CAPSTONE PROJECTS AS COMMUNITY CONNECTORS

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ABSTRACT

At the University of Washington, a capstone design project to help artists market their craft, taught students valuable, cross-cultural collaboration skills while providing evidence of the local and global positive impacts of computing. In this project, which took place in the context of a year-long course focusing on technology for low-income regions, a group of senior computing students worked with business students and faculty at Heritage University to create an on-line store for marketing crafts made by artists in rural Washington state and Mexico. In addition to the skills normally gained in capstone design courses, including group work, iterative design, and software engineering, students in this project learned to collaborate over a distance with partners from different backgrounds and to capitalize on the strengths of each group. In this paper, we briefly describe the course as a whole, the specific project, and lessons learned.

INTRODUCTION

Course projects based on real-world needs can serve as the basis for an engaging and memorable educational experience. Interacting with real customers provides much needed opportunities for students to practice communication skills and connects students with the customers' community. In addition, projects that have the potential to make a positive impact on the world have been shown to be particularly motivating to students and can serve to attract and retain students in the field of computing [4].

Communication and Broader Perspectives

ABET asks that by time of graduation, we provide our students with [1][1]:

1) An ability to communicate effectively with a range of audiences

2) An ability to analyze the local and global impact of computing on individuals, organizations, and society

Capstone design courses are often the best opportunity in the curriculum to address these outcomes. Yet even in that context, it can be challenging to expose students to audiences significantly different from themselves and to involve them in projects that truly have the potential to impact the world on either a local or a global scale. Exposing computing students first hand to different cultures and a global perspective is especially difficult in engineering programs with many requirements that

make pursuing dual majors or studying abroad particularly challenging.

In this project, we capitalized on building a relationship between business students and computing students from universities that were geographically close but culturally distinct. The collaboration enabled the computing students to build proficiency with the ABET abilities listed above throughout every stage of the project. The business students were able to address a need that would not have been possible without technological assistance, while at the same time building their skills at communicating with professionals from another field.

Computing for Low-Income Regions

Information and Communication Technologies for Development (ICTD) is emerging as an active area of research that showcases connections between computing and the future of billions of citizens of our planet [2, 16]. Projects currently exist in many Computer Science departments and emphasize the importance of collaboration with fields such as public health, education, agriculture, and business. Examples of work in ICTD include projects that improve HIV/AIDS tracking, increase access to education, make crop process available to farmers, and improve microfinance record keeping.

At the same time, research on attracting and retaining students suggests that educators should portray computing as a field through which one can contribute to the social good. Providing such connections may be particularly important for motivating women and minority students [10, 14]. Exposing students to ways that computing is having an impact in low-income regions and the developing world is one mechanism for making the field relevant and showing its power to impact the world positively.

RELATED WORK

There is a long history of incorporating *service learning* (a pedagogy that integrates academic learning with community-based work) into computer science and engineering curricula [3, 15]. There is also recent interest in socially relevant computing [5], including the incorporation of open-source humanitarian projects [9] and assistive technologies [4] into capstone design courses, or as individual assignments [13].

A few universities are beginning to integrate the topic of ICTD into their undergraduate curriculum [6, 17] although most such courses are at the graduate level or do not involve implementation projects. Other educators have experimented with collaborations between groups of computing students at different universities in order to provide a more “real world” [11][11] or international [12] experience. Our project differs from these in that the collaboration was between a group of computing students and a group of non-computing students from a close-by yet culturally distinct university.

A UNIQUE CAPSTONE COURSE

All computer engineering majors (and many computer science majors) at the University of Washington take a one-quarter capstone design course. These courses are

offered on a variety of topics ranging from animation to embedded systems, and give students the opportunity to design and implement substantial group projects. In 2007–2008, a new capstone design experience on the topic of technology for low-income and developing regions was offered [7]. The traditional, one-quarter capstone course was expanded to include two preliminary quarters of background and discussion in this new topic area. The first quarter took the form of a one-credit literature review, where students familiarized themselves with challenges faced by residents of low-income regions. For the second quarter, worth two credits, the class divided into groups of 4 to 6 students to come up with design ideas and implementation plans. The final quarter followed the more traditional form of other 5-credit capstone courses, although the focus here was primarily on implementation rather than design and implementation. Throughout the last two quarters, student groups frequently presented their ideas to the class and to panels of experts in oral presentations, poster sessions, and written reports. In addition to the project discussed in this paper, other problems addressed by student projects include creating an educational application for the OLPC (One Laptop Per Child) platform, coordinating transportation in Kyrgyzstan using text messages, helping community health workers in Tanzania manage patient care using cell phones, and empowering women in Kenya via community radio [7, 8].

CONNECTING COMMUNITIES

Establishing a relationship between University of Washington computing students and Heritage University business students was both culturally enriching for the two groups of students and convenient because of the two schools' proximity. While the two schools are roughly 3 hours apart, the student populations they serve are quite different.

