

Global Opportunities for Service Learning in Computer Science

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Abstract: Service-learning matches knowledge with experience. It offers special benefits for computer science education. Opportunities for community and global engagement exist with direct benefits for American and overseas students of computer science and engineering.

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1.0 Introduction

"Long gone are the days when it was enough just to work hard and become the go-to person for your technical specialty," ... "Now, it is crucial for professionals who want to advance their careers to pair their technical skills with 'soft skills' — intelligence on how to communicate with and lead other coworkers." IEEE-USA President Ralph W. Wyndrum, Jr [1]

Experiential learning in computer science and engineering is part of curricula around the United States. But quality service learning may need non-traditional faculty oversight and may be slow finding support within traditional programs.

Quality service learning keyed to the application of technical and scientific skills to real, immediate needs is an excellent way for learners to move beyond abstraction into wisdom that covers the broad cloth of human experience:

- 1) technical and scientific knowledge, and the messiness of real-world application of that knowledge,
- 2) the power and difficulty of clarity of thought, clarity of expression and effective collaboration and the development of active learning,

- teaching and communication skills to achieve such effectiveness, and
- 3) ethical, social and legal responsibilities, community engagement, and the expansion of "community" to embrace global relationships.

These concerns are not just aspirations. The Accreditation Board for Engineering and Technology programs (ABET) mandates engineering programs demonstrate their graduates can perform in these areas in the world:

Criterion 3. Program Outcomes and Assessment

Engineering programs must demonstrate that their graduates have

- ...(d) an ability to function on multi-disciplinary teams
- (e) an ability to identify, formulate, and solve engineering problems
- (f) an understanding of professional and ethical responsibility
- (g) an ability to communicate effectively
- (h) the broad education necessary to understand the impact of engineering solutions in a global and societal context
- (i) a recognition of the need for, and an ability to engage in life-long

learning

(j) a knowledge of contemporary issues

(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

[2]

This is more than marketability of computing skills; it is about excellence and leadership in a professional and “moral” context. Failure to address these risks compromise to all.

2.0 What Can Be Achieved

2.1 Service Learning

“Service learning” is a valuable adjunct to engineering education. In examination of a program where students design systems for the disabled, benefits suggested were a) the social good of service and also b) the real-time application of engineering skills and competencies to problems with immediate and serious outcomes for failure.

Pritchard [3] and Tsang [4] observe how reflection on the preparation for and execution of service-learning duties deepens students preparation of ethical problems in their professional futures and hones their focus on what precisely they wish to do as engineers. Tsang details how reflection and reciprocity in social science service learning may be ported to engineering education through adoption of best practices for service learning course development. [5]

American universities are the best in the world. Often, student achievement, especially in the sciences and engineering, comes from individual effort that may outstrip classroom discussion.

That effort and the classroom may both leave much to experience to hone learning. [6] Service learning can integrate that experience and academic study. Quality service learning is keyed to the application of technical and scientific knowledge to solve real, immediate needs. Supervision,

discussion and examination must be part of the learning to maximize the benefits.

Computer science students at the University of Louisville engage in cooperative learning programs through paid internship semesters in industrial environments. Coops and general work experiences let students apply technical and scientific knowledge, and deal with the messiness of real-world application of that knowledge. They may also introduce students to the power and difficulty of clarity of thought, clarity of expression and effective collaboration.

But these “coops” do not have the supervision and reflection a service learning program should offer. They may not teach the student to remedy collaboration problems or develop active learning, teaching and communication skills to achieve greater effectiveness. Similarly, ethical, social and legal responsibilities may not be addressed as those may be seen as the concerns of management; the student may not be in a position to consider how his or her work may be intertwined with such responsibilities.

Community engagement, and the expansion of “community” to embrace global relationships, may but rarely be an issue.

2.2 Work-arounds

The university’s computer science department has addressed some to these through coursework beginning with social impact and continuing through project and software development design methods.

The ethics and law in computing class, CECS 311, is a required course for all computer science undergraduates. Writing skills are stressed through short comments and a major class paper for the semester. Oral and team skills are developed through team projects requiring team presentations at semester’s end. These team projects look at ethical, social or legal issues within computing.

Similarly, a popular elective on information security, CECS 566, also requires written, oral and team assignments

that address legal and social concerns, albeit at a significantly higher technical level.

One outcome from these classes was the student ACM chapter's Computer Security/DHS project.

