

The Implications of Service-Learning for Technology Studies

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Throughout their educational careers students are taught that there are right and wrong answers. Students are also rewarded for finding correct answers and discovering solutions ahead of their classmates. This type of conditioning, or lack of preparation, often leaves college graduates struggling in a workplace that no longer rewards people for the “right” answer but rather rewards those who can get projects accomplished while working with others. Having the right answer and getting tasks accomplished are often mutually exclusive events. These are important skills and learning objectives that educators often fail to deliver.

Technical educators should be emphasizing a student’s social attitude toward working with others while simultaneously providing the formal knowledge required for technical literacy. While a good academic record is part of stated requisites, industrial leaders are also seeking new hires who can work with others to affect change. Although this is important, there are few pedagogical tools to foster students’ competency in this area.

This article describes a pedagogical approach called service-learning. Although it appears that this pedagogical approach is relatively new to those teaching in the area of technology studies, it must be acknowledged that similar work-based or project-based pedagogical approaches have been studied by previous authors of this journal (Harnish, 1998; Resnick, 1987). Service-learning is unique from these work/project-based approaches because of the service orientation and because it challenges students to engage in a high level of reflection and has an important goal of helping students build civic responsibility and social awareness skills. The

philosophy and elements of the service-learning pedagogical tool are discussed, along with some of the implementation issues found while integrating it into a technology management course at Colorado State University.

Service-Learning

The National Society for Experiential Education has defined service-learning as “any carefully monitored service experience in which a student has intentional learning goals and reflects actively on what he or she is learning throughout the experience” (Furco, 1994, p. 2). This definition requires some further discussion, since the term *service-learning* has been applied to many forms of experiential education. Figure 1 shows the distinctions among experiential programs.

Figure 1 also shows how service-learning requires that both the recipient and the provider benefit from the experience. This is a fundamental distinction between service-learning and community service or volunteerism, where the provider of the service does not intend to realize any personal gain. On the other hand, an internship makes the service component an accessory to the study of technology, or may be absent altogether. A mutually beneficial situation could result, for example, from engaging a manufacturing class to design a toy for the Toys-for-Tots holiday gift project. While a community’s children will benefit from the finished toy, the students will also benefit from this service-learning and structured classroom experience. Furthermore, an important element of service-learning is the need for a deliberate learning goal. In the Toys-for-Tots example, if students would simply produce toys without any programmatic design from the class instructor,

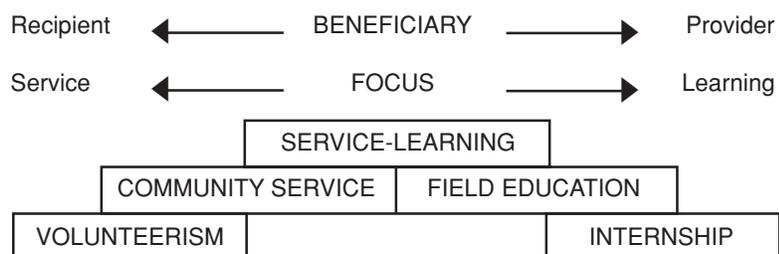


Figure 1. Distinctions among service programs (Furco, 1996).

the experience would qualify as volunteerism, but not as service-learning.

The need to introduce reflection and self-regulation into the learning experience is perhaps the most neglected component of service-learning. However, it is a well-established fact that we learn through combinations of thought and action, reflection and practice, theory and application (Kendall, 1988). Effective learning can be achieved while discussing intellectual, civic, ethical, moral, cross-cultural, career, or personal goals (Kendall, 1990; Lisman, 1998). Using the Toys-for-Tots example again, some valid discussion topics may be: Why should underprivileged families be given toys during the holiday session? How do other countries deal with the problem of poverty? How could the cost of manufacturing the toys be reduced? How should society deal with the issue of poverty during a time of extreme economic prosperity? Should product safety regulations be relaxed for this type of manufacturing? Part of the instructor's duties is to think in advance and discuss such topics with the students. Reflection should not be postponed to the end of the experience, but be part of the learning experience as it unfolds.

