AC 2010-1558: WOMEN-CENTRIC SENIOR PROJECTS FOR FEMALES IN THE COMPUTATIONAL SCIENCES FIELDS

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Women-Centric Senior Projects for Females in the Computational Sciences Fields

Abstract

This paper presents a novel and creative approach to teaching a Senior Project course in Computer Science in a way that allows women to educate themselves about health, politics, and other social and well-being issues while at the same time fulfilling the computational, mathematical, and scientific requirements of the course. The Senior Project is a capstone project where students integrate their scientific as well as their software design and implementation knowledge to a real-world problem. As our institution is a minority serving one, we have strived to attract female students to the science, technology, engineering, or mathematics (STEM) fields through different means including active recruitment, mentorship programs, scholarships, and internships, just to name few. Our latest effort, reported in this paper, is to allow female students to select an area of great impact on their health and/or social well-being, and to investigate it in depth through their senior projects. The approach is called Collaborative Computer Science Women-Centric Senior Projects (CCS-WC-SP). Our goal is to eventually incorporate input from all major departments and schools of the university (University of Texas and Texas Southmost College (UTB/TSC)), thus allowing women in particular to design and implement early in their careers projects that could involve not only computational aspects but also health, medicine, psychology, sports, and politics, among many other subjects.

Introduction

It is hardly disputed that the face of America's workforce in the fields of Engineering and Computer Science (and in fact many others) rarely resembles that of America itself. And despite gender equity and many federal and state anti-discrimination acts, men still dominate these fields, and women lag behind. UTB/TSC, unfortunately, is no different. As the fall-2009 UTB demographics table below shows, 60% of the university's 17,000 students are females; however, less that 27% of the graduates in Engineering and Computer Science are females.

Table 1. UTB Fall-2009 Demographics

UTB at a Glance	
ENROLLMENT	Total enrollment: More than 17,000 • Graduate: 5% • Undergraduate: 59%
STATUS	• Full-time: 48% • Part-time: 52%
GENDER	• Female: 60% • Male: 40%
AGE (Average 26)	• Younger than 18: 35% • 18-25: 41% • 26-35: 15% • 36-45: 6% • Older than 45: 3%
RACE AND ETHNICITY	• Hispanic: 94% • White, non-Hispanic: 4% • Asian: 0.5% • Black: 0.4% • Native American: 0.1% •Unknown: 0.7%

Therefore, the Computer and Information Sciences Department (CIS) has recently focused on improving the retention and graduation rates of its majors population by strengthening the diversity within it and by insuring that female students who enter the program have an equal chance as their male counterparts in succeeding. Moving toward achieving this goal, the department has allowed a new option to complete the required Senior Project course. The course is required for the bachelor of computer science which consists of 120-semester credit hours of course and laboratory instruction; the Senior Project is intended to provide an integrated educational experience or capstone [1-8]. Although the course is a one-credit-hour, one semester course, it is in fact a comprehensive course which requires a broad range of skills acquired over the student's course of study. Many studies have shown the importance of the Design Project in integrating different aspects of their course work [1-8]. The new option allows students, especially females ones, to take advantage of the applied nature of Computer Science which has been utilized in numerous applications such as the Internet, communications, e-commerce business to business and business to customer systems, electronics, and medical devices. Many of these innovative applications have been well studied and documented [4-7]. The dimension we strived to strengthen with respect to this regard is related to selection of topics, previously unexplored or minimally explored, by females that can benefit them beyond computer science. The following diagram shows the 3-tier strategy that the authors (one female faculty and two male faculties) from the CIS department have adopted.

