

Understanding Student and Faculty Attitudes With Respect to Service Learning: Lessons from the Humanitarian Engineering Program

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Abstract

Now entering its second year, the Humanitarian Engineering Program, which is sponsored by the Hewlett Foundation, at the Colorado School of Mines is creating curriculum that will support engineering students in developing an understanding of their responsibility for solving humanitarian problems that exist throughout the world. As part of this effort, baseline data has been collected on both the faculty and student attitudes towards service activities using the “Community Service Attitudes Scale” which was developed and validated by Shiarella, McCarthy, and Tucker¹. During the fall of 2004, 78 students and 34 faculty responded to this assessment instrument. Student data were collected in the first semester of the Multidisciplinary Engineering Laboratory course sequence, a required course taken at the start of students’ sophomore year before they have the opportunity to participate in the newly revised service learning courses. Faculty completed the attitudes survey during the first faculty meeting of the academic year. This paper describes and compares student and faculty attitudes with respect to service activities prior to the proposed intervention. Attention is given to attitudinal differences between male and female students and among students in different age groups.

I. Introduction

Since the Marshall Plan of 1947 and President Truman’s famous ‘Point Four’ of his second inaugural address, United States foreign policy has stressed the importance of applying technical knowledge to aid ‘under-developed’ countries². This has resulted in more than five decades of U.S. funding for humanitarian projects; however, because most U.S. engineers choose to work in the corporate sector, few have made substantial contributions to the solution of the humanitarian problems that face other nations. The few engineers who do work in U.S. aid and development organizations must commit to the objectives of U.S. foreign policy, which emphasizes macro economic growth instead of the fulfillment of basic human needs.

At the same time, prominent engineers and educators have been concerned by engineering graduates’ reluctance to enter political life, community service, and international work in the non-profit sector³. Furthermore, the public’s attitude toward engineering is not encouraging⁴. Leaders in engineering education and the profession have argued that many believe that engineering is irrelevant to humanity’s present and future needs, and this belief has contributed to the steady decline of engineering enrollment over the last decade, as well as the persistent under-representation of women and minorities in engineering. Engineering students are often

misperceived to be more concerned with their personal vocational interests and material goals than they are with society at large⁵⁻¹³.

Engineers that seek to solve the problems of fulfilling basic human needs are likely to require a different education from that which is traditionally provided in an engineering program. These engineers will need an understanding of and sensitivity to human and natural systems and an ethical framework upon which to base engineering decisions as well as a technical education. The Colorado School of Mines (CSM) Engineering Division with funding from the Hewlett Foundation has undertaken a new initiative that will prepare engineering students for careers that will benefit the international community. Specifically, the Engineering Division is collaborating with the Liberal Arts and International Studies Division at CSM to create courses that will help engineering students to understand their obligations as engineers to the well-being of the U.S. and other societies. One of the primary goals of this effort is to create a culture of acceptance and value of community and international service activities throughout CSM faculty and students. The efforts of the "Humanitarian Engineering" program at CSM are consistent with Accreditation Board for Engineering and Technology's criterion (h), which states, "Engineering programs must demonstrate that their graduates have: the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context". This four year project began at the start of the academic year 2003-2004, during which new courses, projects, and assessment activities were pilot tested. The results of several of these activities were presented at the 2004 ASEE Conference in Salt Lake City, Utah.

Now entering its second year, the Humanitarian Engineering Program is focusing on implementing long term curricular changes that are built upon the pilot investigations. As part of this effort, baseline data has been collected on both the faculty and student attitudes towards service activities using the Community Service Attitudes Scale (CSAS) which was developed and validated by Shiarella, McCarthy, and Tucker¹. The CSAS has been utilized by other researchers to investigate attitudes toward service learning in only one other field: gerontology¹⁴. To our knowledge, the current study is the first time that the CSAS has been used to investigate student attitudes toward service learning in engineering education. In the future, we anticipate working with other researchers to make comparisons across fields using the CSAS with respect to service learning.

During the fall of 2004, 78 students and 35 faculty responded to this assessment instrument. Student data was collected in the first semester of the Multidisciplinary Engineering Laboratory (MEL) course sequence. Faculty completed the attitudes survey during the first faculty meeting of the academic year. This paper describes and compares student and faculty attitudes with respect to service activities prior to the proposed curricular changes. The authors of this paper anticipate future research that will examine the impact that curricular changes have on both student and faculty attitudes towards humanitarian engineering activities.

II. Methods

This section describes the course in which the data was collected, the student and faculty populations that participated in this investigation, and the instrument that was used.

