SERVICE LEARNING FIRST YEAR DESIGN RETENTION RESULTS

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Abstract *¾ The College of Engineering and Applied Science at the University of Colorado at Boulder has operated a first-year engineering design course for six years now. The course is required in some curricula in the college, recommended in others, and accepted for credit by all departments. The course stresses teamwork and design, culminating in a 7-9 week team design project. The projects vary with instructor, and usually each of the 4-5 teams per class works on a different project. This paper will first discuss the service learning sections of the course. The paper will then discuss the results of statistical analysis regarding retention and major selection between students who took the first year design course compared with those who did not. We now have six years of experience with the course so we will present data from entry to graduation for the students who entered in the first two years. In addition we have included preliminary statistics to study the effect of using service learning projects as a part of the first year design experience. We will encourage the audience to make this an interactive oral presentation, and work with participants to help identify service learning possibilities in their environment.*

Index Terms ¾ service learning, first year design, retention.

INTRODUCTION

Service learning can be defined as a partnership to meet both the learning goals of the students and needs of a community. Desired outcomes of programs that include service learning are as follows:

- instill awareness of diverse population of community
- promote understanding that doing engineering is being a part of a global community
- foster a sense of caring for others, leadership skills, civic responsibility, and career-related skills
- increase recruitment and retention in engineering.

This paper will describe our use of service learning in a first-year design course. We will report the results from our statistical analysis regarding retention for this course. Finally we will report on the results of our general statistical analysis regarding retention for all sections of first year engineering design (those that include service learning plus all others).

GENERAL COURSE BACKGROUND

Our first year engineering design course, GEEN1400, operates as a part of the Integrated Teaching & Learning Laboratory (ITLL), a pioneering multidisciplinary learning environment in the University of Colorado's College of Engineering and Applied Science [1-8] that integrates engineering theory with real-life engineering design problems. The course promotes creative, team-oriented design experiences.

ASSISTIVE TECHNOLOGY SECTION BACKGROUND

This section of the paper describes a section of the freshman project course focused on the area of assistive technology. For the purposes of this paper, *assistive technology* can be defined as any technological design which increases a person's capabilities or more importantly aids a person to overcome a severe limitation. The authors of this paper have taught assistive technology sections of this lab since 1994.

The assistive technology sections, taught by Avery (EE), Carlson (ME), Louie (ChemE), and Piket-May (EE) directly benefit persons with disabilities and include service learning. First year engineering students learn about engineering design in the process. It is truly a win-win situation. An important aspect of this program is the connection our engineering students make with persons with disabilities and other volunteers in the community. Often persons with disabilities are invisible to the general population. The connection is knowledge all of our students will carry with them through their lives. In addition, we believe that the students taking this course will be more aware of general community service and will spread this knowledge throughout their eventual workplace. These benefits can not be measured yet as the program is too young, but we suspect the community benefits will have far more long-range effects than the direct benefits (retention in engineering) of the program.

The first-year projects course allows the University to provide the student resources needed to do the design work for community oriented projects. Our course in assistive technology design is an excellent opportunity for students to begin learning what design and engineering are about in a way that benefits the local community as well. The technological projects tied to assistive technology often are very unique to an individual. The projects used in the

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assistive technology section are selected in consultation with the community groups who have assistive technology needs but lack the resources to develop solutions. The project class environment is ideal for this type of one-of-a-kind development. The projects also span a wide range of complexity. Technology near the cutting edge of engineering design is important to assistive technology, but simple technology is often more effective and more accessible to the people who will use it. Our course uses whatever level of technology is appropriate.

Students in the course decide on specific design projects necessary for a specific client's need. The goal is to take a project to completion, so that the completed article can be given to the client. We require significant input from the client on the issues that define the design. The students are required to identify the problem they wish to solve; evaluate potential designs that solve the problem, taking into account many supporting issues such as client capabilities, limitations, and interests; do financial analysis and feasibility studies on the design choices; develop a final design specification; and finally complete the project.

Many of our current contacts/clients are communication specialists and occupational therapists in the Boulder public schools. The contacts/clients have given us very positive feedback on their involvement, which has already gone significantly beyond providing us with projects. For example, when appropriate, the engineering students have been invited into classrooms in order to work with their clients in the clients' daily environment.

OTHER SERVICE LEARNING

We were successful in implementing an assistive technology section of the first year design course and fairly quickly the scope of "designing for the community" was broadened to include designing interactive exhibits for museums and zoos as well as designing interactive modules for schools or other not-for-profit organizations. Many GEEN1400 sections are now generally focused on designing for the community. These sections have been taught by Milford (ME), Hertzberg (ME), Carlson (ME) and Piket-May (EE).

The project development is similar to that described above for assistive technology. However, in these sections, we work with local school teachers and museums developing hands on learning modules for a specific topic. Another modality Piket-May has explored is designing learning modules for a non-for-profit agency. In Fall 2000 six leaming modules for the Breathe Better Bus Foundation bus were designed. The Breathe Better Bus will travel throughout Colorado educating students about the importance of air quality, the dangers of smoking, and issues related to asthma.

ONE-YEAR RETENTION RESULTS

This section includes retention data for all sections of the GEEN1400 courses taught 1994-1999. We have included initial statistics related to the community service-learning aspect of GEEN1400. We were hoping to identify specific trends associated with the service-learning sections. Service learning section data has been labeled GEEN1400sl. In analyzing the retention data for GEEN1400, we have found encouraging statistical trends.

