A Survey of the Impact of Community-Based Computer Science Education on Undergraduate Students

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ABSTRACT

The engagement of computer science students in community activities is a challenge in all institutions of higher learning. This paper describes a paradigm for civic engagement through community-based learning used successfully by the author. With the pervasiveness of computers throughout society, there is a growing demand for diligent computer science education to satisfy the growing needs of a multiplicity of enterprises. This paper describes one approach to teaching computer science while requiring students to develop systems for various community, school, and university organizations. The benefits derived by the students and the clients receiving their services are many. A survey of undergraduate students involved in community based projects provides a good summary of the impact of this type of education. There is a wide range of opportunities for civic engagement through project-oriented computer science courses that serve community needs. The results of the survey indicate that this type of education has a very positive impact on the students involved.

Introduction

Engagement of students with real-world community projects is a goal being pursued by many institutions of higher education. This may not be difficult for students pursuing college majors such as political science, sociology, and business. However, students in computer science and in other science fields are not typically attracted by community projects. Faculty and staff in these disciplines face many challenges when they try to get students connected with the community and the world that they will support upon graduation. This paper describes a paradigm for community-based computer science education for undergraduate students and the impact of this experience from a group of students. Over the past two years, very successful community projects have been pursued and completed by computer science students at Texas A&M University – Corpus Christi. Evidence is presented to indicate the beneficial impact of project-oriented computer science courses that serve the community.

Conflict of Mindsets: Traditional Versus Engaging

After several years of experience developing and managing the development of systems for many organizations, the author can stipulate the existence of a certain mindset among computer science professionals[2]. Even while teaching software engineering courses, the author has heard comments from students, such as, “users are idiots.” Obviously, these comments are meant as jokes, but it is clear that many students have a bit of a negative attitude against the non-computer-oriented community. In the

past 25 years, little has changed in the attitudes of students pursuing degrees in computer science or software engineering. In fact, little has changed since the NATO conference which was the genesis of software engineering.

It is a fact that the majority of computer science graduates will not be developing large NATO-type projects, but rather much smaller systems with an interactive component. Therefore, a user-centered development methodology like human-computer interaction (HCI) is a much needed discipline within all computer science programs. This discipline is the basis for an engaging mindset.

HCI is an interdisciplinary methodology that involves skills from disciplines such as psychology/cognitive science, engineering, informatics, computer science/software engineering, ergonomics, human factors, and social sciences[4]. Therefore, HCI is more closely aligned with user-centered development. Alan Cooper relates his experience of the broader perspective which he could only see after he extricated himself from the "programming grip"[1]. He claims that only then did he see that programming is such a difficult and absorbing task that it dominates all other considerations, including the concerns of the user.

The traditional mindset of computer science students needs to be addressed in software engineering and HCI courses, as well as senior capstone courses. Actually, there is a need to address the traditional mindset throughout the curriculum of computer science. The author regularly teaches two courses that are well-suited for educating students to see their profession as a service type profession that caters to the needs of users. However, there is a need for more faculty to take up this challenge of emphasizing that computer science is a service profession that requires students to learn how to communicate well with users in order to build applications to solve their problems.

User-Centered Development Education

The author's objective in educating computer science students is to develop a strong user-centered development mindset. To accomplish this objective, the author bases much of his teaching on HCI design which has the main goal of building interactive systems that are easy to learn, effective to use, and enjoyable from the user's perspective[3]. These characteristics are summed up in one word – usability. Usability can only be understood from the user's mind-set. Software developers find it difficult to get into the user's mind to capture the essence of the requirements to be able to build a product that satisfies the user's real needs. The role of an user-centered design educator is to redirect students' creative efforts to develop products that meet the needs as defined by the user's own mind. In other words, in order to have an engaging mind-set, a CS professional must become totally committed to the user-centered approach.

There are few good textbooks that address the user-centered methodology with the rigor and span that is appropriate. The three most commonly cited by authors are the books by Preece et al.[4], Shneiderman & Plaisant[6] and Rosson & Carroll[5]. The author recently used McCracken and Wolfe[3] for an undergraduate HCI course with good results.

COMMUNITY-BASED CS-ENGAGING EDUCATION

This redirection of the traditional mind-set of software developers can be started with typical HCI textbooks, many of which have been cited in the discussion above. All of these deal with the broader approach of user-centered development. However, there is no substitute for real-world

experience. Two community-based computer science (CB-CS) education courses at Texas A&M University – Corpus Christi provide such an experience.

The two community-based education courses are the human computer interaction course and the senior capstone course. There is actually a graduate level HCI course that also used community-based projects. Before initiating these courses, contacts are made with city, school, and university organizations in order to find CS type requirements that are real and can provide the basis for student projects. The types of projects that seem to fit best for the HCI courses are Web-based systems with interactive components. The principals in each of the project offices are visited in order to get a better understanding of the needs and to explain to the users how the students would be approaching them and how they would be completing their projects.

Students present the first version of their high-fidelity prototype of the project to the class for initial comments from their peers. After the system is in semi-final form, students are asked to prepare questionnaires and evaluation sheets for usability evaluations by class members. Using a large computer lab, students evaluate each other's work and provide written feedback to the developers. Some of the students expressed that this had been a valuable experience for them because they could see how what seemed obvious to a developer may not be that obvious to a user.

