AC 2011-673: WORK IN PROGRESS: RECRUITING COMPUTING STUDENTS THROUGH IN-COMMAND CS-0: AN INTRODUCTION TO COMPUTING THROUGH MOBILE APPLICATION DEVELOPMENT

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Dr. Miguel Alonso Jr. has been a faculty member in the Department of Engineering and Engineering Technology at the Miami Dade College School of Computer and Engineering Technologies since August of 2007. He is currently an Associate Professor of Engineering and prior to his appointment at MDC, Dr. Alonso worked as a Researcher at the Digital Signal Processing Lab at Florida International University, a Software Engineer in Algorithm Research and Development for Beckman Coulter, Inc., and as a the lead Computer Engineer at CPS Products, Inc. His research interests include Mobile Computing Applications & Development, Cloud-Based Scientific Computing, and Parallel/Distributed High Performance Computing & Machine Learning, all with a central focus on Human-Computer Interaction. Dr. Alonso is a member of IEEE and ACM, as well as the engineering honors societies Tau Beta Pi and Eta Kappa Nu. Among his accomplishments as faculty, Dr. Alonso is the Principal Investigator on NSF Grant CNS-0940575 entitled "Scaling and Adapting CAHSI Initiatives (SACI)", and had a major leading role in developing the first Baccalaureate Degree in Electronics Engineering Technology at MDC, which was approved in January of 2009 by the State Board of Education in Florida. Dr. Alonso has also been involved in numerous projects promoting diversity in engineering & science, including serving as the Faculty and Student Advocate Lead for the Computing Alliance of Hispanic Serving Institutions (CAHSI), a mentor for the Advancing Careers of Excellence, Tools for Success, and Windows of Opportunity scholarship programs and the director for the Summer Institute for Science, Technology, Engineering, & Mathematics (SISTEM). Dr. Alonso is a National Science Foundation Graduate Research Fellow.

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Work in Progress: Recruiting computing students through IN-COMMAND CS-0: An INtroduction to COMputing through Mobile ApplicatioN Development

Abstract

As part of a larger effort to recruit and retain Hispanics in computer engineering, the first author created a weeklong summer course for college students to develop applications for Google's Android mobile phone. Ten students, having little to no prior programming experience, designed and tested applications (apps) for Google's Android platform. Students used a software development environment, complete with a software emulator for the phone to develop the application and a real platform running the Android OS to demonstrate the application. Students were exposed to the main aspects of App development, such as setting up the development environment, Graphical User Interface (GUI) design through the Extensible Markup Language (XML), Multimedia and Graphics programming, Java programming and OpenGL. At the end of the weeklong session, students initiated the development of a Sudoku application for the Android System. Students involved in the weeklong course took a survey based on social cognitive career theory (SCCT), which posits that individuals base career decisions on their confidence, interest, and perceived sense of mastery in a field (Lent, et al 2005). Following the course, students reported increased interest in computing careers and in the computing major, increased confidence that they could succeed in the major, and perceived academic support in their department. Students commented that the structure of the course and real-world problem solving associated with developing apps contributed to their learning. Future efforts will involve developing a full semester course as well as disseminating the curriculum to high school and post-secondary populations.

Introduction

CEN1990 - IN-COMMAND, an Introduction to Computing through Mobile Application Development, was developed as a three-credit course designed for students with little to no background in computing (with basic mathematics and computer skills) and with a variety of interests. This course would be offered to students in their last year of High School or first year in College/University. IN-COMMAND capitalizes on the ubiquitous nature of smart-phones, engaging students through a topical technology. The course excites students to the possibilities of Computer Engineering and Computer Science through showing students how to development fun, yet challenging mobile applications that will be deployed to a wide audience.

A pilot of this course was developed and taught in a "Boot-Camp" fashion during the first week of August 2010. Ten students, recruited through the Student Life department at Miami Dade College, attended the workshop. The pilot served as a starting point to work out the details that are critical for running a successful, full term course. These students were surveyed and the results can be found below in the Results section.

Using the pilot experience as a starting point, the experimental version of the course, along with full competencies, was developed in the first months of the Fall 2010 semester, with the intentions of offering the course in the Spring 2011. The offering of the experimental course will serve as a trial for both the competencies, as well as to determined if three credits are sufficient for this type of course.

The requirements for running the course are minimal. A computer lab with machines running updated version Windows, Linux, or Mac are the only hardware requirements. The software tools used for the course are freely downloadable from Google's Android website: http://developer.android.com/. Using Google's tools, the course can be easily scaled to a high school or even middle school environment, with

very little support other than helping the students setup the tool chain if they wish to practice on computers other than the ones available in the lab.

