https://doi.org/10.48009/1_iis_2006_77-82

COLLABORATIVE TEACHING: CHANGING THE WAY WE EDUCATE COMPUTER INFORMATION SYSTEM MAJORS

Kathleen K. Molnar, St. Norbert College, kathy.molnar@snc.edu
Bonita M. McVey, St. Norbert College, bonnie.mcvey@snc.edu
David C. Pankratz, St. Norbert College, dave.pankratz@snc.edu

ABSTRACT

This paper explores changing the way we educate our CS/CIS majors by combining the CIS and CS majors and creating three separate concentrations: computer science, business information systems and graphics design and implementation. We believe lessons learned in the process are transferable across academic disciplines and may help address declining enrollments and resources and increase interdisciplinary interactions.

Keywords: Collaboration, Teaching, CS/CIS, Concentrations

INTRODUCTION

"Computing we have a problem…." That's the title of a May, 2005, article in *Computing Research News* by Jim Foley [2]. In the article, Dr. Foley discusses the image problem that the computing community suffers because the public does not "…fully understand, and hence does not appreciate, what computing is…" The public, including prospective students and their parents, equate computing with programming rather than seeing programming as a tool used in developing software solutions to difficult problems. This image problem is causing reduced funding and decreased enrollments. That was one of the problems we had in the computer science (CS) and computer information systems (CIS) departments of a small, private, liberal arts college. We thought we had a brand recognition problem. Potential incoming students didn't understand our majors. In the beginning, we addressed the problem by trying to segment our market. We had a CIS major and a Math/CS combined major. In 2000, a major in CS was established and the Math/CS major was dissolved. We believed that this segmentation would better clarify our majors to incoming students and employers; this would help in the admissions recruitment process and also create stronger programs in both areas. Although this initially resulted in an increase in the number of new CS majors, the number of majors in CIS drastically declined. Further, the number of CS majors nationally has been declining [4, 12, 14].

The separation of the CS and CIS majors caused administrative difficulties as well. In 2002 the required documentation of assessment efforts and student learning outcomes increased substantially. Additionally, in 2003 the entire college began the process of an overall program review of each and every major and program. As we began the CIS and CS program assessments, the process brought to light many similarities in the objectives and goals for the students in these majors as well as in the curriculum. In addition, we felt we were lacking an important option in the major since several students were attempting to double major, to minor, or even to create a personal major in the areas of graphic design and implementation which was not currently addressed in either the CIS or CS majors. Furthermore, through our program review process, it became evident that the numbers of both CIS and CS majors were continuing to decline and that we were competing with each other for majors. Our funding and resources were also declining.

In response to these problems, the CS discipline and CIS committee opted for a radical change. We had already somewhat combined forces in teaching the CIS and CS capstone courses [7, 8]. We took the next logical step and combined the CIS and CS majors into one and from that created three separate transcriptable concentrations: computer science (CS), business information systems (BIS), and graphics design and implementation (GDI) (Table 1). This paper is a discussion of how we went about accomplishing this goal, the problems encountered and lessons learned. We believe that the lessons we have learned in the process are transferable across academic disciplines and may help others in addressing declining enrollments and resources as well as increasing interdisciplinary interactions.

Table 1. Computer Science Major with 3 Concentrations

	Computer Science Concentration	**Business Information Systems Concentration**	Graphic Design and Implementation Concentration
Common Core (6):	Calculus I Intro. to Programming Software Engineering & Elementary Data Structures Advanced Data and File Structures Machine Organization and Assembly Language Senior Capstone Experience in CS		
CS Required:	Programming Languages Operating Systems Theory of Computation or Analysis of Algorithms CS Application Elective (4)	DatabaseTechniques & Modeling CS Elective (2)	Event Programming CS Elective (2)
Other Required Courses:	Calculus II Discrete Mathematics (2)	Financial Accounting Foundations of Management Marketing Concepts and Issues Stats. for Business & Economics Bus. Apps using Sys Anal. & Design BA Elective (6 BA Courses)	Basic Drawing Drawing, Design & the Computer Computer Graphics Design for the Web Photography & Electronic Imaging or Advertising Design (5 ART Courses)

BACKGROUND AND LITERATURE REVIEW

For this new major with concentrations concept to work, we had to continue and even expand our collaborative teaching approach. 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. While most team teaching approaches often involve teachers in the same subject [13], the collaborative approach allows for teachers representing different disciplines. Further, the collaborative approach does not mean that both 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 simply means multiple teachers directing separate class projects.