The following are examples of Web-based development and user-centered capstone projects completed by students:

- Coastal Bend Alliance for Youth Web Site
- Nueces County Community Action Agency Web Site
- Head Start Web Site
- YMCA Administrative Support System
- Catholic Charities Aid Support System
- Parks and Recreation Client and Course Tracking System
- Driscoll Children's Hospital Vendor Verification System
- YWCA Inventory and Reservation System
- Best of the Best Companies Project
- Head Start Students and Meals Reporting System

Other examples and details of student-led projects are presented by Fernandez[2].

COMMUNITY ORGANIZATIONS SATISFIED WITH THE WORK

All the clients were very pleased with the final products delivered by the students. Two examples are presented here. The Catholic Charities Aid Support System was built for Catholic Charities of Corpus Christi. The organization moved from a total paper-bound process to one that is mostly electronic. The Executive Director, Sister Barbara Netek, was extremely pleased with the results and the system has been operational without any problems since the implementation.

Students worked diligently to build a system for the YMCA that was based on national specifications. With the talented students who worked on the project, the local chapter saved over $100,000 in development costs. Ms. Gloria Jackson, Executive Director, was elated with the results of the project.

IMPACT OF COMMUNITY-BASED EDUCATION ON STUDENTS

Using a set of questions developed by Dr. Linda Avila, Dean of Community Outreach at A&M-CC, a survey of students in two classes was conducted by the author in order to determine the impact of community-based CS education on the students. The questions can be seen in the Figure 1 below. Questionnaires were distributed to collect basic information about the student's experience in providing technical services to local community organizations. Although not shown in the Figure below, the questionnaires consisted of Likert scale questions with possible answers ranging from Strongly Disagree (1) to Strongly Agree (7). Responses on the high end of the scale indicated positive results on the part of the students.

1. Through my civic engagement projects and activities I applied my learning and new knowledge to "real world" situations.
2. My civic engagement projects and activities caused me to improve my problem analysis and critical thinking skills
3. Through civic engagement I have improved my ability to work successfully with others.
4. My civic engagement projects and activities have increased my ability to communicate effectively.
5. I feel prepared to perform successfully in a new career because of what I have learned in my civic engagement experiences.
6. I can use experiences and knowledge gained through civic engagement as I apply and interview for jobs.
7. Civic engagement projects and activities help me to understand and appreciate people who are different from me.
8. I am committed to being involved in my community to improve our quality of life.
9. My civic engagement experiences have increased my confidence in myself.
10. Through my civic engagement projects and activities I have clarified my goals and who I am.
11. I have gotten to know faculty well through our civic engagement projects and activities.
12. I feel more connected to the university because of my civic engagement.
13. My civic engagement projects and activities require consistent attention and involvement.
14. Overall, my civic engagement activities have been well structured and meaningful.

Figure 1: Questions on Civic Engagement

The highest ranked question, with an average score of 6.22 and a standard deviation of 0.52, was: *Through my civic engagement projects and activities, I applied my learning and new knowledge to "real world" situations*. The next highest ranking, with an average score of 5.74 and a standard deviation of 0.86, is attributed to: *Overall, my civic engagement activities have been well structured and meaningful.* The lowest ranked question, with an average score of 4.52 and a standard deviation of 1.38, still indicated a somewhat positive attitude: *I feel more connected to the university because of my civic engagement*. Obviously, some students did not feel a university connection when they are in the community, serving the client.

The overall average score for all questions was 5.29 with a standard deviation of 1.29. This indicates a very positive response to the experience on the part of the students in two computer science classes involved in community projects.

CONCLUSIONS

Using a community-based paradigm for teaching user-centered software development has proven to be quite successful. Students have bridged the gap between classroom theories and the real world of users. Letters of appreciation have been received from client organizations. Community leaders have built relationships with local and international students. The benefits continue today as students have obtained employment or moved on to complete their degree and the applications they built are serving the community. Student surveys indicate that students received very positive results from the experience of working for real world clients. This is surely one great way to find joy in one's craft.

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REFERENCES

1. Cooper, A. (1999). *The Inmates are running the asylum*, Sams Publishing, Indianapolis, IN.

2. Fernandez, J.D. (2004). Engaging students with community organizations by using computer technology, *SIGITE 2004*, October.

3. McCracken, D., & Wolfe, R. (2004). *User-centered Website development: A Human-Computer Interaction approach*, Pearson Education Inc., Upper Saddle River, NJ.

4. Preece, J., Rogers, Y., & Sharp, H.(2002). *Interaction design: Beyond Human-Computer Interaction*, John Wiley & Sons, Inc., New York, NY.

5. Rosson, M.B., & Carroll, J.M. (2002). *Usability engineering: Scenario-based development of Human-Computer Interaction*, Morgan Kaufmann Publishers, San Diego, CA.

6. Shneiderman, B., & Plaisant, C. (1998). *Designing the user interface, 4th Ed.,* Addison Wesley Pearson Education, Inc., Boston, MA.

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