The remainder of this paper is organized as follows. Section 2 describes the overall course, including a course description, competencies, objectives, and the necessary tools required to run the course. In section 3 we present the evaluation methods used to assess the efficacy of a pilot run of the course, the results of which are outlined in Section 4. Section 5 provides a conclusion, with a description of future work in section 6.

IN-COMMAND Course Structure

Course description

The official course description is:
"This course is designed as a recruitment tool for high school and/or college students, for the following computing disciplines: computer science, computer information systems, computer engineering, or computer engineering technology. Students, using software engineering problem solving methods, with work in teams to develop applications for mobile computing devices. Students will use a software development environment that includes a software emulator and a real-time platform running a mobile operating system (OS), to develop, demonstrate, and test applications. 3 hr Lecture. Prerequisites: None."

The courses description summarizes the key aspects of IN-COMMAND that contribute to its success:

- Problem Solving using software engineering methods
- Working in teams
- Developing applications for mobile computing devices
- Low barrier to entry for students/faculty (Google's development tools are free and run on Windows, Linux, and Mac computers)
- Using an emulator, as well as a "real" device to develop and test the applications

Course competencies

The following course competencies were developed as a guide to both the students, as well as the instructor. A detailed version of the competencies will be available online at http://www.cahsi.org following Spring 2011 term. Lecture modules and activities were developed to introduce and reinforce these competencies. These modules will also be available on the CAHSI website after Spring 2011.

1. The student will demonstrate the ability to identify key components of mobile computing platforms.
2. The student will demonstrate the ability to create the appropriate development environments for various mobile platforms.
3. The student will demonstrate the ability to compile and run sample applications.
4. The student will demonstrate the ability to plan the development of a mobile application.
5. The student will demonstrate the ability to implement mobile applications that solve practical problems.
6. The student will demonstrate the ability to test mobile applications.
7. The student will demonstrate the ability to design a functional User Interface (UI).
8. The student will demonstrate the ability to build, create, and program multimedia and graphics animations to run on mobile platforms.
9. The student will be able to create mobile applications that access the Internet.
10. The student will demonstrate the ability to create applications that use location and sensing technologies on mobile platforms.

Course objectives

The overall Course objectives fall into five main areas: Design Specification, Tool chain installation, Existing Source, User Interface (UI) Design, and Deployment.

- Design Specification: Creating design specifications for selecting a mobile computing platform to deploy applications
- Tool chain: Install the compiler and simulator for various mobile operating systems, such as Google's Android OS or Apple's iOS4
- Existing Source: Extend and modify existing sample open source projects to build new ones
- UI Design: Create functional, yet appealing user interfaces using the extensible markup language (XML)
- Deployment: Plan, implement, and deploy functional and practical mobile applications

Evaluation methods

Students involved in the weeklong course took an online survey based on social cognitive career theory (SCCT), which posits that individuals base career decisions on their confidence, interest, and perceived sense of mastery in a field (Lent, et al 2005). The survey was modified from a reliable, validated instrument, and has proven robust across multiple versions of CS-0 at six other Hispanic-serving institutions. Students were invited to complete the online survey at the end of the summer course. Participants rated their *changes in interest, aspiration, and confidence* from the beginning of the course to the end. This post-test only methodology focuses on students' self-reported change in perceptions and attitudes during the course, is not susceptible to response shift bias (Howard & Dailey, 1979) and specifies that students should only mark changes they attribute to the course experience.

Several follow-up emails were also sent to remind students that had not yet completed the survey. Ten students completed the post-course survey for a response rate of 100%. Results were compiled and analyzed using Excel software across all students, as dividing by gender and ethnicity was not practical, given the small number of student participants.

Results

Students in the pilot summer course were primarily Hispanic (88%), male (63%), and college sophomores (88%) at a college transitioning from community college to a four year institution, hence rising sophomores made up the majority of students in the summer course. All students were computer science/computer engineering majors. The rates of enrollment of Hispanics and women in the course are higher than either the enrollment or graduation rates of those groups within the department overall. Thus, CS-0 has the potential to be an effective recruitment and retention tool for Hispanics and women.