Service-learning should also include a strong reflective and self-regulation component that directs students to discuss current social issues and encourages them to talk about values and what being an active member of society means to them (Lisman, 1998; Rhoads, 1997).

Purpose: What Service-Learning Has to Offer Technology Studies

In order to appreciate the need and advantages of service-learning and similar hands-on pedagogical approaches, it is necessary to reflect on the state of higher education. Recent articles have criticized the current environment in institutions of higher education for their "indifferent undergraduate teaching, overemphasis on esoteric research, failure to promote moral character and civic consciousness, and narrow focus on preparing graduates for the job market" (Jacoby, 1996, p. 4). Also, in a 1999 Society of Manufacturing Engineers (SME) education report a group of industry education leaders identified competency gaps among newly hired college graduates in the areas of development of personal character and the ability to work well with others. Deficiency areas included

communication skills, teamwork, personal attributes, and an ability to affect change. The communication skills included presentation skills, written report generation capabilities, graphic computer software usage, and meeting organization and facilitation.

Service-learning combines all the advantages of expanding knowledge acquisition with practical exposure. In virtually all modern learning theories, the need for such hands-on opportunities is a central component. Bloom's taxonomy (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956), generally recognized as a central element of modern learning theory, identifies six major divisions of the cognitive domain: knowledge, comprehension, application, analysis, synthesis, and evaluation. These are useful to demonstrate the richness of service-learning. Solving a typical service-learning problem requires a deeper understanding of the meaning of technical alternatives than the simple aggregation of technical facts (comprehension). It also requires the application of these facts in a particular concrete situation (application): the breaking down of a relatively complex problem into manageable pieces and then finding a wholistic solution to these pieces (analysis and synthesis). A reflective assessment of the problem and the applied solution (evaluation) is a central element of the service-learning. Components of other learning theories such as Perry's theory of development of college students and Kolb's learning cycle also support service-learning (Culver, 1985; Kolb, 1984; Perry, 1970).

The strengthening of character through service is discussed less in the literature. The manufacturing industry, however, offers testimony of improvement and even dramatic change in the character of many participants in internships and similar practical experiences that are arranged through Colorado State University. In addition, *Time Magazine* conducted a survey of 608 middle and high school students with some previous exposure to community service. It found that 75% of the students said that they "learned more during community service than in a typical class" (Cloud, 1997, p. 76). Although judgment must be exerted to extrapolate these results to all technology study students engaged in service-learning, Colorado State University's Industrial Technology Management (ITM) students show that Bloom's taxonomy seems to hold true insofar as the education value of

service in general.

The Higher Education Research Institute at the University of California, Los Angeles conducted a number of studies on the impact that the service-learning experience has on the development of undergraduates. One study involving 3,450 students attending 42 institutions concluded that student participants in service-learning were more likely than those in non-service-learning classes to strengthen their commitment to participating in community action programs, influencing social values, and promoting racial understanding. In the area of life skills, service participants showed greater positive changes in understanding community problems, knowledge of different races/cultures, interpersonal skills, understanding of the nation's social problems, the ability to work cooperatively, and skills in conflict resolution. In addition, students who have had a community service course tend to carry these attributes with them over the long term. The strongest of these long-term attributes was related to the students' commitment to volunteerism and community activism (Sax & Astin, 1997). Eyler, Giles, and Braxton's (1997) study on the impact of service-learning on college students found similar effects including that service-learning was a predictor of students valuing a career helping people and that students volunteering time in the community resulted in students being more active within the political system. A positive impact on skills of political participation, tolerance, communication, issue identification, and critical thinking were evidenced.

Although these studies provide evidence of the impact of service-learning, a common objection to this pedagogy is that service-learning consumes time and energy that students may otherwise devote to academic pursuits. Sax and Astin (1997) asserted that "this argument has been laid to rest by the results of our longitudinal analysis which reveal significant positive effects on all ten academic outcomes included in the study" (p. 27).

