INCORPORATING SERVICE LEARNING INTO COMPUTER
SCIENCE COURSES

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ABSTRACT
The skill set expectations of new computer science graduates have become more demanding in recent years. New graduates must not only master the technical skills of design and programming, but also be proficient in other skills such as teamwork and inter-personal communication as well as understand ethical and social values that are important to computing. Two capstone computer science courses at our university offer excellent opportunities for students to integrate service learning with the concepts learned in the classroom to outside projects. For the past three years, students in these courses participated in small service learning project teams and interacted with “real” clients while supervised by a faculty member of the computer science program. This sort of experiential learning helped instill a sense of social, professional and ethical responsibilities now considered so vital in the computing field.

I. INTRODUCTION
In traditional computer science courses students are normally given a problem specification by the course instructor and are expected to find a solution to the problem through design or programming. Nontraditional teaching by introducing service learning into computer science courses [10] has been difficult. Alternatively, team-oriented project courses [12, 13] with an added service component provide students with opportunities to be exposed to other important aspects of computing such as social skills (inter-personal...
communication), ethical issues (confidentiality), community awareness (digital divide), and economic issues (impact of computing on surrounding communities).

Service learning [8, 11] goes the extra mile by allowing students to apply what they learn in the classroom to outside projects. This form of active and direct interaction with real clients is more comprehensible to students than simple passive learning in the classroom environment. It can connect the theory taught in a classroom environment to practice in real-world situations in order to meet challenging social problems [3]. The benefits of collaboration gained with outside organizations (both for-profit and non-profit) are indispensable to students. The real life issues and experiences resulting from such lessons will prove invaluable to the learning efforts of students in the computing field.

Over the past three years, various student projects were completed that emphasized social skills such as teamwork and inter-personal communication, and provided service to the community. These projects were supervised by an instructor in a two-course sequence, offered at the junior and senior level, for both computer science and information systems majors at our university. Sample projects are shown in table 1. Furthermore, service learning projects require the course instructor to manage the course differently than a normal lecture type course. Managerial issues involved with teaching these courses are also discussed in a later section.

**Table 1. Service-Learning Team-based Projects**

<table>
<thead>
<tr>
<th>Type of Project</th>
<th>Service Recipient</th>
<th>Academic Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employee Tracking System</td>
<td>Regional company</td>
<td>2002-2003</td>
</tr>
<tr>
<td>Inventory Control System</td>
<td>Regional company</td>
<td>2002-2003</td>
</tr>
<tr>
<td>Student Accountability System</td>
<td>University Provost Office</td>
<td>2003-2004</td>
</tr>
<tr>
<td>Heirloom Craft Ordering System</td>
<td>Regional small business entrepreneur</td>
<td>2003-2004</td>
</tr>
<tr>
<td>Bank Human Resources Intranet System</td>
<td>Regional bank</td>
<td>2003-2004</td>
</tr>
<tr>
<td>Nursing Home Care Plan System</td>
<td>Regional Nursing Home</td>
<td>2004-Present</td>
</tr>
</tbody>
</table>

**II. BACKGROUND**

Many forms of work outside the classroom can be valuable for students. These include volunteer work, internships, field education, community service, and service learning. Volunteerism places the emphasis on services provided and often the recipient is the beneficiary. Internships provide students with valuable hands-on experience, but in this case the student is the primary beneficiary with new skills and experience obtained from the internship provided. In community service work, the recipient receives the primary benefits, but at the same time the
student learns some useful social values. Field education enables students to gain practical experience as part of their academic education. Examples are student teaching for education majors and hospital on-site training for nursing students. Service learning that is associated with relevant coursework, though, enables students to integrate academic study with service in the community in order to better understand course content through direct engagement. It places additional demands on an educational aspect [1] for the student. Moreover, service learning will benefit the student as well as the service recipient.

There is growing awareness of the usefulness of collaborations between academia and outside organizations. Service work in engineering [4, 5, 8] has gone on for almost a decade. It is important that the educational institution provides strong support for the collaborative effort between a department and its surrounding communities when offering service learning opportunities to its students. By providing students with service learning work a sense of social responsibility is encouraged that would otherwise be missing from the traditional computer science curriculum. Many of our recent graduates have commented on the practicality of these two service learning courses offered in our computing and information science program. Companies are also more willing to hire new employees with technical skills, team experience, ethical understanding, and social skills.

III. CLIENT-ORIENTED SERVICE PROJECTS

Three sample projects that students completed over the past two years are described in this section. In these client-centered projects students were grouped into small teams of approximately six to eight people. Representatives from each team kept close and constant contact with their respective clients. Student activities included, but were not limited to, interviews with client/end-users, preparation of questionnaires and survey for users, observation and documentation of the business process in the client organization, validation and verification of business requirements with users, and keeping the clients updated with the progress of their respective projects.

Student Accountability System

The Office of the Provost at our university maintains a record of student absences each semester in order to follow up on students who have excessively missed their classes. Tracking of student absences has traditionally been handled by pen and paper. A project team of six students provided a service to the university’s provost office by developing an information system named Student Accountability System (SAS), which automatically tracks and generates reports for excessive absences of students. A project of this size and scale required a tremendous amount of effort, organization, motivation, and time investment on the part of the students.

In addition to implementing SAS, this project team also created an online system, named bugTracker [5], for tracking, updating, organizing, and reporting modification requests. This system created a reliable and standard method of maintaining software defects that were found during the testing phase. It also helped improved communication between developers and testers.