A. Course

The MEL course sequence at CSM is a three-semester sequence of engineering laboratory courses (MEL I, II, and III) that are designed to mimic industrial practices by combining traditional disciplinary topics like electrical circuits, fluid flow, and material stress into automated, integrated, measurement systems. Through this sequence of courses, engineering students learn to connect concepts that are introduced through their various engineering courses. Over time, the subject matter of the MEL sequence increases in depth and multidisciplinary breadth.

MEL I is a 1.5 credit hour course required for all engineering students, regardless of specialty. Civil and environmental specialties are also required to take MEL II, and mechanical and electrical specialties are required to complete the entire sequence. MEL I was selected to be the focus of this investigation, because it is required of all engineering majors. Additionally, it is recommended that students complete MEL I in the spring of their sophomore year. At this point in the students' undergraduate studies, they have not yet had the opportunity to complete a course that is offered through the Humanitarian Engineering Program. They have, however, received a very general lecture containing examples of humanitarian engineers in a required freshman class called Nature and Human Values. In other words, this is an ideal time to collect baseline data concerning students' attitudes prior to the curricular intervention.

B. Subjects

For the purpose of this investigation, baseline data was collected from both engineering students and faculty. All appropriate human subjects procedures were followed. Each participating population is described in the sections that follow.

1. Students

During the second and third week of classes in the Fall 2004, the 101 students enrolled in various sections of MEL I were asked to sign a project participation consent form. Students who agreed to participate in the investigation then completed the CSAS. To ensure consistency in the administration process, the five instructors leading the seven sections of MEL were given written administration instructions. Seventy-eight of the 101 students (77.2%) agreed to participate in this study and completed the CSAS.

2. Faculty

Engineering faculty were invited to participate in this study during the first faculty meeting of the 2004-2005 academic year. As was the case with students, faculty were first asked to provide their consent to participate in this investigation. Faculty members at all levels—full, associate, assistant professors; lecturers; and adjunct/instructors—were included. Those who agreed to participate completed the CSAS. For those faculty members who were not present at this meeting, the division director sent a letter of invitation to participate. Attached to this letter was the CSAS and instructions for submitting the completed consent form and survey. Of the 58 faculty members, thirty-four (58.6%) returned the consent form and survey.

C. Community Service Attitudes Scale

As was discussed previously, the CSAS was developed and validated by Shiarella, McCarthy, and Tucker¹. The authors of the current paper contacted the survey developers and acquired their consent to use the CSAS in this investigation. The only alterations that were made to the CSAS for this investigation were with regard to demographic information. Different demographic information was collected from students than was collected from faculty. The remaining 46 questions were that of the original CSAS instrument.

The CSAS was developed based on Schwartz's altruistic helping behavior model which consists of four phases¹. These phases are displayed in Table 1. The first phase reflects an individual's acknowledgement or awareness of a need for community service. This is followed by a belief that oneself is morally obligated to act on such awareness—the second phase. The third phase is an individual's evaluation of the costs and the benefits of participating in a community service activity. The fourth and final phase is an overt response, or an action that is taken with respect to community service. Theoretically, an individual passes through each phase in a sequential order before reaching the final phase in which the individual makes the decision to engage in a community service action. As is reflected in Table 1, each phase is divided into subphases. Each of these subphases is measured through a series of questions on the CSAS that are specifically designed to measure the extent to which the respondent displays beliefs consistent with the given subphase.

Table 1: Phases and Subphases measured in the CSAS

Phase	Phase Title	Subphase	# of Questions
1	Activation: Perceptions of a need to respond	Awareness	4
		Actions	5
		Ability	3
		Connectedness	6
2	Obligation: Moral Obligation to respond	Norms	5
		Empathy	3
3	Defense: Reassessment of potential responses	Costs	6
		Benefits	6
		Seriousness	5
4	Response: Engage in helping behavior	Intention to Engage in Community Service	1
		Desire to Participate in Service Learning	2

As is suggested by Table 1, the *Activation* phase is subdivided into four subphases: Awareness, Actions, Ability, and Connectedness. For example, the *Awareness* subphase measures the respondent's recognition that others are in need. The *Actions* subphase measures the respondent's belief that *actions* could relieve the perceived human need. The *Ability* subphase measures the respondent's recognition of his/her own *ability* to provide the appropriate assistance, and the *Connectedness* subphase measures the respondent's sense of responsibility to become involved based on a sense of *connectedness* with the community of the people in need.

The second phase is the *Obligation* phase which is divided into two subphases: Norms and Empathy. The Norm subphase measures the extent to which the respondent feels a moral obligation to provide help, generated through personal or situational *Norms*. The Empathy subphase measures the extent to which the respondent feels a moral obligation generated through *empathy* to provide assistance.