2.3 The Computer Security/DHS project

Ethics class students devised a team project that taught home and small business the technical fundamentals of computer security. This team project was expanded for the Information Security class and presented a toolkit for installing and maintaining basic firewall, anti-virus and safe computing systems and practices.

The project received encouragement from the Kentucky head of the federal Department of Homeland Security (DHS). This support recognized the threat of unsecured home and small business computer systems to the national data infrastructure. The *National Strategy to Secure Cyberspace*. [7] Found home/business systems "...are being increasingly subverted by malicious actors to attack critical systems." *Id*, at 38.

The student chapter of the Association for Computing Machinery (ACM) offered to support and house the effort and host web-based tools on its website, www.speedacm.org/dhs. This became an official project of the student chapter.

The training outlines the threats to home and small business systems and "best practices" to address those threats.

The basic protective technologies addressed are:

- 1) software patches and updates,
- 2) firewalls [8],
- 3) anti-virus software and
- 4) anti-spyware software to remove advertising/monitoring software.

System maintenance practices addressed

- 1) an update policy for all software on a machine, including patches for

the operating system, application, anti-virus, firewall and anti-spyware software,

- 2) a recovery plan for data and machine when compromise occurs (e.g., backups) and
- 3) how to access and install programs, patches and updates.

Safe personal computing practices [9] are addressed:

- 1) do not open e-mail from unfamiliar sources,
- 2) do not download files of unknown provenance off the 'Net, including music files, or using unclean diskettes,
- 3) do not let others, whether children, parents, grandparents or janitors download such files,
- 4) for home computers, do not leave Internet connections on when not on the machine and
- 5) *Do* use and protect strong, harder-to-crack passwords, for everything. [10]

The project was rolled out first as a class project and then as a case study for the students. The student ACM chapter adopted the project as a community service effort for the chapter.

Once the initial training package was completed, students began presentations to schools and agencies with written evaluations for audience response. In all presentations audience responses were very favorable. Anecdotal comments were that some participants had *never* heard of even basic computer security threats that could be easily dealt with.

Although the students had some faculty support, the project was run by the students outside their normal work and academic duties. One result of this was as the student leadership left for their coop semesters, project activity would slow.

2.4 Service Learning Integration

This student project may be a model on which to build service learning within the curriculum such that there is further student reward and learning. It requires both significant technical knowledge as well as communication, teamwork and management skills.

It may be integrated into the curriculum, given the training package is complete, as a requirement of the CECS 311 or CECS 566, or of any higher-level course involving immediate real-world application.

There are yet matters to be resolved:

- 1) learning outcomes must be clearly defined and keyed to the course of study (the learning must not be forgotten in the service),
- 2) reflection and reciprocity must be maintained at each level,
- 3) student expertise must be validated to assure their competence in the services they provide.

Administrative issues to be addressed include:

- 1) scheduling of presentations,
- 2) supervision of presentations,
- 3) preparation of presentation teams
- 4) post-presentation analysis with the teams and
- 5) grading of the efforts.

And students should be involved in the creation of this teaching program.

A suggested structure is from the California State University, Monterey Bay service learning course assigning students to evaluate communications needs with technology and propose solutions for community agencies. [11] A minimum of 33 hours of on-site service are required of the students. Action, reciprocity and reflection are integrated into the grading; each of these elements is shown in the respective portion of the final grade:

Journals = 20%

Proposal to client = 15%

Panel and Threaded Discussions = 20%

Professional Service and Client Evaluation = 30%

Term Paper = 15%

Traditional learning, service and reflection are all integrated and a model for computer science service learning courses.

3.0 Globalization & Community

International service learning programs can promote understanding of “the impact of engineering solutions in a global and societal context” ABET Engineering Criterion 3 (h) [2] Many international service learning programs focus on overseas humanitarian service. [12] Computer science is uniquely positioned to pervasively integrate service learning in community and global contexts.

Martin notes success requiring computer science students perform social impact analyses of computer use in social service organizations; students were both concerned about the real-world impact of effective systems for the disadvantaged as well as disturbed at inappropriate or useless technology. [13] In her study, students confronted contemporary problems, the impact of the technology on people and the need to work as effective teams to solve these problems. Can this be applied in an international relationship?

Computer science service learning has a plethora of opportunities to engage different communities in good ways, both in promoting the good and defending against the bad.

