Development of a Material Reuse Information Guide
A Community Service Project for First Year Students

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Abstract

Over the last 20 years, recycling programs have developed throughout the United States and internationally. However, though "recover, recycle and reuse" (the new 3R's) is a familiar mantra in most communities, it is the recovery; the physical act of separating waste into recyclable materials, that is the most widely known element of this triad. Once the "recycled" material is placed at the curbside or brought to the recycling center, what happens next? Researching and describing what happens next was the project of a course on the reuse of waste as construction materials. The course serves as an introductory course for first-year engineering students to see what type of work engineers may do in their professional careers. To create an appropriate, "real-world" component of the course, students were tasked to research options for recycled material reuse.

This paper describes how this effort was transformed into a community service-learning project. Community service learning, the pedagogy of combining education with community service, has value in a number of academic fields. The students in the course were assigned communities (municipalities) in Massachusetts, who have recycling programs, and were tasked with developing a Material Reuse Information Guide for community residents.

The projects were successful in a number of areas. Since they were real problems, they carried more meaning and encouraged greater student learning, enriching the students' educational experience. Additionally, the projects not only benefited the students, but also the affected communities, providing additional information that could be delivered to their residents. This paper will also discuss the student's reflections of what they learned about recycling by doing the project.

Introduction

Why recycle? This question was posed to students in a course entitled "Waste Not, Want Not", an introductory engineering course offered at Tufts University during the Fall 2002 semester. The course has been offered since Fall 1999 and has traditionally focused on the engineering aspects of waste reuse and recycling in the US. However, components of community service learning (CSL), which combines education with community service, were introduced as a way for

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engineering students to delve deeper into these engineering aspects of recycling and reuse by making the project real, and immediately relevant. This paper presents the revised course, details of the course projects and student findings, and how the student's views on recycling were changed or reinforced due to working on their projects.

Course Background

"Waste Not, Want Not", a course on the recycling and reuse industry, was initiated by the lead author in Fall 1999 as an extension of his research efforts. The course was meant to provide students an introduction to the processes involved in recovering recyclable materials and the engineering aspects associated with their potential reuse. Student assignments and projects focused strongly on introducing students to engineering concepts such as stress, strain, compressibility, and strength of construction materials. For the Fall 2002 offering, the course assignments and project were changed to also incorporate aspects of CSL. Community service learning has been found to provide a better educational experience for both students and course administrators for other environmental courses (Swan et al 2000 and 2002) as well as provide a benefit to affected communities. It was hoped that the use of community service learning in this course would deepen the education experience of the students, leading them to develop more meaningful solutions to real problems.

For CSL to be effective pedagogy, there must be a reflection of what was learned, and its value, at the end of the process. To accomplish this, the course was revised by condensing the existing five assignments to three; yet cover the same material of stress, strain, and material properties. These assignments were then sandwiched by two new assignments that required the students to first address why they think recycling is good (Assignment No. 1) and later to reflect on how they perceive recycling having now completed the course project (Assignment No. 5).

The course project, the major component of the course, involved the evaluation of the reuse options for recovered municipal solid wastes (MSW) for a number of communities in Eastern and Central Massachusetts. Each of these communities control their waste management practices, so these documents were tailored for each entity with the goal to provide:

- Vital facts about the community,
- The overall rationale behind recycling,
- What are current (and historical) disposal and recycling practices,
- What communities can do, overall, to increase recycling, and
- What outreach activities community administrators can do to increase community participation.

The final product could be used to develop Material Reuse Information Guides that could be disseminated to the residents of affected communities. If possible, recycling costs were to be compared to disposal costs. In addition, the projects were to explore the technical and non-technical issues or constraints that existed in the community.

Table 1 lists the eight communities examined along with some pertinent information.

