Practical Experience with CSMET Affinity Groups

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ABSTRACT

This paper describes a program at Texas A&M University – Corpus Christi which seeks to involve a substantial number of undergraduate students in active research. This program receives funding from the National Science Foundation, grant number DUE-0094898. Students receive a small stipend in return for participating in one of several multidisciplinary projects. Projects include funded and unfunded research conducted by engineering technology, computer science, mathematics, and geographic information science professors.

The literature indicates that the benefits of working in a research group are clear: students develop domain experience, gain an understanding and appreciation of the research process and its practice, and acquire team, communication, problem-solving, and higher-level thinking skills. Students with this experience are better equipped to make informed judgements about technical matters and to communicate and work in teams to solve complex problems.

This paper discusses how the CSMET affinity model provides an infrastructure that supports the development and management of research groups that engage undergraduate students, who have a wide range of skill levels and experiences, in research projects.

UNIVERSITY AND DEPARTMENT BACKGROUND

Texas A&M University-Corpus Christi is an urban, comprehensive university located on the South Texas Gulf Coast with a student enrollment of 7300. The University focuses on the higher education needs of the South Texas region and the state. A&M-Corpus Christi research emphasizes solving problems related to South Texas urban and coastal regions.

The Department of Computing and Mathematical Sciences (CAMS) is located in the College of Science and Technology. CAMS consists of the content areas of Computer Science, Mathematics, Engineering Technology (ET), and Geographic Information Systems (GIS). The computer science and mathematics programs are well established programs. The GIS program was added in 1994 and an ET program was implemented in the Spring 1998 semester. In Fall 2001, the computer science program had 338 undergraduates and 87 masters-level students, while the ET program had 28 control systems majors and 77 mechanical engineering technology majors. There were 66 GIS undergraduates and 58 math undergraduate majors. The university as a whole is 39% Hispanic and 55% White, with a female enrollment of 62%.

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CAMS-NSF SCHOLARS PROGRAM

CAMS received a National Science Foundation (NSF) Computer Science, Engineering, and Mathematics Scholarships (CSEMS) grant to support 44 students for fall and spring semesters for two years. "The primary objective of the CSEMS program is to provide educational opportunities to low-income, academically talented students through scholarships that promote full-time enrollment and degree achievement in higher education[2]." This scholarship program at A&M-CC is referred to as the NSF-CAMS Scholars Program. The objective of the NSF-CAMS Scholars Program is to encourage students to pursue undergraduate degrees in science by providing financial support and to stimulate them intellectually by involving the students in interesting and challenging projects. Because a majority of our students must work at least part-time to support their schooling, we believe the financial component of the program is especially effective for increasing retention.

In the Spring of 2001, CAMS began soliciting applications for the NSF-CAMS Scholars program. All CAMS faculty announced the program to their classes, flyers were posted, and a letter was sent by the CAMS degree coordinator to appropriate CAMS students. Successful applicants were required to be a full-time CAMS major, sophomore or junior, with a GPA of at least 2.60. The NSF program guideline had required that the scholarship money be used to support juniors and seniors, however, we successfully argued that sophomores and juniors are the critical years for retention. NSF-CAMS Scholarship application materials include two letters of reference and an essay explaining the student's career goals. A committee of four CAMS faculty reviewed the application materials to select the 44 participants.

We believe, as well as other researchers such as Gates, et.al.[1] and Tinto, et.al.[4], that a key component to retaining at-risk students and a useful technique for developing students' analytical ability is to involve students in near-peer or affinity mentoring groups and research projects. Therefore, in return for receiving $3125 over fall and spring semesters, the Scholars students must agree to participate in a professor's research project for ten hours per week. Student groups are required to meet with the professor heading their project at least once per week. They are also required to meet as a whole once per month. These monthly Friday afternoon meetings, which includes lunch of pizza, are used to help the participants share ideas, share problems, and discuss their interests with other students. Other than these brief monthly oral status reports, the Scholars Program does not require participants to submit any formal reports.

The Scholars students began active participation in projects at the beginning of the Fall 2001 semester. A few days before the semester started, an organizational meeting was held for the students and faculty. Students responsibilities were once again explained. However, the primary purpose of the meeting was for sixteen CAMS faculty to provide students with overviews of thirty-four different projects. Each faculty member briefly presented the nature of his or her research and explained how they would like to incorporate these students into their projects. Scholars then completed a preference form that was used to assign students to projects. An interesting side effect of this meeting was that most students did not previously realize the amount or nature of research being conducted by their faculty.

Approximately 20 of the Scholars are enrolled in the computer science course Undergraduate Research. The objective of this course, open only to computer science majors, is to introduce students to the full scope and nature of research work. This includes not just how to conduct an investigation, but also how to obtain and manage funds, write reports to funding agencies, and present findings. Student groups first respond to a mock Request For Proposals by writing an NSF-style grant proposal. Students then use their Scholars projects to write interim and final reports. Throughout the semester course, students also manage script funds.

EXAMPLE PROJECTS

A wide array of projects was offered to the NSF-CAMS Scholars students. Four students chose to work with Dr. Patrick Michaud, Professor of Computer Science and Director of the Division of Near-shore Research at the Conrad Blucher Institute (DNR-CBI). DNR-CBI operates a series of tide stations along the gulf coast for the State of Texas and NOAA. Staff at the institute are engaged in a number of environmental monitoring and modeling projects. Scholars students are working with neural network software developers to develop a water level prediction system for the bays of south Texas. Other Scholars are working with hardware specialists to develop new interfaces for the station monitoring and telecommunications equipment. Because of the opportunities made possible through this program, our students are working side-by-side with professionals on large high-profile multi-year projects in which the students play a small but integral part of the successfulness of the projects.

