Software Engineering Projects with Social Significance: An Experience Report at a Minority University

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Abstract

Recent research indicates that women and minority students find computer science more meaningful and engaging when they have a chance to apply their knowledge within communal and societal context. We report the experience gained while incorporating a software engineering project that aid community and society at a university that predominantly serves underrepresented minority students. The project that we utilized allows the students to apply the theories and principles of software engineering on a real life scenario while keeping them engaged and motivated, addresses the needs of community and society, and better prepares the minority students for their professional career through improved academic achievement, enhanced self-reliance and community engagement. The project can easily be replicated and adopted to any project-based software engineering course taught at any university and likely to generate similar benefits to students and society that we noticed.

1. Introduction

The acceptance and integration of social issues into computer science curricula is becoming significant now-a-days. In addition to the possession of significant technical skills and knowledge, computer science graduates should be able to assess the societal impact of their work. Current research study [1,2] indicates that Minority students and Women commonly want to dedicate their lives to support their communities. For female and minority students, working within communal and societal contexts makes the study of computer science more meaningful and interesting [1,2]. This suggests that minority serving institutions should strive to demonstrate the value of solving problems for their community and society to the prospective and current students. This paper rationalizes the importance of offering projects that demonstrates how computer science can be used to aid community or to hold some practical value.

Where most universities may prefer industry-sponsored software engineering projects, we argue that the community-based projects to be more effective for student learning and success at minority serving institutions. Underrepresented and educationally disadvantaged minority students in engineering/computing fields typically encounter significant learning barriers [3]. In our senior level software engineering course, we find it increasingly difficult to keep students engaged and motivated in their project works. As many of these students are first generation college students in their families, lack of direction and proper guidance from their families cause an obstacle to persistence in learning. It is important to engage their interests in order to achieve persistency and software engineering projects that aid society and their community can potentially serve that purpose. Additionally, many of them have a low sense of self-efficacy regarding to the programming and technical aspects and placing them with professionals in an industry-based project makes the situation more intimidating. Projects within communal and societal context typically include sponsors that are not technology savvy. Students typically feel competent to interact with such clients, which eventually
creates a friendly environment for them where they want to be active, engaged and eventually successful.

At Winston-Salem state University (WSSU), an HBCU, we favor software engineering projects that has practical and social significance over the projects with commercial focus. This paper reports our experience that we gained while incorporating a project that aid community and society at a senior level software engineering course. The project that we utilized allow the students to apply the theories and principles on a real software project while keeping then engaged and motivated, address the needs of community and society, and better prepare the minority students for their professional career through improved academic achievement, enhanced self-reliance and community engagement. The project can easily be replicated and adopted to any project-based software engineering course taught at any university and likely to generate similar benefits to students and society that we noticed. Few other research works [4,5] also used community-based projects to improve educational experiences, however our goal is to captivate underrepresented minority student’s interest by allowing them to work in a project that support their community and society.

The rest of the paper is organized as follows. Section two describes the project we adopted. In section three, we detail the implementation and current status. Section four summarizes our observations and lessons learned from the execution of this project.

2. Project Overview

The project is conceived in order to provide search and browse capabilities for repository of scanned newspaper clippings that belongs to WSSU’s O’Kelly library. These newspaper clippings contain photographs, stories, and articles related to WSSU over a period of about twenty eight years. These clippings have significant educational or historical value to the community and to the general public. Currently the library preserves the hard copy of the newspaper articles in several boxes sorted according to dates in their Archive section. Presently, to find a specific article that published in a specific newspaper on a specific date, one must search through many shelves of boxes sorted according to dates. Once the box with their desired date range is located, the person must inspect each and every article until they find their desired one. The process is much more tedious and time consuming if one is trying to identify articles related to a specific topic without having any knowledge of the newspaper or the date. One may even overlook the article due to a tireless amount of time searching. This method also necessitates a massive amount of physical storage space with public access within the library. As the amount of archived information grows, searching intended information from the archive becomes more difficult. Sophisticated archive management software with powerful search and navigation mechanism is needed to gain the best possible information from the archive for immediate consumption.

The software development project creates a searchable digital collection to allow the public access to these precious stories pertained to WSSU. The objective is to open a world of information that is not currently available to anyone. The software allows the user to perform keyword-based search and also navigation through particular newspaper or date range. The project was undertaken during the semester of Fall, 2012 and four seniors in Computer Science were involved in the project.

3. Project Implementation

The overall scope of the software is reflected in the use case diagram shown in Figure 1. The diagram describes the user and the functionalities provided by the newspaper archive
software. The visitor is able to search or browse according to keyword, date or newspaper and the administrator is able to add new articles in the archive, index them and generate usage report. The non-functional requirements of the project include creating an intuitive and simple interface which is easy to navigate and search. Designing an appropriate software architecture that allows efficiency, extension and future maintenance are equally important. The following few sections explains the main aspects of the design and implementation.