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 [9]. 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 [3]. In terms of our collaborative teaching approach, one instructor is in charge of the capstone class and then instructors with expertise outside his/her discipline provide supplemental instruction and support for the instructor and the students. This alleviates the problems associated with team teaching, while at the same time allows for interdisciplinary integration of material.

In our collaborative teaching approaches, we created learning environments where students were not only encouraged, but were also required to seek expertise from instructors outside the course. As suggested by Langenberg [6], the ultimate responsibility for effectively delivering all forms of learning is shifted from the individual faculty member to the department, and in our case, multiple departments. We had to combine resources including expertise.

PROJECT OVERVIEW AND METHODOLOGY

The collaborative teaching approach only makes sense if you do not lose the integrity of the programs. The main objective of collaborative teaching in CIS/CS courses is to develop teaching methods and approaches that are more meaningful and interesting for the student. The first courses taken by CIS/CS students allow the instructors to introduce and develop the theory of their particular disciplines, including basic programming. The second and third year courses taken include team projects using software engineering, database and system analysis and design approaches. The core courses taken for all three concentrations are identical. Each concentration has additional requirements for the particular concentration. The computer science concentration takes additional computer science and math courses, the business information system concentration takes database, a CS elective, and additional business and systems analysis and design courses, and the graphics implementation systems concentration takes event programming, a CS elective, and additional art courses. The final portion of the courses taken includes a capstone course. In the past, before the majors were combined, the capstone course for the CS major involved an individual project that integrated several areas within computer science. For the CIS major, this was a systems projects class in which the students must complete a real world project integrating the computer science concepts with the different business functional areas of an organization. By creating one capstone course for all three concentrations, collaborative teaching became a necessity. Now the capstone course needed to fulfill the requirements for all three concentrations in each specialized area. The teachers' role in these projects had to change from an instructor to the role of a facilitator of learning and coordinator of learning environments and had to include outside expertise from each concentration area.

For this first semester of the revised capstone course, which is now the same for all three concentrations, there was one lead instructor who is in the CS discipline. A major concern was that we not lose the integrity of the programs. We wanted to ensure that the business information system concentration was still a CIS team project, not a CS individual project and the graphics design and implementation project was a GDI project. Since the aim of these projects is to allow students to apply the knowledge and skills they have acquired and to extend their knowledge, we needed to make sure the capstone course was still unique to each concentration and included all aspects of what they had learned in their respective concentrations. 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"[10] 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"[10]. Jarvinen [5] states that one of the most important things in education is to adjust the teaching methods to the nature of the content. We had to make these adjustments to maintain the integrity of this program. The only way to accomplish this was through a collaborative process.

Since the lead instructor for the capstone course was from the CS discipline, the computer science concentration projects retained essentially the same process. At the beginning of the semester, computer science concentration students are given a project description and requirements. The first requirement is to research methods to solve the problem, determine all necessary hardware to implement its solution and then using good software engineering principles, build their solution. The CS projects are general application problems with a focus on ease of use and the development of systems such as detecting motion for a security system, operating robots using vision, or encrypting secret messages within images. When necessary, students are expected to acquire any additional skills to complete their projects. All CIS/CS faculty collaborate with the students, serving as resources for information and feedback. In addition, students often collaborate among themselves for their projects may be related through a larger problem.

However, for the business information systems concentration a team project had to be selected in conjunction with the CIS discipline instructor. That is, for the business information systems concentration, the capstone project had to be a CIS *team* project. The focus of the CIS project was a specific business application for a specific user such as an online voting system for the faculty, a database system for a parent volunteer organization for a school, or a building permit database for a city. The CIS instructor also had to assist in the systems analysis and design aspects as well as being the point person for the CIS team project. This is a major concern that needed to be addressed, since given the nature of CIS, the project needed to be drastically different than the CS projects. Additionally, the team project needed to be addressed from a CIS perspective. In many instances, the CIS faculty disagrees with the CS faculty particularly in terms of

design and process. So now comes the dilemma: How do we go about accomplishing this?