Table 1 Communities Examined in Course Projects for Waste Not, Want Not in Fall 2002			
Communities	Incorporated	Population (2000 census)	Area (square miles)
Arlington	1867	44,630	5.5
Concord	1635	17,080	25.9
Grafton	1735	13,035	23.3
Medford	1630	57,410	8.6
Needham	1711	27,560	12.7
Somerville	1842	76,210	4.2
Tufts University (Medford/Somerville Campus)	1852	8,490	0.23
Wayland	1835	11,875	15.9

Project Deliverables

Groups, consisting of three to four students, were assigned to address each community. The project required each group to provide a 50% submittal, a final written report, an oral presentation, and a web-based document that presented "fact sheets" of a community's recycling practice. The written and oral presentations had to outline the following:

- Community information,
- Historical community waste disposal/handling process,
- Benefits of recycling,
- "Fact Sheets" that would present data and statistics on each component of the waste stream and recycling/recovered materials (i.e., what is it, how much, where located, how reused, existing markets, etc.) for a community,
- An examination of the engineering and non-engineering issues involved with the reuse of recycled/recovered materials, and
- Current and future outreach efforts that communities could engage in to increase recycling rates.

Groups were encouraged to use both written and electronic library resources and to visit the recycling/waste handling facility of their community.

Exerts from Course Projects

Though course project requirements were stated, how students performed their work or completed these requirements was open to their interpretation and ingenuity. Students were allowed and encouraged to seek out information from a variety of resources. With help of student aides and the course teaching assistant, students contacted the recycling coordinator for their particular community and, if possible, visited the recycling center or facility used by the community. Some of the materials developed by the student groups are presented below. These materials include images from site visits, oral presentations, web-based documents, and written reports.

Site Visit – Conigliaro Industries

Recyclable materials collected at Tufts University are processed at Conigliaro Industries recycling facility, located in Framingham, MA (12 miles west of the university). Conigliaro recycle all types of materials including papers, corrugated cardboard, newsprint, and magazines; difficult materials such as computers, mattresses and box springs, batteries; and commingled steel, aluminum, glass, and plastic containers. A site visit was arranged for the entire class to not only see the recycling and reuse processes, but also discuss the business of recycling with the company president and founder. Figure 1 shows images taken during the facility tour.

a. Aerial view of Conigliaro Industries in Framingham, MA

b. Glass crushing and sorting equipment

c. Storage bin for recycled plastic containers

Figure 1 Images from Site Visit to Conigliaro Industries in Framingham, MA
(Images by Alison Meisel)

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Oral Presentation - Grafton

The oral presentation for the Town of Grafton discussed potential outreach activity involving the development of a playground from recycled materials. Images from the presentation are shown in Figure 2.

Figure 2 Exerts from Presentation on Potential Outreach Efforts for Recycling in Grafton, MA

(Group Members: Becky Swartz, Aman Chabal, Mann Sakbodin)

Web Page – Medford, MA

Figure 3 shows an image of the web page developed for the town of Medford, MA. The developed website includes information on the recycling procedures in Medford, links to general recycling information, and outreach activities that the Medford community could pursue.

