well as present their semester projects in class. For cyber ethics, a collection of articles of software engineering, software development responsibility, hacking, and other ethical issues selected by the instructors are required discussion material. For career paths, students are required to submit resumes, philosophy statements about the computer profession and how they fit within the discipline. Speakers including the Director of Career Services are invited into the class to present career path plans and to discuss career goals. Students are also required to help host an Information Technology Symposium where invited CS and CIS alumni discuss their own career paths and goals. For each session, one student from each group (CS or CIS) is responsible for leading the discussion topics. Normally, a portion of each topic (systems, cyber ethics and career paths) is covered in each session.

**Problem**

One of the major concerns we had was in discussing these topics. Take, for example, cyber ethics. The major problem with ‘teaching’ cyber ethics is that when discussing new information technology the impact or consequences of that technology may be yet unknown. Herein lies the dilemma for cyber ethics. How do we teach our students how to resolve unknown ethical conflicts? There are many ethical principles for resolving moral and ethical conflicts, for example, the golden rule, Kant’s categorical imperative, Descartes’ rule of change, Utilitarian principle, the risk aversion principle, the ethical ‘no free lunch’ rule, egoism, natural law and respect for persons, to name just a few. Unfortunately these ethical rules have too many logical and substantive exceptions to be absolute guides to action. Add to this mix, college students. Research on contemporary college students suggests that current students do not necessarily follow laws or rules unless they see direct implication and meaning in their own life (14). We need to empower our students to shape their own lives and make their own decisions based on rational and ethical thought, particularly for those in the computing disciplines. Solving discrete ethical problems as a deontologist or as a utilitarian is not enough. The focus should be on how to develop ‘practical wisdom’ rather than what to do in an isolated situation. This holds true for each of the three areas of professionalism. But how do we go about accomplishing this?

**Pedagogy**

Our solution was to let the students be responsible for and to lead the discussions. However, true collaborative learning occurs only through carefully structured educational experiences, experiences coordinated by teachers to create circumstances under which students can deepen their own learning while they share academic and social experiences with others (13). So we had to create an environment open to sharing and learning while at the same time structuring the experiences. We accomplished this by placing the chairs in the classroom in a circular format and selecting appropriate materials while maintaining direction. In addition, we were concerned about the makeup of the class. Five of the students were male and were CS majors. The
remaining five students were from the CIS capstone course, four of them male (two business majors and two CIS majors) and one female CIS major. There were three instructors who normally attended the joint sessions. Two instructors were female (one CS faculty and one CIS faculty) and one instructor was a male, CS faculty. The three instructors added valuable insights and discussions, particularly since they were from different disciplines and also helped provide a gender balance, however, the focus was always on what the students had to say. We thought the mix of similarities and differences would create a lively, stimulating environment in which people would learn from each other and would enable us to show that professionalism has a direct implication and meaning for each of the students.

To determine the benefits or problems our students had with this approach, we conducted a brief anonymous survey. Additionally we asked test questions on what the students had learned regarding the material in the Tuesday joint sessions at the end of the last joint session. We report these results as well as our own reflections on this approach.

**SUMMARY AND CONCLUSIONS**

Perhaps the most important objective was to encourage the applications of student learning in experiential collaborative settings involving the synthesis of professionalism into the student’s perceptions of the computing discipline. We hoped that this would also provide ancillary benefits to the students involved; leading discussions should enhance their personal skills and self-confidence and the career discussions should prove helpful in job-hunting. In order to assess the results of this experience for the students, at the end of the joint sessions we asked the students to respond in writing to two open-ended questions, one about the software engineering and systems methods readings and discussions and one about the ethics readings and discussions. Additionally, we asked the students to complete an anonymous survey asking about their perceptions regarding software engineering and systems methods, ethics and career goals as well as this collaborative approach. The survey was ten questions with responses based on a 5-point Likert scale (1-strongly disagree to 5-strongly agree) with the option to add comments after each question. The questions about each specific area were mixed throughout and question reversals were used. The students were asked to write their majors on the survey.

**Student Response**

For the open-ended questions, the students’ responses were mainly related to the stage of development of their semester projects at the time of the survey. That is, on the software engineering and systems methods questions, both CS and CIS students stated they learned more about design and planning issues, the importance of documentation and specifying the scope of their projects. The five CS students were also concerned with time constraints and project scope whereas the five CIS students stated they also learned more about team building and prototyping. The open-ended question on ethics again brought forth many similar responses from both CS and CIS students. Both CS and CIS students mentioned programming responsibility, professional certification issues and testing. The CS majors were also concerned with project management and reliability issues. Overall, the responses from the students stated that they liked this collaborative approach, it contributed to their overall learning and had direct implications and meaning for them about software engineering and systems methods, ethics and career goals (i.e.
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professionalism). From the survey, the highest positive response was to the question, “Classroom discussions of assigned readings have added to my understanding of accepted software engineering practices.” All CS and CIS students responded to this question with ratings of 4 or 5 on a 5-point scale. Evidently, the Mythical Man-Month readings and discussion made a significant impression on the students. The next highest positive responses were to the questions, “The diversified learning environment created by the presence of both CS and CIS faculty members has exposed me to a wider variety of perspectives” and another question concerning “…exposure to a wider variety of perspectives.” This suggests that our collaborative approach added value to the students by providing them the opportunity to see themselves and their peers as constructors of new knowledge as well as the opportunity to offer their opinions and have a greater connection to the faculty. One CS student remarked, "Interesting being exposed to the managerial and etc., factors that I do not experience in CS." A CIS student stated that "I think this has been the most informative/fun format of learning I have been exposed to."

There were however, some drawbacks. One of the discrepancies that we noticed was that most of the students agreed that professionalism did not differ substantially between CS and CIS majors (8 out of 10). However, two of the students felt there was a significant difference between CS and CIS professionalism. Additionally, students saw the ethics readings as dealing more with developing secure and trusted software, rather than directly addressing ethical responsibilities of computing. We plan on addressing these issues in future courses and reexamining our ethical articles and materials.

Faculty Response

Faculty participants separately wrote and then discussed the benefits and problems encountered in this collaborative approach. For us, the synergy of collaborative teaching has opened the door to improving our teaching by continuous scrutiny of our approaches and course materials, which improves course content, improves pedagogy and contributes to our own intellectual development. Collaboration also reduces isolation, allows for another perspective on our own ideas of professionalism and creates connections between disciplines. This collaborative approach has also helped us in terms of program assessment and development in both CS and CIS programs. But most importantly we were able to meet our mutual educational goals with interdisciplinary and interacademic approaches to teaching. Finally, this approach increased the rapport among students and instructors, instructors and instructors, students and students, which adds to the overall college community experience. Actual conversations took place. Due to the valuable experiences gained by all involved, we now feel committed to continue and expand this collaborative teaching/learning approach for all CS and CIS students in all our future capstone courses. According to Denning (3, p. 19), "IT is a profession of many specialties. No one traditional degree program has the required breadth. IT curricula must include a professional body of knowledge complementing the intellectual body of knowledge." We feel our collaborative teaching/learning approach provides a unique educational opportunity for integrating professionalism into the CS and CIS curriculum.
REFERENCES