The business information systems concentration students had essentially two 'bosses.' The students had to satisfy the requirements of the capstone course while also making sure they satisfied the requirements set by the CIS instructor for their team project. Communication and coordination between the capstone instructor and the CIS instructor was crucial. Given the previous collaboration experiences between these instructors, only minor issues resulted. The instructor of the capstone course ultimately graded the students; however, this was in consultation with the CIS instructor. The instructors had to discuss the project on a regular basis to make sure everyone was on the same track. The CIS instructor met with the CIS team on a regular basis just as though this was a part of the course. The CIS team was also required to submit a weekly progress report to both the course instructor and the CIS instructor.

The project for the graphic design and implementation majors is an individual project, but similar to the business information systems majors, the student has two 'bosses': the capstone instructor and a member of the Art discipline. The GDI projects are general application problems with a focus on visual, human-computer interactions for both general and specific uses such as animated electronic postcards or an advertising/marketing campaign for a specific user. There is little confusion as to the split of responsibilities: the capstone instructor is concerned with functionality and design principles and the Art instructor monitors artistic design and appropriate use of graphics. Since this concentration was created with substantial input from the Art faculty, the necessity for and description of how this collaboration would work were outlined early on. The student met with either instructor individually throughout the semester but the instructors were also in weekly or biweekly communication.

It is essential that the capstone instructor and the outside expert have an excellent working relationship. They must be on the same page as to the requirements of the project and of the students. They must be able to work together to make sure they don't put the students in the middle and to give the students the benefit of multiple expert experience and opinions. They must respect and acknowledge each other's expertise. Outstanding communication and coordination between all faculty and students involved is essential.

SUMMARY AND CONCLUSIONS

Our new major is in its infancy and it remains to be seen how it will finally work out. However, we have already seen benefits from this new CS major with concentrations: it is pedagogically correct, it is more attractive to the students, it is administratively efficient and most importantly, it benefits our students.

The new major is pedagogically correct. The assessment process showed that the goals and objectives for the CS and CIS majors were identical for the courses that are part of the common core. The primary difference of the concentrations is the area in which students apply this core knowledge. Although upper level requirements differ, many of the upper level CS courses are appropriate for students in any area. Therefore, students interested in a computer-related career can explore various options before choosing which area best suits them and CS majors will be more likely to take courses in various areas (both in Social Sciences and/or Humanities), obtaining a more rounded background. Computing is increasingly becoming more cross disciplinary and providing options that partner computer science with other disciplines better prepares our students for careers in designing software solutions in a broad array of fields.

The new major is more attractive to students. We have retained students we otherwise would have lost and the number of contacts from prospective students has increased. We feel that the content of a CS major with a concentration in Business Information Systems is better understood than the CIS designation by both students and industry. The flexibility of being able to choose from an area of emphasis within the CS major makes the CS major more desirable to prospective students and, therefore, should enhance the ability to recruit students. The number of women pursuing CS majors nationwide is very small and is a concern to the computing community. Studies have shown that providing a CS program with curricular options and faculty role models addresses concerns of prospective female CS students and, therefore, will attract more female students to the CS major.

The new major is administratively efficient. The CIS major was monitored by a committee. The CIS committee was eliminated and the CS discipline assumed responsibility for the Business Information Systems concentration of the Computer Science major, consulting with appropriate BA faculty members. Duplication in the assessment and program review process for CS and CIS was eliminated.

Having one capstone course frees up one course in the spring semester and revising the content for a previous systems analysis and design course opened the door to attract other students outside the CS/CIS disciplines.

The new major benefits our students. It exposes introductory students to a wider array of computing professions and perspectives. And because the core courses support all three concentrations, classroom examples and assignments have been altered to reflect the options in the major. The CS majors essentially are a cohort for the first two years and are then reunited in the capstone, bringing a wider array of experience and interests to share and contribute to discussions of ethics, professionalism, design and analysis. But, perhaps the most important learning objective occurs in the capstone course. The course encourages student learning in experiential collaborative settings involving integration of computer science, business concepts, and human-computer interface in terms of graphic design with IS technology. Students discuss and present projects from three different perspectives relative to their concentrations. The interaction of these students from different perspectives broadens their thinking processes. We have increased the ability of our students to work in multidisciplinary groups and to collaborate with other disciplines. We have better publicized and marketed these successful collaborative projects to other disciplines and hence encouraged further interactions. Further, the experience is helpful to the students in job-hunting after graduation. They have created real-world projects in an interdisciplinary environment while incorporating various perspectives.