Toys-for-Tots: Implementing Service-Learning at Colorado State University

An attempt to integrate service-learning into the manufacturing technology curriculum was made by author James Folkestad, who modified the traditional delivery of Process Planning and Costing, a required junior course

in the ITM curriculum at Colorado State University. The course is offered during the spring semester and has an average enrollment of 25 students for each section. Students enrolled in Process Planning and Costing typically have already taken courses on quality improvement and safety. A traditional lecture/laboratory format, slightly adjusted to accommodate each instructor's teaching style, had been the standard for more than 10 years. Folkestad chose to implement a Toys-for-Tots experience into Process Planning and Costing because the course content aligned with the service project although service-learning can be introduced in other courses, such as in a capstone experience. This required the development and planning of a toy using a planning process that was directly related to the learning objectives of the Process Planning and Costing curriculum content. In order for students to fully understand the class concepts, they were required to work with various stakeholders. Stakeholder diversity is similar to what students would experience working in industry. The Toys-for-Tots program brings diversity to the class by including stakeholders such as parents, students, and professors who have dissimilar backgrounds and usually different and sometimes conflicting demands.

A local community service agency called Even-Start Learning Center had been involved with the ITM program for 11 years, receiving toys that were manufactured by students and given to economically disadvantaged families during the December holiday session. Until 1997 toy designs had remained the same and were designed by retired faculty members and former students. Although these toys were greeted with great excitement each year, the program needed new ideas, toy designs, and production plans.

The goal of the Process Planning and Costing students was to provide designs for new toys and toy production plans. Course requirements included establishing processes, planning, and determining costing for a manufacturing project. These basics include "best practices" in the definition and control of the scope, costs, quality, and time. The students were introduced to best practices and then expected to apply them to the service-learning project. These best practices included problem definition and statements, project mission and mission hierarchy, scope definition and control techniques, stakeholder



Figure 2. Project milestones and deliverables.

identification and interviews, quality functional deployment, duration estimating and scheduling, schedule control, and project progress reporting. All of these items were documented in a project notebook and given to the manufacturing student club for toy production (Folkestad, 1999).

The class began the project approximately halfway through the spring semester with four major deadlines. Figure 2 shows the project schedule, which outlines the project deadlines and project deliverables. The project was assigned halfway through the semester to allow students to complete the requirements and to avoid end-of-semester pressures.

Students worked to develop their project

notebooks (which were the course's final project) in teams of four to five students. Students were randomly assigned to teams in order to distribute talent and friends and to simulate the workplace where employees are required to work with a variety of individuals (motivated, not motivated, etc.). Each team was responsible for designing one toy that would meet all stakeholder demands. The first task was to establish a list of stakeholders, including the children, their parents, teachers, and internal university stakeholders such as manufacturing club members (those individuals responsible for manufacturing the toys) and the department's machine shop director. Figure 3 represents an example of a

STAKEHOLDER LISTING AND ANALYSIS

- 1. Project Manager & Dr. James Folkestad** - Must be aware of the progress of entire project. Information needs consist of project progress reports and audits throughout the planning process.
- 2. Parents** - Must be certain that product conforms with cultural and moral beliefs that the parents are trying to teach. Initial consultation will be done to narrow design specifications for product. Information needs consist of final product design(s) for verification and/or suggestions.
- 3. Even=Start Family Center** - Must be certain that product does not violate company standards or applicable laws. Initial consultation will be done to narrow design specifications for product. Information needs consist of final product design(s) for verification and/or suggestions.
- 4. Design Team** - Must be aware of cost and time factors as well as product specifications and design constraints. Information needs consist of milestones for design(s) and manufacturing constraints.
- 5. Marketing Team** - Must be aware of design features and project milestones. Information needs consist of consultation with parent(s), final product design with features, and dates needed for customer confirmation.
- 6. Manufacturing & Dr. Steve Schaeffer** - Must verify that product can be manufactured using tools available. Information needs consist of product design(s), manufacturing process assumptions and material list.
- 7. Suppliers** - Must be certain that suppliers will be able to meet the cost and time restrictions that production will require. Information needs consist of delivery dates, lot sizes and payment process.
- 8. Notebook coordinator** - Must be certain that thorough documentation is given to the project manager and Dr. Folkestad on time. Information needs consists of all documentation required for notebook fulfillment.