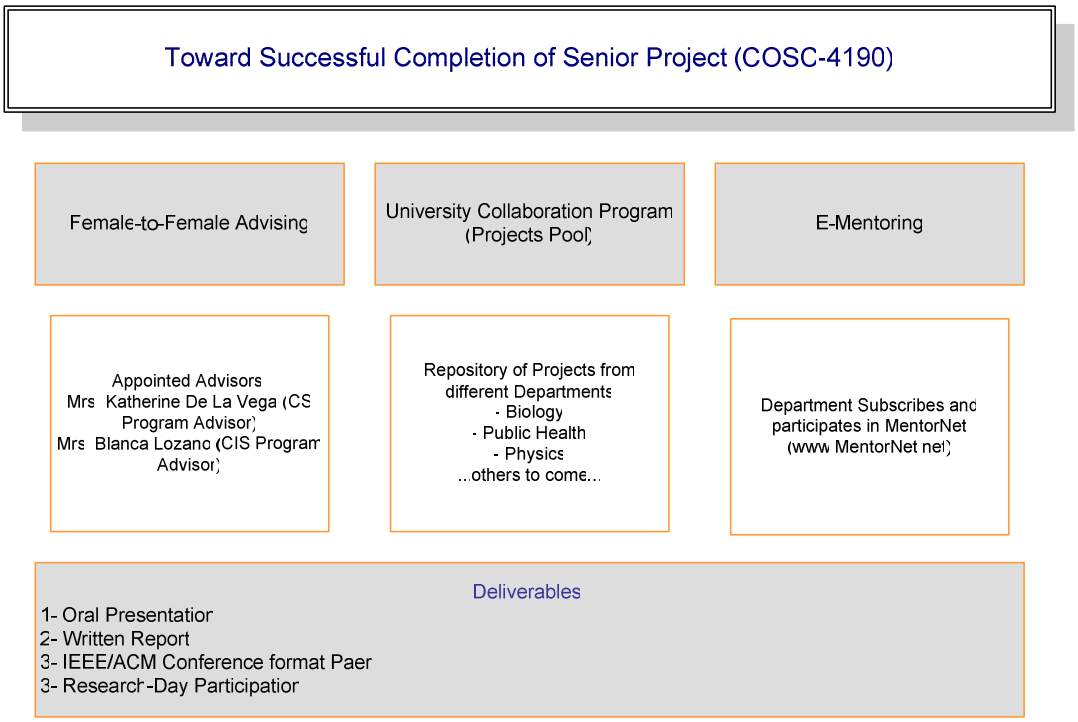

Figure 1. CIS strategy for the Senior Project course

The strategy has three components:

- **Female-to-female Advising**
- **Collaborative university-wide projects**
- **Establishment of industry-based mentoring program**

The following sections will discuss each component in detail. The components contribute directly or indirectly toward retaining our students, especially female ones. Initial collected data, through an exit-survey, support these statements.

Female-to-female Advising

The first tier of the strategy outlined above relates to advising students early in the program. As the National Center for Women & Information Technology (NCWIT) stresses, research shows that a relationship with an advisor (as steward of the discipline) is critical for retention and completion of the degree (graduate and undergraduate). As part of the retention aimed at female students, the CIS department has hired a female faculty with extensive experience in the administration field in addition to her expertise in the Computer Science and Information Technology fields. Besides one current female faculty who advises CIST (Computer Information Technology) majors and BAT (Bachelor of Applied Technology) majors, the new faculty has an MBA degree, worked extensively in the industry in Europe and the US, and has additional background in Aeronautics Engineering from the University of Texas A&M. The new faculty has half-time load dedicated for advising students in general, and females in particular.

Female students meet with the advisor during open enrollment period, and during the semester on by-appointment basis. The advisor works closely with faculty on a myriad of issues related to

advising, class scheduling, transfer credits, and prerequisites. More importantly, the advisor has been a great role model for female students. In addition to teaching and advising (and being a Ph.D. student herself), the professor is also the faculty advisor for the ACM (Academic Computing Machinery) student chapter; in that capacity, she has organized many seminars and workshops related to computer science as well as organized may social events to acquaint the students with each other and enjoy game and fun contests during holidays and special events.

Collaborative University-wide projects

To add a social/economical/political dimension to the scientific projects, the department has created a pool of projects that appeal to female students in additional ways. The initial pool of the CCS-WC-SP was created mainly in cooperation with the public health department, with the intention to expand it to include other departments from the university once the new model is evaluated and deemed successful. For the spring/fall semesters, two projects were selected for inclusion:

- Study of effects of diet and exercise habits on diabetic patients in the RGV (Rio Grande Valley) region (Science Internship)
- Raising awareness of the need for early breast cancer screening (Senior project title: Pseudocoloring of mammography medical images for better diagnostics)

The two projects were assigned to tow Hispanic female students. The first project was assigned to a recent graduate student who has finished her undergraduate degree in Computer Science and was exploring the possibility of graduate study in an inter-disciplinary field. The Second student has just finished a digital image processing course and was looking for a Senior Project related to that area. The following table summarizes the