The third phase is the *Defense* phase. This phase is divided into three subphases: Costs, Benefits, and Seriousness. The Cost subphase is designed to measure the respondent’s assessment of personal *costs* associated with helping and the Benefits subphase is designed to measure the respondent’s assessment of personal *benefits* associated with helping. The Seriousness subphase measures the respondent’s reassessment of the human need based on the *seriousness* of the need.

The fourth and final phase is the *Response* phase. This phase consists of two subphases: Intention to Engage in Community Service and Desire to Participate in Service Learning. The first subphase, *Intention to Engage in Community Service*, consists of a sequence of questions that are designed to measure whether the respondent will participate in community service activities. The second subphase, *Desire to Participate in Service Learning*, is designed to measure the extent to which the respondent intends on participating in service learning activities.

In the development of the CSAS, Shiarella, McCarthy, and Tucker¹ completed a factor analysis to determine whether there were linear combinations of the community service attitude questions that conformed to the Schwartz model. This analysis resulted in a five-factor solution. However, an eight-factor solution was adopted in order to be consistent with Schwartz’s theory. As is displayed in Table 2, survey questions were assigned to the factor on which the pattern coefficient was largest. The majority of factors aligned with complete subphases. The benefits subphase, however, was divided into two factors with the “other benefits” comprising one factor (VI) and “career benefits” comprising the other factor (VII).

Table 2: CSAS organized into Factors

Factor	Subphase	Corresponding Phase
I	Actions	1
	Ability	1
	Norms	2
II	Connectedness	1
III	Costs	3
IV	Awareness	1
	Empathy	2
V	Intention to Engage in Community Service	4
	Desire to Participate in Service Learning	4
VI	Benefits: Other Benefits (four questions)	3
VII	Seriousness	3
VIII	Benefits: Career Benefits (two questions)	3

III. Results

This section begins with a description of the analysis process. This is followed by statistical comparisons between faculty and students, males and females and among different age groupings with respect to each factor.

A. Analysis

Student and faculty demographics and responses to the CSAS were entered into an Excel spreadsheet for analysis purposes. Each question on the CSAS was examined to determine whether a high score indicated a positive or negative attitude with regard to the given question. The coding of responses to negative questions was reversed before entering them into the database. In other words, a high score in the database always reflected a positive attitude. The scale offered a minimum value of one and a maximum value of seven.

Next, the data was analyzed based on factors. For each respondent, an average was calculated with regard to their responses within a factor. Higher averages within a given factor suggested a more positive attitude with respect to that category. Questions that were not answered were treated as missing data and were not included in the analysis. Comparisons were then made between faculty and students, males and females and different age groups with respect to each factor. These comparisons are described in the next several sections.

B. Faculty vs. Students

Table 3 displays the average faculty and the average student response within each factor. As this table suggests, faculty members had more positive attitudes with respect to service activities for all factors except VIII. Factor VIII concerns the career benefits of community service. This suggests that faculty members were less likely to recognize career benefits in service activities than were students.

In order to identify significant differences between faculty and student attitudes, a t-test was used to compare average faculty and average student attitudes within each factor. Statistically significant differences were found for factors I, II, III, IV, V, and VIII. For the first five of these comparisons, the faculty attitudes were significantly higher than the student attitudes. The consistency in this observation suggests not only a numerical difference, but also a true underlying attitudinal difference between the groups. Furthermore, on a seven-point scale, we would anticipate that even a modest difference reflects an actual attitudinal difference. For factor VIII, the faculty attitudes were significantly lower than the student attitudes. Once again, factor VIII refers to career benefits. .

Table 3: Faculty vs. Student Averages and Two-tailed T tests

Factor:	\bar{x}_{Faculty} n=35	$\bar{x}_{\text{Students}}$ n=78	p two-tail
I: Actions, Ability & Norms	5.77	5.45	0.047*
II: Connectedness	5.23	4.70	0.017*
III: Costs	3.80	2.78	0.000*
IV: Awareness & Empathy	5.67	5.39	0.098*
V: Intention to engage in helping behavior	5.43	4.61	0.004*
VI: Other Benefits	5.46	5.34	0.579
VII: Seriousness	4.89	4.47	0.062
VIII: Career Benefits	3.27	4.97	0.000*

*→Significant

C. Male vs. Female

The next comparison that was made was between male and female attitudes with respect to service activities. Table 4 displays the average score with regard to each factor as was observed between males and females. Visual inspection of this table suggests only small differences. A t-test was completed on each factor to examine statistically significant differences. As this table suggests, only one statistically significant difference was identified and this was with regard to factor IV. Factor IV concerns awareness and empathy. Females displayed a greater awareness and empathy with regard to community service than did males. This result must be interpreted with caution due to the small sample of participating females.