Through this project, the students learned both ethical and professional issues. From an ethical point of view, the project team had access to sensitive student information. This required the project team members not to disclose sensitive information pertaining to student records. From a professional aspect, the project team had to work closely with university administrators as well as work-study students in the provost’s office. As a result, project team members had to behave professionally while performing the work of information gathering, requirements specification, design, and prototyping.
Human Resources Employee Intranet

A local bank needed a systematic way of allowing employees to access different forms for various purposes. A project team consisting of five students was selected to work on a web-based solution for the bank through implementation of an information system. Students had direct interaction with the human resource administrator at the bank and provided her with regular updated status of their project.

Due to the sensitive nature of the forms involved students had to sign a confidentiality agreement with the bank. Hence, this project taught students about ethical and professional issues not normally encountered in a traditional classroom setting. Sensitive forms, for retirement, tax and employment purposes, that are used by the bank had to be kept confidential after being viewed by the project team. Students learned, first-hand, the business working of a financial institution while interviewing, interacting, and observing the work of bank employees. Therefore, students learned ethical and social values through implementing a web-based information system for a local bank.

Heirloom Crochet Crafts

An regional entrepreneur business submitted a request for a proposed online E-commerce system for their small arts and crafts business. They wanted to increase their production and output through publishing their business on the World Wide Web, but had no prior experience with computers. A team of six students worked on the development of web-based information system that offered many valuable features for the business owners. Students were actively engaged in learning about the business and kept in constant communication with the client.

As a result of this project, students had direct exposure about the realities of digital divide [2] as well as learned about important social and economic issues that have an impact on the vast community. The clients for this project had minimum knowledge of computers and required extensive coaching and computer training from the project team. Since our university is located in a rural environment, many other local nonprofit organizations can also benefit tremendously from students at the university by learning about both hardware and software that can help their computing needs.

IV. MANAGEMENT OF SERVICE PROJECTS

Many issues have to be taken into consideration when teaching computer science courses that require students to work on service projects. Additional requirements have to be specified and a different set of grading criteria may have to be used than a normal lecture style course. This section provides an explanation of certain managerial issues that should be considered.

First, service learning projects have to be found for all project teams. This was usually done between semester breaks by the instructor through correspondence with regional organizations and businesses. Another option is to offer bonus credit to individual teams for finding projects on their own. This option proved to be quite a strong incentive to students. There is no guarantee that service projects will always be available each year. When new projects cannot be found there is the further option of performing maintenance or enhancements on existing information systems from previously completed projects.

Second, managing teams of five to eight people can be quite challenging for the course instructor. One way to better manage them was to assign certain roles to each person in a team. Traditional roles that have been used include project leader, project manager, systems analyst, system designer, system developers, system testers, database administrator, and end-user. Giving roles to students places more responsibilities on the students. Management of each team also falls...
on the team project leader and project manager. The instructor can then interact mainly with these two important people in each team.

Third, the grading criterion for such courses has to be carefully thought out before they begin. Our approach attempts to spread out the workload between all members in each team. It is important to assign an individual grade component and a team grade component. In each service project course, students were required to write professional technical documents during each stage of the software development lifecycle. For each document to be written there is both an author and a reviewer. The author’s work is counted as an individual grade and the reviewer’s responsibility for reviewing a document is counted as a team grade. Each student is also required to submit a biweekly report (individual grade) of his/her contribution to the project for the previous two weeks. Students had to attend team meetings (individual grade) each week to discuss current and outstanding issues for their projects. Moreover, each team then submits a report providing minutes of their meeting discussion to the course instructor. The course instructor also gave quizzes/examinations during each course. Over the past three years, the final letter grades of many students were found to be closely correlated to the grades on their examinations. Last, but not least, a 5-10% assessment grade was reserved for the instructor to assess each student’s service and contribution to the projects.

Finally, each team had to submit a final project report summarizing the entire semester’s work, do a post-mortem report for the service project, and give a formal team presentation of their service work. In previous years, many teams have submitted well-documented folders of their service projects to the course instructor at the end of each semester.

V. IMPACT OF SERVICE LEARNING

Courses that provide service-learning work with organizations in local and regional communities build lasting partnerships that can benefit students, faculty, the university, community organizations, and the service recipients. The two-course sequence in computer science is content-driven but also service-based, and seeks to strike a balance between traditional academic coursework and service work. Students experience many important values not normally learned in a traditional classroom environment, including social and ethical issues while completing service work through these courses. Service learning experience also afford students with visions of career development, value expression, understanding self and world, and self enhancement. Students get a glimpse of what kind of work they can expect to do after graduation. Through service learning, faculty has an avenue to invigorate their teaching. Community organizations benefit from services provided by participating students in service learning courses.

VI. CONCLUSION

Service learning enhances academic achievement by providing reality-based experiences that meet identified community needs. These experiences reinforce learning as well as develop professional values in students through active participation with real clients. As a result, students take more responsibility for their own learning. Through active learning students are empowered by a sense of influence that can make a difference in their own lives and in the lives of others in the community. New computing graduates will greatly benefit from the experiences gained through participation in the team-oriented service learning project courses offered. They will be more confident about their inter-personal skills, technical writing skills as well as the ability to improve themselves and the surrounding community. We hope incorporate a service learning component into our program in the future and make it a permanent requirement for every computing major.
REFERENCES


[6] Erickson, B., bugTracker: A system for tracking, organizing and maintaining modification requests, Internal Memo, Mansfield University, May 2004