University of Washington

The University of Washington is a public R1 research university located in an urban environment. Although 82% of its 38,000 students are from Washington State, a majority of them are from the western part of the state, and only 1% of its students come from Yakima County (where Heritage is located). Only 6% of its undergraduate students identify themselves as Hispanic or Native American. The Department of Computer Science and Engineering graduates roughly 160 undergraduate majors per year from its highly competitive program. The lure of local industry keeps many students in the Seattle metropolitan area, both for summer internships and jobs after graduation.

Heritage University

Heritage University is a private, non-denominational university that was established to serve a largely place-bound community in rural eastern Washington. Its student body of 1,500 students is made up principally of students from the surrounding Hispanic and Native American populations. The vast majority of students are first in their families to attend an institute of higher learning. 95% receive financial aid and 75% are women. By focusing on experiential learning, students from Heritage have gone on to distinguish themselves in many areas: over 75% of graduates in the social work program go on to earn their Masters of Social Work, and students in the Business program are being placed as interns and employees in Fortune 500 companies.

The collaboration discussed here was between computing students at UW and students involved in the Students In Free Enterprise Organization (SIFE) at Heritage. SIFE is a volunteer-based student organization with a long history of leading projects that benefit the community. The SIFE group at Heritage typically has a dozen or more projects going on at a time, many of them lasting for several years. In the past three national SIFE competitions, Heritage has placed second, fourth, and tenth, respectively. Besides connections to their local community, students at Heritage SIFE also have strong ties with SIFE organizations in several parts of Mexico.

THE PROJECT

The Heritage SIFE students were in contact with local Native American artists and indigenous people of Mexico (through SIFE chapters at universities in Mexico) who had difficulty obtaining fair prices for their traditional art forms. The UW computing students determined that current systems (e.g. Etsy, EBay, OpenEntry) were not a good match for artists' needs for a variety of reasons: they required artists to master complex interfaces or interact directly with customers, did not provide ample opportunity to describe the cultural heritage of the artist, or had prohibitive costs. The Heritage students suggested a new commerce model where local SIFE students would act as both art documenters and trusted transaction mediators, thus eliminating the requirement for artists to interact directly with the system, and leveraging SIFE students' interest in helping the local community and their role as a trusted entity within that community.

To address these needs the UW students designed a system consisting of three components. The devices in the **art documentation kit** (a digital camera and audio recorder) were chosen to provide low cost, high quality, standardized data collection facilities for SIFE students who would interact with artists. The **administrative interface** for uploading content to the system and viewing the status of orders was designed to be usable by SIFE students of varying technical skills. Finally, the **e-commerce website** was designed with input from the Heritage team on how to best present the work of artists interested in communicating their cultural heritage. By the end of the third quarter, the UW students had implemented a full prototype of the system (using Ruby on Rails), including documentation for users of varying technical ability.

LESSONS LEARNED AND NEXT STEPS

Here we briefly outline a few of the lessons learned from our experiences:

ICTD/low-income regions projects in Computer Science courses: Overall the capstone course was well-received by students and has been repeated a second time. A video about the course was created for use as a recruiting tool for the course and the major [8]. The one-credit reading seminar portion of the course [7] could easily be used at other institutions, or selected papers could be used in networking, operating systems, or HCI courses to expose students to the broader impacts of computing. Doing projects in this area exposes students to issues that rarely occur in other courses. For UW students

involved in the Heritage collaboration, issues such as internationalization and cost took on new meaning when their system had the potential to be deployed for use with artists in remote areas of Mexico. They designed their system to work easily in multiple languages and for users with varying levels of technical sophistication.

Importance of regular communication: The Heritage and UW groups met regularly via video conferences to iterate on prototypes and discuss next steps. Although email and teleconferences were also used, video conferencing was critical for allowing the groups to get to know each other and promoting accountability. All forms of communication provided opportunities for students to practice their cross-disciplinary communication skills. For example, working with business students required the computing students to explain concepts that they generally assumed their audience would understand, such as domain names, search engine optimization, and user interface.

Leveraging the strengths of both partners: Regular communication also helps build trust, allowing students to rely on the strengths of each group. In our case, the Heritage students had a unique understanding of artists' needs and the local culture. Their business training helped them identify a new commerce model that could be supported with technology. Both groups grew to appreciate each others' strengths despite their differences in academic discipline and university setting. In addition, unlike projects where a single client interacts with a group of students, in student-student projects both sides reap the benefits of a larger group working towards the same goal. For example, the Heritage students were able to gather input from more artists than the UW students could have communicated with by themselves or if working with an individual partner.

Visits to each site: Selecting a partner in close physical proximity was important for allowing the two groups to visit each other's institution. Although each group only visited the other campus once, face-to-face contact between the two groups increased accountability, allowed both groups to learn more about each other's cultures, and accelerated the design process. When UW students visited Heritage, not only did they meet with the SIFE students, but they also toured the local area, visiting a local tribal center and meeting local artists first hand.

For both UW and Heritage students, the partnership had value beyond the success of the product created. However, several issues remain to be addressed, such as deciding on a permanent host for the site and the best mechanism for handing off management to Heritage. Our experience demonstrates that collaborations between computing students and non-computing service organizations can be enriching for both sides, particularly when they come from local yet culturally distinct universities.

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