Table 4: Male vs. Female Averages and Two-tailed T tests

Factor:	\bar{x}_{Male} n=97	\bar{x}_{Female} n=14	p two-tail
I: Actions, Ability & Norms	5.56	5.55	0.984
II: Connectedness	4.82	5.17	0.403
III: Costs	3.09	3.06	0.924
IV: Awareness & Empathy	5.42	5.85	0.036*
V: Intention to engage in helping behavior	4.79	5.50	0.138
VI: Other Benefits	5.39	5.55	0.417
VII: Seriousness	4.62	4.37	0.148
VIII: Career Benefits	4.46	4.64	0.550

*→Significant

D. Student Age Groupings

For analysis purposes, the students that participated in this investigation were divided into two age categories: 1) those 20 years of age and under and 2) those greater than 20 years of age. Table 5 displays the average score for each of these categories with respect to each factor. As this table suggests, students over the age of 20, on average, displayed more positive attitudes toward community service than did students 20 years of age and younger. In order to identify statistically significant differences, a t-test was performed between the categories with respect to

each factor. Only one statistically significant difference was identified and this was regard to factor VI. Factor VI concerns benefits to others. Those that were over the age of 20 had more positive attitudes with regard to community service and its benefits to others than did those that were 20 years of age or younger.

Table 5: Student Age Grouping Averages and Two-tailed T tests

Factor:	$\bar{x}_{\leq 20}$ 20 & Under n=45	$\bar{x}_{> 20}$ Over 20 n=32	p two-tail
I: Actions, Ability & Norms	5.35	5.57	0.285
II: Connectedness	4.58	4.84	0.375
III: Costs	2.71	2.90	0.474
IV: Awareness & Empathy	5.23	5.59	0.093
V: Intention to engage in helping behavior	4.41	4.93	0.152
VI: Other Benefits	5.18	5.63	0.047*
VII: Seriousness	4.25	4.76	0.058
VIII: Career Benefits	4.84	5.13	0.328

*→Significant

IV. Summary

As the above results suggest, there were a number of statistically significant differences identified between student and faculty attitudes with respect to community service as measured by the CSAS. For example in general, faculty had more positive attitudes with respect to community service than did students. The only factor with which students displayed a statistically significant higher score was with respect to career benefits. This result suggests that students were more likely to believe that their careers would directly benefit from participating in community service than were faculty.

Comparisons were also made across genders. Given the small number of females that participated in this investigation, both faculty and students were included in this analysis. Examining the means within each gender for each factor suggests that, in general, there was little difference between male and female attitudes with respect to service activities. There was one exception to this observation. Women were significantly more likely to have a high score with regard to awareness and empathy than were men. Given the limited number of women that participated in this study (n=14), this result must be interpreted with caution and will require future research for verification.

Another observation that can be made from the data presented in this paper is that students that were over the age of 20 had more positive attitudes, in general, than did younger students with regard to community service. However, this improved attitude was only found to be statistically significant with respect to factor VI. Factor VI addresses the benefits of service activities to others. Older students were more likely to recognize the positive impact that service has on the others than were younger students.

The astute reader may question the relevance of statistically significant differences between two groups when those differences are less than a point. However, the CSAS is a seven point scale and therefore, even modest differences are likely to reflect true attitudinal differences between groups. Evidence to support this assumption is not currently available and is, therefore, left for future research.

As was discussed at the start of this document, the purpose of this investigation was to collect baseline data concerning student and faculty attitudes with regard to community service before curricular interventions are implemented as part of the Humanitarian Engineering program at CSM. The data discussed above should only be interpreted based on the population in which it was collected. In other words, the results described above can only be generalized to students and faculty within CSM's engineering program. These data suggest that differences currently exist between the attitudes of students and faculty, males and females, and older and younger students with respect to service activities. One goal of the Humanitarian Engineering Program is to improve each of these groups' attitudes with respect to service activities through curricular intervention. As these attitudes improve, we hypothesize that there will be a subsequent increase in student and faculty participation in community service activities. Specifically, the Humanitarian Engineering Program aspires to increase the number of CSM students entering occupations related to community or international service and to increase the number of engineering students entering internships in community or international service. Our targets are to increase the current baseline by at least 25% in each of these areas. Whether we will be successful in attaining this goal is left for future research.

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