And this includes the global community, in ways only the Internet has now made available. By leveraging the ubiquity of computing’s personal computers and the Internet, there may be special global opportunities for service learning.

With reciprocal relationships established with overseas computer science departments, student service learning could be applied to address such matters as:

- 1) peer training on ethical, social and legal responsibilities in computing, particularly as to intellectual property (a priority of the U.S. Government),
- 2) assistance in creating computing organizations that themselves promote these, e.g., student ACM chapters,
- 3) assistance in developing industry relationships, particularly in establishing industry advisory boards, and
- 4) assistance in establishing service learning and cooperative learning programs at those universities.

Indeed, this may be the most cost-effective model in promoting these values in overseas institutions with reflection on these values in American students who may take them for granted.

This leverages and exploits the sophistication of engineering students here and abroad, their very curiosity and *need to know*, and their early adoption of the Internet communication technologies.

Connections with overseas schools may be facilitated by the international composition of many engineering

departments and their relationships with possible partner institutions.

The expansion of on-line class support, both for purely on-line and blended courses, naturally lends aid to such global initiatives. Proprietary systems such as BlackBoard® or open source tools for teaching support over the Internet can serve both synchronous and asynchronous support for these programs. And the very nature of this endeavor may curry resource support that enriches the learning of all participants. [14]

4.0 Conclusion

The computing disciplines have special opportunities to benefit from service learning. The United States and other countries around the world can equally benefit from these special opportunities to engage students in practical, real world applications of computing to people's problems.

Yet it is the students who will benefit the most, in their development their life beyond the academy and the world in which they'll live.

Whether for ABET accreditation, alumni loyalty or a better world, we must build these programs and implement them before illiberality makes any such innovation impossible.

References

- [1] IEEE-USA President Ralph W. Wyndrum, Jr "Making Ourselves More Marketable", <http://boldfish.ieee.org:80/u/2296/100639> (press release March, 2006)
- [2] Accreditation Board for Engineering and Technology (1998) Engineering Criteria 2000 (3rd Ed.), Criterion 3, Program Outcomes and Assessment
- [3] Pritchard, Michael "Service-Learning and Engineering Ethics" International Conference on Ethics in Engineering and Computer Science, Case Western Reserve University, Cleveland OH, March 21-4, 1999
- [4] Tsang, Edmund, "Service Learning as a Pedagogy for Engineering: Concerns and Challenges," *Projects That Matter: Concepts and Models for Service-Learning in Engineering*, Edmund Tsang, ed., American Association for Higher Education (2000)
- [5] Tsang, Edmund, "Introduction" to *Projects That Matter: Concepts and Models for Service-Learning in Engineering*, Edmund Tsang, ed., American Association for Higher Education (2000)
- [6] Aristotle, *Metaphysics*, Part I, translated by W.D. Ross, (350 B.C.E.) (<http://classics.mit.edu/Aristotle/metaphysics.1.i.html>)
- [7] Administration of President George W. Bush, *The National Strategy to Secure Cyberspace* (2003) <http://www.whitehouse.gov/pcipb/> ; http://www.dhs.gov/interweb/assetlibrary/National_Cyberspace_Strategy.pdf
- [8] see, e.g., CERIAS (2004) e-document on home firewalls, http://www.cerias.purdue.edu/training_and_awareness/home_users/firewalls.pdf
- [9] <http://www.staysafeonline.info/>,
- [10] Cybersmart.Org, (2004) *Top Ten Cyber Security Tips for Teens, Teachers and Families*, http://www.cybersmart.org/for/top_ten.asp
- [11] Syllabus, "Communication: Tech Tutors," Instructors: Kevin Cahill, Geri Philley, California State University, Monterey Bay, online at <http://www.compact.org/syllabi/syllabus.php?viewsyllabus=390> (last viewed April 20, 2006)
- [12] International Service Learning, "Who We Are" <http://www.islonline.org/> (last visited April 20, 2006)
- [13] Martin, C. Dianne "Integrating Service Learning Into Computer Science Through a Social Impact Analysis," *Projects That Matter: Concepts and Models for Service-Learning in Engineering*, Edmund Tsang, ed., American Association for Higher Education (2000)
- [14] Goldstein, Harry, "Networking Nigeria: IEEE Helps Engineering Students Get World-Class Internet Facility" IEEE Institute, March, 2006