3.1. Digitization and Text Conversion

The concerned collection contains newspaper articles that have been printed for almost three decades (1984 to Now). Library staff is responsible to scan them to a PDF file while following the naming convention such as NewspaperName_Year_month_day.pdf. For example, the file Asheboro Courier Tribune_1985_Feb_24.pdf contains an article that has been published on February 24th, 1985 in the newspaper Asheboro Courier Tribune. The collection currently contains 3446 PDF files containing articles about WSSU for the period of three decades. To make the scanned PDF text recognizable, we used Adobe Acrobat X to convert them to OCR-text enabled PDF.

3.2. Search and Browse Interface

Rather than building a custom newspaper database or using the software specifically designed for digital library construction and manipulation (i.e. Omeka, ContentDM, Greenstone), the project adopted the open-source platform Drupal mainly for the sustainability that its large development and hosting community provides. Drupal’s flexible architecture, actively supported feature modules and relatively easier and common skill set allows the students to implement data models and taxonomies that capture the important characteristics of newspaper archive without having to support and maintain custom code. Figure 2(a) and 2(b) illustrates the software tool performing keyword search and fetching the corresponding results from the archive. The end of semester presentation was well accepted to the Library community and CS community. The WSSU O’Kelly library is in the process of integrating this search engine to their main website.

4. Lessons Learned

Our experience report is based on the survey and interview data provided by both students and clients during and after the development and observation data provided by the teaching faculty. We experienced benefits with respect to stakeholders involved in this project and they are summarized as follows.

4.1. Benefits to Community

The outcome of the project serves as a highly valuable information asset for the widest range of information consumers in the community such as: students, researchers, historians,
administrative personnel and the general public. The collected newspaper clippings not only document the work of WSSU, also tell the story of the community and its people, their successes and the issues that they believe to be important. By preserving these valuable records, organizing them, and making them available for future use to those inside and outside the organization, this project significantly benefit WSSU community and the general public.

As representatives of knowledge-based agency and the largest area of information use and need, universities can significantly impact on information society by creating repositories of their own unique collection of resources. The outcome of this project places WSSU on a higher ground on the access, preservation and maintenance of their historical data. The project also opens the door for all kinds of digital repositories to be built and utilized for public use. It may be a collection of music composed by the seniors in music department, or a collection of abstract arts composed by the arts student. The possibilities are limitless when it comes to preserve and share the accomplishments and research with the rest of the community.

4.2. Benefits to Students

The grade-level data verifies student’s academic improvement in the community-based project. The survey data reveals that students found it interesting to solve a real problem that addresses the need of their community while interacting with real clients. In general, they enjoyed applying abstract and theoretical software engineering and project management concepts that they learned in the classroom to a real problem. In particular, students mentioned that they gained valuable hands-on-experience on requirements gathering and analysis, project estimation and schedule, time management, user interface design, planning and writing test cases, configuration management, installation etc.

In addition to the enhanced learning in the application of software engineering principles, students also commented very positively on their feeling of fulfillment regarding the impact they make by doing this project. Students feel that their work extent beyond a learning exercise and the impact reach beyond determining their grades. The gathered data confirms...
their appreciation and preference for projects that are supportive to their communities than the mock or commercial projects. It really stimulates them to see that the software that they developed performs a keyword search on their classmate’s name (a well-known player in WSSU football team) and found three news articles mentioning them. This boosts up their confidence and self-reliance significantly. The survey and interview data also exposes following enhancements on student learning.

- Regular on-site meetings were arranged with library personnel, which gives the student a chance to interact with real clients in the design and development process and keeps them motivated and interested. The data also reveals that, these meeting are specially important to keep both clients and students informed and engaged. These meetings also inspire the students to effectively manage their time so that they can reach to the next project milestone before the next meeting.

- This project exposed the participating students to the design and implementation of a tool that must be incorporated successfully into existing web and database technology that O’kelly library is currently utilizing. This constraint forces the students to thoroughly understand existing technologies and develop and analyze solutions that leverage them.

- When it comes to client interaction, students have to deal with two different types such as archive personnel and IT personnel (responsible for maintaining library database, website etc). The former have domain expertise but minimal technical knowledge, on the other hand the later have technical expertise. This setting compels the students to understand the real needs of the non-technical client and integrate their work to an environment maintained by tech savvy.

- By utilizing Drupal, this particular project exposes the students to the open-source methodologies of software development. They actively read forum posts to solve problems, post questions that is unique to their situation and even propose a solution to a posting that they identified while doing their project. The Drupal skills also allow the students to gain proficiency in web development, information management and component-based software engineering.

5. Conclusions

In this paper, we presented our experience with the adoption of software engineering project that help community and society at a minority serving institution. The feedback from both students and clients were very positive, showing increased student engagement and interest on software engineering project work. Nevertheless, due to the short implementation period, the assessment data collected so far is not enough to provide a solid study of the strategy and its effect on student learning. In future, continuous assessment effort will be made to further justify the approach and its long-term impact on enhanced educational experiences.

References