According to survey results, participating in the weeklong CS-0 summer session increased students' commitments to their major and to completing an undergraduate degree. This section describes the survey results from the 10 pilot-test students, and details these results by item when possible. Fully 100% of students reported a positive increase (slight to strong increase) from participating in the course in their *intention to remain enrolled in their discipline over the next semester, to obtain a college degree in their major, earn a bachelor's degree, and work in computing after graduation.*

Students also rated the impact of the course on their confidence that they could achieve their career goals. Students reported substantial increases in their confidence in computing because of the CS-0 course. For example, 100% of students reported a slight or strong increase in *confidence that they could excel in their discipline over the next semester, complete all the math requirements for their major with a grade of B or*

higher, and complete the upper-level courses in their major with a grade of B or higher. Almost all students also reported an increase in their confidence that they could *program a computer*—one student reported a slight decrease in confidence.

Students reported that the CS-0 course increased their interest in computing and technology applications. Fully 25% of students reported that they already had strong prior interest in computing and, therefore, the course had simply helped to maintain that strong interest. The rest of the students reported that their interest had slightly or strongly increased. No students experienced a decrease in interest from the course. See average scores below for various elements of computing activity, based on a 10 point scale.

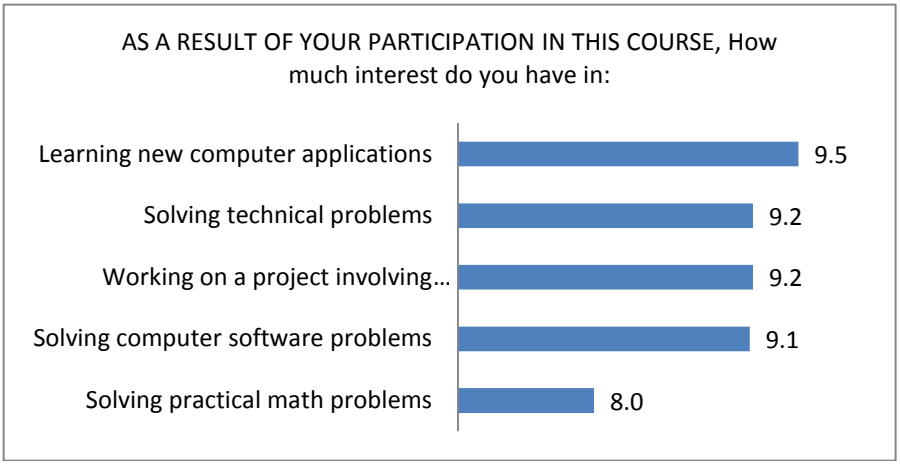

Figure 1: Student interest in computing activity

Students noted that the real-world applications and problem solving within the course helped to spark their interest and increase their confidence that they could be successful in computing. In open-ended questions, students were asked to name a project or assignment that they were proud of, and they were also asked why the project was meaningful to them. All of the CS-0 students listed real-world projects or assignments as the most meaningful aspect of the course. Typical student responses to this question were: "coding Sudoku," "creating a binary digital clock," or "making the app myself." Students cited these projects as meaningful because they were challenging and involved effort and problem-solving. Following are typical student responses describing why these real-world applications were meaningful to them:

"We had to work on it with a group and problem-solve ideas to make a theoretical idea a reality."

"We had errors on every step of the install, yet managed to solve all of them and get it installed."

"It taught me the patience you need to have when creating a digital system from the drawing board using the bare minimum in electronic parts."

Conclusion

Preliminary data from the pilot evaluation of IN-COMMAND indicate a potential to support student success and may hold promise for student advancement in computing majors. In conclusion, students received many positive benefits from participating in the summer CS-0 course at COLLEGE. Students became more committed to their major and their pursuit of an undergraduate degree. Students also gained a more positive view of computing careers and increased their interest in computing. They also perceived more academic and social support in their major. Students credited the authentic projects and problem

solving within the course as providing a window into "real-world" computing and increasing their confidence that they could succeed in their major. These data suggest the CS-0 initiative may impact student success in the major.

Future work

The development of course activities is on-going and will continue through the end of the first section of the course (May 2011). As IN-COMMAND developers are part of an alliance of institutions seeking to recruit underrepresented individuals into computing, there are many opportunities and outlets for dissemination. Possible next steps include dissemination to established and developing K12 outreach groups within the alliance, incorporation into other CS-0 courses taught in these institutions, and use of the modules in extracurricular clubs throughout the alliance. This will include additional development of sample applications for students to use as seeds for their own applications, as well as further evaluation of the efficacy of the course over several semesters. Additionally, future efforts will also involve disseminating the curriculum to high school and other post-secondary populations (e.g., freshmen and upperclassmen) at the home institution, including recruitment beyond the major.

Howard, G. & Dailey, P. (1979). Response shift bias: A Source of contamination of self-report measures. Journal of Applied Psychology v 64, no 2 144-150.