One major drawback to this approach is that only the actual course instructor gets load credit. However, this is the only way this approach can work for us given that 1) there is no other choice with our current limited resources, 2) this is the only way we can maintain the integrity of the program, and 3) we believe this approach is in the best interest of our students. As Vince Lombardi once said, "Individual commitment to a group effort—that is what makes a team work, a company work, a society work, a civilization work."

The June 2005 President's Information Technology Advisory Committee (PITAC) report [11] states that "…universities must significantly change their organizational structures to promote and reward collaborative research that invigorates and advances multidisciplinary sciences (p. 19)" The report further states that

> "Students benefit when their classroom research training is coupled with hands-on experiences. This suggests that new programs should provide experiential and collaborative learning environments at the graduate and undergraduate level.… These learning experiences should place students in real-world situations, including internships and field experiences.... In undergraduate education, the difficulties of implementing multidisciplinary programs are particularly acute, as both students and prospective employers tend to focus on traditional single-discipline degrees. Nevertheless, undergraduates must be exposed to the capabilities and opportunities in computational science so that they graduate with a more informed understanding of the field and more interest in pursuing graduate computational science programs or degrees. One way to begin is through individual course offerings that may eventually lead to concentrations, minors, and majors in computational science… It is past time for universities to take action. They must examine their educational practices and organizational structures to provide and reward interdisciplinary and collaborative research and education. New structures, programs, and institutional incentives are urgently required" (p. 24).

This new major attempts to address these concerns and yet maintains the integrity for each concentration. We are changing the way we educate our CS/CIS majors.

REFERENCES

1. Bakken, L., Clark, F. & Thompson, J. (1998). Collaborative Teaching, *College Teaching*, *46*(4), 154-157.
2. Foley, J. (2005). Computing, we have a problem…, *Computing Research News*, *17*(3), 2.
3. Forcey, L. & Rainforth, B. (1998). Team teaching "conflict resolution in educational and community settings": An experiment in collaboration and conflict resolution, *Peace and Change*, *23*(3), 373-385.
4. Foster, A. L. (2005). Student interest in computer science plummets. *The Chronicle of Higher Education*. May, A31-32.
5. Jarvinen, E. M. (1998). The Lego/Logo learning environment in technology education: An experiment in Finnish context, *Journal of Technology Education*, *9*(2), 1-14.

6. Langenberg, D. N. (1992). Team scholarship could help strengthen scholarly traditions, *The Chronicle of Higher Education*, 2 September, A64.
7. McVey, B & Molnar, K. (2003). Collaborative teaching using constructionism in computer information system courses. *Issues in Information Systems. IV*(2), 598-605.
8. Molnar, K., Pankratz, D. & McVey, B. (2004). Integrating professionalism into CS/CIS capstone courses using a collaborative teaching/learning approach. *Issues in Information Systems, V* (2), 214-220.
9. Murata, R. (2002). What does team teaching mean? A case study of interdisciplinary teaming, *The Journal of Educational Research*, *96*(2), 67-77.
10. Olsson, B., Berndtsson, M., Lundell, B., & Hansson, J. (2003). Running research-oriented final year projects for CS and IS students, *Proceedings of the 34th SIGCSE Technical Symposium on Computer Science Education*, 79-83.
11. President's Information Technology Advisory Committee (PITAC) Report. (2005). Computational Science: Ensuring America's Competitiveness. http:// www.nitrd/gov/pitac/reports/20050609_computational/computational.pdf.
12. Vegso, J. (2006). Drop in CS Bachelor's Degree Production. http://www.cra.org/CRN/articles/march06/ vegso.html.
13. Winn, J. A. & Messenheimer-Young, T. (1995). Team teaching at the university level: What we have learned, *Teacher Education and Special Education*, *18*(4), 223-229.
14. Zweben, S. (2005). 2003-2004 Taulbee Survey. Record Ph.D. Production on the Horizon; Undergraduate Enrollments Continue to Decline, http://www.cra.org/ CRN/articles/may05/taulbee.html.