Table 2. Senior Projects Demographics

Project Title	*Student*
Effects of Diet and Exercise on Diabetic patients in the RGV region.	Female Hispanic Second Generation College Graduate Age: 24
Pseudocoloring of mammography medical images for better diagnostics	Female Hispanic First Generation College Graduate Age: 22

The first step was to work closely with faculty from the Public Health department. Each student was assigned a project mentor from the Public Health department in addition to the Senior Project advisor from Computer Science. For the first project, the student elected a data-mining project that extracted valuable information from a database with information collected from a recent survey; for the second project, the student elected to implement a visualization system

which applies digital image processing techniques to enhance the diagnostic ability of a doctor to detect lumps and anomalies in mammography images.

As an interdisciplinary project, a great amount of time was spent in formulating a set of specifications from which computer scientists were able to work and create program modules. The females involved in the projects spent considerable time learning about the topics from a non-computational point of view as well. As shown later in their feedback and testimonials, they have gained valuable knowledge that they deemed of great importance to them, their families, and their social peers. The educational experience and the interaction between the students and the health team were invaluable. The CS students, and their professors, benefited immensely from not only coding the design and requirements, but also from learning (in these particular projects) about the extent to which diet, exercise, and early screening are lacking in their region, and about the need to become active in areas besides Computer Science.

As the software development process started, the two females met on a regular basis with faculty from both schools to iron out any issues or detail and solve open questions. The Public Health team was kept abreast of every development from the specification to the design and implementation to the graphical user interface and operation and maintenance. Their feedback was evaluated and incorporated early in the process.

Future Projects

Some of the projects that were suggested by female faculty for future students include:

Project 1- Streaming the Political Process for faculty and student: This project calls for an on-line Academic Senate system implementation that allows students to understand the legislative process at the university level. When implemented, the projects would allow students to watch all academic senate meetings streamed live to their laptops or desktop computers. The goal is to engage students, males and females, early in the political process and to let their voices be heard.

Project 2- Women's World Cup Highlights and Scheduling software: This project calls for creating GUI-based stand-alone program to highlight the soccer teams and the qualifying matches for the upcoming World Cup to match that of the Men's World Cup.

Project 3- An Automated Academic Advising Program: This program will act as a preliminary and always-on (server-based) program that can be accessed through the department's website 24/7. The program will be an expert-based system with a web-interface that suggests a list of courses to be taken in the coming semester based on current program of study and course offerings.

Project 4- the Fine Arts department suggested creating an in-house program to be used by music majors for exercises and for audio manipulation for the Music Appreciation Course.

The pool of projects will be maintained by the Senior Project instructor of record, but projects are being solicited every semester from faculty in every department of the university.

Software Tools

Each project is unique in terms of the tools needed to produce the final product. Here, we present the tools used in the two projects included in this paper just to show their broad range.

The technologies used in the samples projects are as follows:

Table 2. Sample Project Tools

Tools Used in a Sample Projects	
Project Title: Pseudocoloring of mammography medical images for better diagnostics	**Project Title:** Effects of diet and exercise habits on diabetic patients
Platform: Windows Vista with Matlab	**Platform:** Windows with Visual Studio & SQL
Libraries/Kits: Image Processing Toolbox	**Libraries/Kits/Framework:** .NET Platform
Programming Language: Matlab OOP	**Programming Language:** C#
GUI: GUI building & Interface using Matlab	**GUI:** GUI using C# with windows forms.

Uniqueness of the Senior Project & Meeting the COSC-4190 Course Goals and Outcomes

From an academic point of view, and in order to meet course outcomes and goals, the projects met all criteria set by the department. Specifically, the projects have the following characteristics:

- Interdisciplinary projects
  - Every project involves aspects from at least on other discipline bedsides CS
- Potential for great social impact on community
  - The projects expanded the horizon of the students
  - The projects allow students to impact socially their immediate family and friends through literacy and education
- Projects allow students to build on their academic courses and expand them
  - Project use the set of skills learned in program of study
- Projects develop effective communication skills (verbal and written)
  - Oral/Written presentations are required

With regard to the ABET outcomes, the projects meet at least the following criteria:

- An ability to function on a multi-disciplinary team
- An understanding of professional and ethical responsibility
- An ability to communicate effectively

- Recognition of the need for, and an ability to engage in life-long learning.
- Knowledge of contemporary issues.
- An ability to apply knowledge of mathematics, science, and engineering knowledge
- An ability to design and conduct experiments, as well as to analyze and interpret data

The deliverables for the project are; a class presentation, a written report, and an entry to the University Research Day, an annual university-wide event where students showcase their projects and research results.