Many of the projects are multidisciplinary thereby allowing students from different majors to work in real-world environments. For example, Dr. Tim Coppinger, Coordinator of the Engineering Technology program at A&M-CC, is guiding two engineering technology and two computer science students in the development of a new engineering technology laboratory. A Department of Defense grant was used to furnish a laboratory with a $250,000 Computer Integrated Manufacturing (CIM) cell. The four Scholars are creating demonstrations for the equipment, as well as developing lab manuals to be used in engineering technology courses. These students have been given the responsibility of making important decisions that will guide the learning of many other students.

Dr. Gary Jeffress, Professor of GIS, is guiding two GIS students in creating an auto theft tracking system for the Corpus Christi Police Department. The NSF-CAMS Scholars students first worked with local police to gather requirements and objectives for the system. They are working closely with GIS professors and the Police Department during development and deployment of their system. These students are the sole designers, developers and trainers on this project. Meanwhile, other GIS and computer science students are working with Dr. Joe Loon, Associate Professor of GIS, to develop a prototype of a real-time weather GIS system for the airline industry.

Other projects include developing software for new laboratory equipment in the CAMS Real-time Laboratory. Under the direction of Dr. Stephen Dannelly, Associate Professor of Computer Science, students are creating device drivers, simulators, and library routines to operate a model railroad purchased via an NSF CCLI grant[3]. Dr. Karen Heinz, Assistant Professor of Mathematics, is overseeing four mathematics majors in a project to study the learning styles of math students. Dr. Holly Patterson-McNeill, Assistant Professor of Computer Science is conducting Scholars projects using mobile robotics. Students of Dr. Dulal Kar,

Assistant Professor of Computer Science, are researching new internet traffic management algorithms. Students of Dr. George Tintera, Associate Professor of Mathematics, are developing a system to allow students to use PalmPilots in chemistry lab activities.

OUTCOMES

We are endeavoring to make "the university" not a place where our students go to sit in class, take exams, work on a long series of small one semester projects, then after four or five years graduate. But instead, we want "the university" to be thought of and regarded as a group of students, faculty, and staff with which the students are aggressively engaged in their own learning and involved as a critical component of the success of a project, laboratory, or course. In short, we want our students to "*connect*" with their discipline.

We have just begun the Scholars program, but preliminary results are encouraging. During the application process, many students were apprehensive about being required to participate in a large research project. They were concerned about their ability to effectively contribute and they were concerned that the ten hours per week would force them into a boring job. Their attitudes quickly changed. All the participants are enjoying their roles in their projects. We believe they are learning a great deal and, as hoped, are taking ownership of their projects. Samples of student responses to a survey administered after the first semester of the project are included below.

With regard to the students' confidence in their preparation for participating in research.

> "NO! I thought research was a lot bigger and scarier. It's actually fun..."

> "No, I had never participated in research, and I was not sure what was expected of me."

> "No, I knew nothing about trains and had very little programming experience."

Regarding student enjoyment in participating in research.

> "It was very interesting: provided a new aspect to programming I had never learned."

> "It was one of the things that kept my head on straight in light of the terrorist suicide bombings in New York and Washington D.C."

> "Yes,[the research project was enjoyable] because I was able to build a robot out of Legos and make it create facial expression by using logic and the material I learned in my computer science class. "

Regarding their relationship with their research mentor.

> "I have developed a strong relationship with my mentor as well."
>
> "I did develop a strong personal relationship with Dr. Patterson"
>
> "I was learning something new, and having one-on-one time with Professor Moore, taught me alot [sic] more than I would have learned in a classroom."

Regarding learning to work as part of a team.

> "I was surprised that I could be a part of such a large project..."
>
> **"**I like the idea of working in a group and contributing to some kind of project."
>
> "I have learned the concept of working with other people better. Before I would just like to work by myself on things. Now I can work with other people so that we can help each other out, and we can all learn together. I think it is neat to be on a team…"

Regarding student perceptions with regard to learning material that will useful in the "real world."

> "Since I am going to be a math teacher, interviewing children on a one-to-one basis helps me understand how they think about math. Then, in turn, it will be easier to effectively communicate ideas and concepts to them. Also, I now have a better understanding of where children are at that age in terms of their understanding of math."
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> "I have learned how to use neural network software in order to predict weather patterns. I started not even knowing what a neural network was... I have learned not only what a neural network was, but designs and implementations."
>
> "The material was not only interesting, and reinforced what I learned in class, but it is also a marketable skill in the engineering tech world."
>
> "I have learned how to use Perl, and I have also learned several methodologies for predicting tides. I can see several tide prediction systems that could potentially save lives and millions of dollars in inefficient shipping."

While not all responses and reactions to the project were positive, those listed above are representative of the overwhelming majority of responses.

Finally, an outcome that we had not expected.

"After working on the robotics research, my team decided to start a Robotics Society along with some engineering majors. "

"I have joined the robotics society as a "charter member" and as an officer."

"I did join the robotics society…"

We expect the enthusiasm of the NSF-CAMS Scholars students to carry over to other students. Placing students in a supportive environment, both intellectually supportive and financially supportive, is expected to greatly enhance retention. Word-of-mouth between beginning students has already begun to spread the word that the concepts they are learning have real applications to real problems right here on campus and elsewhere.

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