Figure 3. Stakeholder listing and analysis.

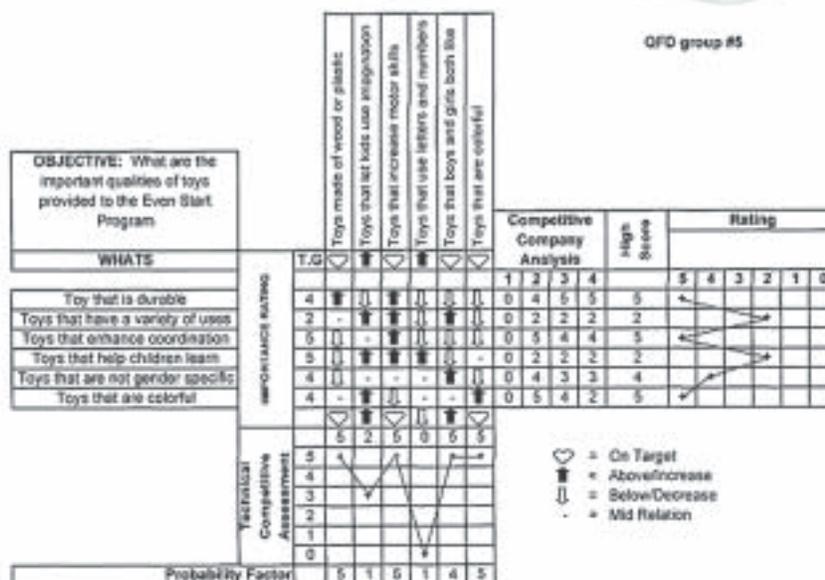


Figure 4. Quality functional deployment (QFD) chart.

stakeholder analysis document. This stakeholder analysis led the students into the service-learning activity requiring them to work closely with key stakeholders within the Even-Start Program.

The next step was a field trip to the Even-Start Learning Center to conduct the stakeholder interviews. Although all teams identified the children as major stakeholders, it was agreed that they would not be interviewed to preserve the surprise of the holiday celebration. However, the parents and teachers of the children were interviewed. During this interview, students were instructed to capture the customer's voice in their own words. An example of a typical statement was, "My child likes the toys that are bright and have moving parts." Comments such as this were then inserted into a quality functional deployment (QFD) chart to translate the "voice of the customer" into product/engineering specifications as shown in Figure 4.

During these interviews the students learned several facts about their customers' interests. The parents interviewed spoke limited English. Although a translator was required, students and parents overcame this barrier by using paper and pencil to sketch ideas and gather information through drawings. Many of the parents wanted their children to have traditional toys similar to those found in Mexico. These included items ranging from a simple wooden noisemaker to an intricate hand-carved wagon and horse. One of the comments was related to a previously produced

toy, a (wooden) duck. One parent expressed her concern that she had six children and that for the past three years at least half of them had received a duck. Her concern, humorously expressed, was that she was running out of room for ducks.

In general, several reflective sessions are recommended for a service-learning experience. The fact that only one was conducted in this case reflects more the instructor's inexperience in this field than any deliberate decision. Overall, the service-learning experience was very positive for the majority of the students in the class. In the student evaluation of the course at the end of the semester, service-learning was consistently considered to have enhanced the learning of the course contents.