We are happy to report that the project titled Pseudocoloring of mammography medical images for better diagnostics was presented by Gisela Hinojosa at the annual University's Research Day and has won the first place in the computer science category. The University's Research Day is in its 11th season; it usually has more than 100 presentations, and is attended by many current and future students. Such an achievement by a female student in a male-dominated field gives a great boost of confidence to upcoming female students in the CS field.

Figure 2. Picture from the 11th Annual UTB/TSC **Research Symposium**

Industry-based Mentoring Program

Many studies show that mentoring can have a great impact on the career of students [9-12]. Defined as a process whereby a more experienced person (mentor) provides guidance, support, knowledge, and opportunities to a less experienced person for the purpose of career advancement, mentoring is a great way to provide support and encouragement for students early in their academic career. The literature is full of studies about the benefits of mentoring which include:

- Mentors can fulfill both career and psychosocial functions.
- Provide role modeling, acceptance, validation, counseling, and friendship
- Provide support and encouragement

The CIS department has participated in several mentoring programs in the past including one coordinated by HETS (The Hispanic Educational Technology Services, formerly known as the Hispanic Educational Telecommunications System), which is the first bilingual consortium

dedicated to serving the higher education needs of the fast-growing Hispanic communities. Building on the success of that program, the CIS has recently subscribed to MentorNet (an award-winning nonprofit e-mentoring network for diversity in engineering and science). The vision of the department is to allow women full participation and access to a network of professional who could act as mentors and role models.

The mentoring program has been implemented for less than a year now. The generation of mentees who will take the Senior Project will come over the next two years. Although we are getting positive feedback from the students, we have not conducted an official study about the effectiveness of MentorNet as an integrated electronic mentoring program; we plan to collect and present the data in a future ASEE meeting.

Faculty Feedback

The two projects presented here had one CIS faculty member as advisor to both of them and two advisors from the Public Health department. Below is a summary of the comments received from them:

- I was extremely happy with the students' performance.
- The Research Day presentation was great and the demonstration attracted many attendants.
- I was impressed with the level of knowledge the CIS students have. They implemented the projects with great confidence.

Student Feedback

We received positive feedback from many students who were informally surveyed. A more formal survey and a study will be conducted in the future to assess the broad impact of the initiative. Below is a summary of the comments received from the students (CIS students and students who attended the Senior Project presentations:

- The project was very informative and it opened my eyes to the need for early screening for breast cancer.
- I really liked working with an MD faculty from another department. It gave me a whole new perspective of looking at things
- I will definitely educate my family and friends about taking preventive measure to reduce diabetes.
- I like the hands-on nature of these projects. I can actually see the end-product.

Conclusion

The goal of this project was to introduce a new option for female students to meet the Senior Project requirements in creative ways. We have implemented a comprehensive 3-tier strategy that does more than that; in involves early advising by female role models, a pairing of the female student with a mentor from the industry, and the choice of a senior project that complements the student's fluency and expertise in the computational field. The two projects presented in this paper, and the current pool of projects created, show the great impact such projects can have on one's life. While still in its infancy, CCS-WC-SP can grow to become a

great way to recruit, retain, and graduate female students in a way that reflects the true face of America, at least at a local level.

Future Work

Enhancements for the Collaborative Computer Science Women-centric Senior Projects (CCS-WC-SP) are under way. The vision is to have a two-semester cycle, one for each semester, to replenish the current set of projects used. The projects will come from not only the university's academic departments, but also from the industry, the mentors, and from the community's current concerns. As we were writing this section, a teacher in an elementary school recommended a project to raise the awareness about the H1N1virus that presents the facts and dispels any unfounded myths and rumors about its nature. A CIS student can definitely delve into certain aspects of how viruses work, mutate, and develop immunity from current vaccines.

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