One goal we have for GEEN1400 is to improve retention of engineering students. We are specifically interested in year 1 to year 2, when traditionally we lose many students. Table 1 shows the year 1 to year 2 total student retention rates. [Note that the number of students taking GEEN1400 has increased to ~290 students per year (approximately 50% of our incoming students) and in 1997 we taught GEEN1400 in our new facility for the first time.] Table 1 shows that on average we have an 82% retention rate from year 1 to year 2. Table 2 shows the year 1 to year 2 retention rates when analyzed with respect to the students taking GEEN1400, or not. Our data shows that on average 6.38% more students stay in engineering from year 1 to year 2 if they take GEEN1400. This is a weighted sum average taking into account the different numbers of students each semester. This is a significant number for us as it has been a hard percentage to move.

Looking at the data in Table 2 for 1997-1999 we see a positive trend as to the one year retention rate related to participating in GEEN1400, 4.18% to 7.87% to 9.97%. The service-learning data is inconclusive. The sevice learning retention raw data vary alot which may indicate the statisitcs are heavily faculty dependant , or there is some other factor that significantly impacts the outcome. In any case, we do see up to 9.85% increased retention from year 1 to year 2 for students who participate in GEEN1400. We also see an overall average, though small, increase in retention for students involved in service learning.

GRADUATION RETENTION RESULTS

Table 3 shows the overall graduation retention rates as well as the engineering retention rates, with respect to participation in GEEN1400. One can see that there is a significant increase in the overall graduation retention rate. 6.83% more students graduated having participated in GEEN1400 when compared to the student base not taking GEEN1400. Even more significant, when observing the retention rates for engineers staying in engineering, participation in GEEN1400 has increased the retention by 13%. It is important to note that these two years of graduation data are done for students who took GEEN1400 in the old building. The total number of students taking GEEN 1400 was significantly less, and we suspect that the students may have been more self selecting for these two years. The trend is still very encouraging. If the 1 year

retention data in table 1 is extrapolated to graduation, we should see improved graduation rates as expected. There is currently not enough data to look at the impact of service learning on graduation rates.

Table 1 One-year retention rates for 1994-1999 for all students in the database. GEEN1400sl refers to the Service Learning Sections of GEEN1400.

	entering engineering Students	GEEN1400 students	GEEN1400sl students	total students still here next year
1994	473	107	18	370
		22.62%	3.81%	78.22%
1995	498	156	42	409
		31.33%	8.43%	82.13%
1996	497	198	42	404
		39.84%	8.45%	84.34%
1997	551	270	44	476
		49.00%	7.99%	86.39%
1998	584	303	138	479
		51.88%	23.63%	82.02%
1999	597	286	118	495
		47.91%	19.77%	82.91%
total	3200	1320	402	2633
avg		41.25%	16.72%	82.82%

Table 2 One-semester retention rates for 1994-1999, for students who took and did not take GEEN1400. GEEN1400sl refers to the Service Leaming Sections of GEEN1400.

	students next year who took 1400	Students next year who took 1400sl	students next year who did not take 1400	students next year who did not take 1400sl	Retention change with GEEN1400	retention change with GEEN1400sl
1994	88	15	282	355		
	82.24%	83.33%	77.05%	78.00%	5.19%	5.33%
1995	133	38	276	371		
	85.26%	90.48%	80.70%	81.40%	4.56%	9.08%
1996	170	32	234	372		
	85.86%	76.19%	83.27%	85.10%	2.59%	-8.91%
1997	239	42	237	434		
	88.52%	95.45%	84.34%	85.60%	4.18%	9.85%
1998	260	117	219	362		
	85.81%	84.78%	77.94%	81.20%	7.87%	3.58%
1999	252	96	243	399		
	88.11%	81.36%	78.14%	83.30%	9.97%	-1.94%
total	1142	340	1491	2293		
avg	86.55%	84.90%	80.17%	82.57%	6.38%	2.33%

Table 3 Graduation rates for 1994 and 1995, for students who took and did not take GEEN1400

	graduated students	Graduated students with GEEN1400	graduated students without GEEN1400	increased graduation with GEEN1400	Standard Deviation
1994	317 67.02%	79 73.83%	238 65.03%	8.80%	0.06
1995	309 62.05%	102 65.38%	207 60.53%	4.86%	0.03
		Average Increased Graduation Rate		6.83%	0.03

	graduated students	graduated students in Engineering with GEEN1400	graduated students in Engineering without GEEN1400	Engineering increased graduation with GEEN1400	Standard Deviation
1994	226 67.02%	65 60.75%	161 43.99%	16.76%	0.12
1995	236 62.05%	84 53.85%	152 44.44%	9.40%	0.07
		Average Increased Graduation in Engineering		13.08%	0.05

CONCLUSION

A first year hands on engineering design class has been integrated into the University of Colorado engineering curriculum. Many of the sections provide community service while educating our students, which we are defining as service learning. Participation in this class appears to be improving year one to year two retention, although we were unable to see any clear statistical difference for the service learning vs total GEEN1400 class data. In addition, data from the first two years of graduating students suggests that we are improving retention to graduation, especially among engineering students. We are encouraged by the analysis of the GEEN1400 class data and plan many further studies that will take into account such things as gender, instructor, time of class, specific class topics, and incoming student statistics.

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