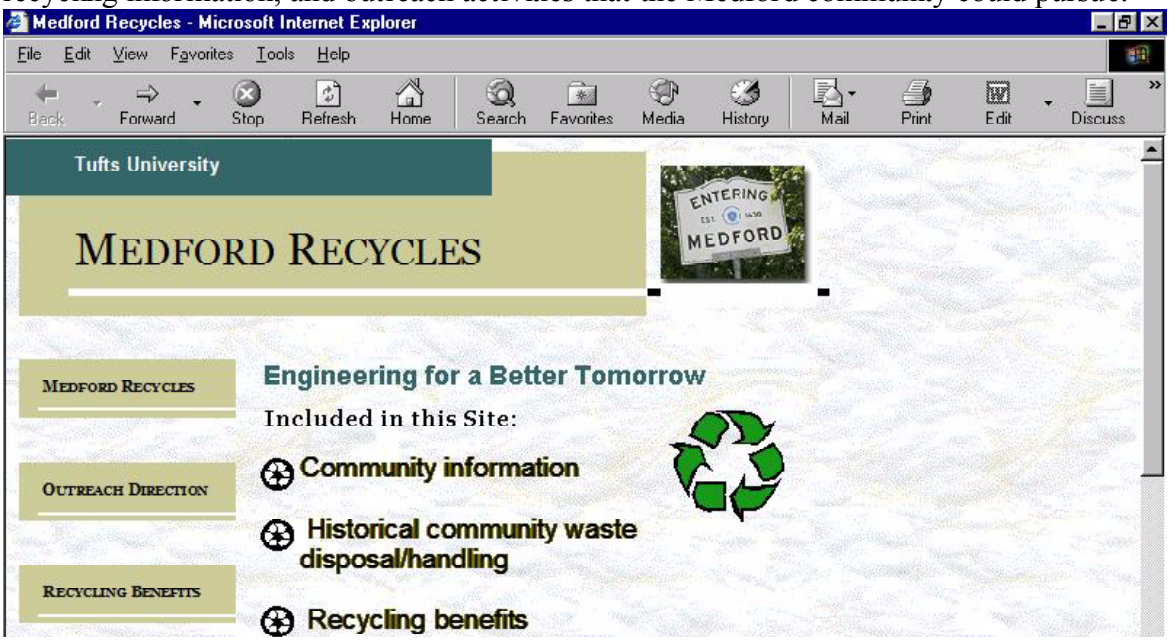

Figure 3 Homepage Developed for a Website Detailing Recycling in Medford, MA
(Group Members: Tait Nielsen, Catherine Connolly, Ilan Behm)

Final Report Exerts – Somerville

The final report for Somerville included a section on "What happens to my recyclables???" that discussed the procedures and final reuse of certain recycled materials. Table 2 summarizes the fate of listed materials.

Table 2
Recyclable Material Management in Somerville, MA
(Group Members: Lydia Claudio, Pat Willis, Lisa Moretti)

Material	Process	Reuse
Paper	Sorted by grade and baled	Used to create paper with recycled content
Glass	Sorted into clear, amber, and green piles	Crushed to use for making other glass products or as construction material
Plastics	Sorted by plastic type, cleaned and baled	Pelletized and used to make recycled plastic products
Aluminum	Sorted into different grades and baled	Melted to be cast as new aluminum product
Yard Waste	Collected and placed in piles	Biodegraded into compost

Course Reflections

As mentioned earlier, two course assignments required the students to first force the students to address why they think recycling is good and then reflect on what they now think of recycling having done the course project. The responses for the first assignment ranged from "recycling is the environmentally correct thing to do" to personal admissions of why recycling was a personal choice that they wished all could, or would, make. The response at the end of the course indicated a growth in knowledge that the students gained in recognizing the importance of economics in successful recycling programs and that future outreach efforts should focus on children and adolescence if recycling is to be sustained.

Conclusions

The effect of CSL on student performance of the course was evident by their efforts in completing their projects. In addition, the projects allowed new collaborations and partnerships to develop between participating communities and the university. For example, Arlington will continue to develop high school projects and curriculum on the benefits of recycling. Other benefits to student learning include:

1. Students are forced to recognize that engineering and non-engineering aspects in solving societal problems are important.
2. Students are forced to "think outside the technical box" to develop appropriate and realistic solutions.
3. Students come to realize that professional and social responsibilities go together.

From the perspective of the course or program administrators, inclusion of CSL projects provides a successful way to have students recognize the importance of soft constraints in developing solutions to what is perceived a technological problem. This is important since engineers should develop into more well-rounded, global thinkers and leaders - an ABET criteria.

From a community's perspective, the projects provided a tangible benefit in that an actual problem is being evaluated. In fact, the community can now look to the university to partner in evaluating and solving other problems. Therefore, there is a pedagogical rationale for using CSL and an opportunity to establish collaborative relationships with community partners. If properly implemented, this service can bridge across the various academic disciplines of the university and become a vital part of the students' educational experience. This implementation and partnership(s) must be maintained continuously.

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