Challenges to Service-Learning and Implications

The first challenge to consider regarding service-learning comes from the fact that it has only recently been applied to technology fields such as industrial technology management. In areas of study such as social work, students are expected to gain a deep understanding of their community. There is an evident link between service-learning and their educational goals. This is not often the case in technology studies. An instructor trying to implement service-learning in a course has the burden of proof to convince colleagues of the merits of this approach. An extensive literature search was conducted before implementing Folkestad's project, and it became apparent that another

consequence of this absence of precedent is that there is no instruction or lessons learned specifically for technology education. In contrast, and of great importance, is the sizable body of literature offering insights about experience gained from implementing service-learning in the social science areas.

Another challenge for new service-learning instructors is the nature of the reflection component. A few possible topics that were mentioned previously (i.e., why should underprivileged families be given toys during the holiday session?) may seem too ideological to technology instructors and distant from the scope of their traditional curriculum. However, civic and industrial leaders are emphasizing the importance of this type of social awareness. Discussing social issues is an important component of service-learning, and perhaps the awkwardness of dealing with social issues is the best testimony of the chronic deficiency of the technology studies field to address this important area.

The above aspects can be overcome by a willful instructor. However, other issues are generally beyond the control of anyone in particular (Senior, 1999). An issue may be identifying an appropriate project in the first place. In Senior's (1999) case study, the Service Integration Project staff at Colorado State University identified a project and provided the initial contacts. Senior reported that several of these contacts led to projects that didn't fit the objectives of his course and were discarded after interviewing representatives from the involved agencies. Furthermore, several of the project's timelines did not meet the course's semester duration and could not be accommodated. Conversely, the Toys-for-Tots activity is well suited for a service-learning project. First, the toys can be designed and the project notebooks developed within a semester course and well in advance of toy production. In addition, the toys are produced annually and are delivered at the end of the fall semester. Finding a service-learning project with similar time demands is critical to success. Instructors should identify a project that can be completed within a standard academic timeframe and that offers a level of year-to-year consistency.

Assistance in implementing service-learning is readily available on many campuses. Instructors are likely to have access to some level of institutional support through their

office of community services (or equivalent). There, they can find literature and get help in locating suitable service projects, modifying the course syllabus, and other initial tasks. For example, Colorado State University offers grants to help in the start-up of such efforts. In general, service integration seems to have political momentum. The state of Maryland now requires 75 hours of community service from all high school students. Miami began requiring 75 hours in 1996, and Chicago began requiring 40 hours in 1998 (Cloud, 1997). Although revolutionary by American standards, these requirements are still shy of the more extensive service system that has been in place for decades in Germany, Austria, and other European nations. Furthermore, the current federal administration is pushing for service-learning as a requisite for federal grants and local service programs (Cloud, 1997).

Such momentum does not guarantee ultimate success. In an article dealing with community service entitled "Involuntary Volunteers," Cloud (1997) explained that even though 91% of students polled agreed that they should be "encouraged" to participate in community service, only 36% think that they should be required to participate. At the more immediate level, untenured instructors may face the dilemma of keeping their teaching within the comfortable realm of traditional lecturing, or entering into relatively uncharted territory with service-learning. As Morton (1996) noted, "the growth of service-learning will require that executive officers, from department chairs to presidents, find ways to recognize and reward different teaching styles, assign equitable teaching loads...and otherwise protect and promote the careers of faculty who wish to commit to the integration of service and learning" (p. 289).

Service-learning presents a uniquely positive opportunity for technology studies students and their community. Significant nationwide studies do indicate the positive impact this type of program has on students within a variety of educational disciplines. The members of Colorado State University's ITM industrial advisory board have stated that they need people with a combination of technology skills and strong personal character; service-learning has helped promote these desirable character traits.

An essential element to the adoption of service-learning for technology studies is the

creation of a body of literature specific to this discipline. The publication of new case studies should be encouraged to achieve this objective. This case study shows encouraging, though informal, indications that the students in Process Planning and Costing benefit from the experience. Future research should examine the hypothesis that service-learning indeed improves technology education and promotes civic responsibility and awareness of technology studies students.

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