

# Studying student benefits of assigning a Service-Learning project compared to a traditional final project in a Business Statistics Class

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**Key Words:** Comparative study; Student project assignments; Community engagement; Authentic assessment.

## Abstract

The present study addresses the efficacy of using service-learning methods to meet the GAISE guidelines (<http://www.amstat.org/education/gaise/GAISECollege.htm>) in a second business statistics course and further explores potential advantages of assigning a service-learning (SL) project as compared to the traditional statistics project assignment. Second semester business students were given the choice of participating in a SL project or doing a traditional project assignment.

When the projects were completed, students reflected on their experiences via survey. Both groups responded equally (agree or strongly agree) to the Likert scale questions: 96.15% reinforced learning objectives, 98.08% applied to real world, 84.62% positive experience. Responses to the open ended questions revealed that more students in the SL group ( $p = 0.019$ ) wrote about the benefits of dealing with real world data, more SL students felt their work benefited others (65% felt their statistical expertise was valuable) and more ( $p=0.005$ ) SL students felt that the experience will help them in future classes. These results suggest that while both groups were able to effectively support the GAISE guidelines, participation in the SL option offered an enhanced learning experience that included elements of social responsibility and personal growth. The experience was perceived more enjoyable and relevant to the real world adding elements of student empowerment while assisting a local agency in need of statistical expertise suggesting one can reap positive learning benefits by introducing service-learning pedagogy into a non-majors statistics course.

# 1. Introduction

The practice of teaching Statistics has been undergoing change for several decades. Statistics administratively grew up in Mathematics, Psychology and Engineering departments. In the sixties and seventies, as the importance of statistics as a marketable discipline grew, larger universities began to create separate independent statistics departments. Once statistics became more recognized as its own discipline, and its importance to nearly every discipline was adopted, the scope of teaching statistics began to change. Suddenly, everyone was in need of an introduction to statistics to succeed in their major studies regardless of a talent and/or interest in the mathematical sciences! With it came the difficulties of teaching a subject largely associated to the mathematical sciences but applicable to nearly any subject matter, to students of diverse mathematical and problem solving ability. By the early 1990's, discussions concerning statistical education reform were focusing on the students' grasp of statistical reasoning and their ability to interpret statistical conclusions in writing using understandable terminology.

On the heels of those calling for reform in teaching statistics, ([Cobb, 1992](#) and [1993](#), [Hoaglin and Moore 1992](#), [Hogg 1991](#) and [1992](#), [Garfield 1993](#), [Moore 1991](#) and [NCTM 1989](#) and [MSEB 1993](#)), there was an added call for what many have termed 'authentic assessment'. That is, in order to adequately address the call for reform, we must also add new and innovative ways for assessing what the students know about statistics ([Archbald and Newmann 1988](#), [Crowley 1993](#) and [Garfield, 1994](#)). Since the reform was suggesting ways to improve statistical reasoning, we must have ways to assess the students' mastery of statistical reasoning. [Chance \(1997\)](#) suggested an introduction and/or increase use of computer lab exercises, term projects with presentations and peer review, take-home final exam questions and student journaling.

Throughout this same time period, two other important principles in learning were gaining momentum. Those in general education reform stressed the importance of student engagement suggesting that students learn more when they take an active role in their learning ([Angelo and Cross, 1993](#), [Huba and Freed, 2000](#)). [Newmann \(1992\)](#) coined the phrase "psychological investment" by combining traits of purpose and caring with authentic work that give the student a sense of ownership and connection to the 'real world'.

Also during this time, higher education was experiencing the increased integration of real world experiences with traditional learning strategies. One of the versions of integration included service-learning. First introduced as a term by the Tennessee Valley Authority in the late 60's, service-learning was promulgated by programs that were developed throughout the 70's and 80's. [Titlebaum, Williamson, Daprano, Baer, and Brahler \(2004\)](#) detail the formative years in service-learning history as being peppered with the development of governmental, educational, community, and student-driven programs that encouraged universities and students to participate in community and service-learning. The White House Conference on Youth's 1971 report encouraged the explicit link between service and learning. Concurrently, the National Center for Public Service Internships was founded as was the Society for Field Experience Education. These later merged to become the National Society for Internships and Experiential Education. Other milestone developments included the Southern Regional Education Board in 1967, the University Year for Action in the 1970's, Campus Opportunity Outreach League in the 1980's and Campus Compact in 1985 ([Titlebaum, et al.](#)). Originally initiated by the Presidents of Brown, Georgetown, and Stanford Universities, the Campus Compact website now documents a membership of over 1,100 college presidents and chancellors ([www.campuscompact.org](http://www.campuscompact.org)).

The National Community Service Act in 1990 drew upon movements to increase social and community responsibility and allocated \$275 million toward SL projects from kindergarten through higher education. In 2005,

the fruits of intense labor in statistical education reform produced the GAISE guidelines for teaching statistics to a vast and academically varied audience. Well executed student projects will achieve the goals of the GAISE guidelines but may lose the social relevance that they have helped others or the importance of data in the outside world ([Thorne and Root, 2001](#) and [ICOTS 2002](#)). Implementing SL in an introduction to Statistics class is in near perfect alignment with the GAISE initiative and all attempts to improve learning through student engagement and authentic assessment. [Eyler and Giles \(1999\)](#) found that students were motivated to work harder in their service-learning classes, reported an ability to apply academic concepts to real-world problems, and attributed their enhanced learning to deeper engagement with the community issues they were able to explore.

The present study addresses the efficacy of using service-learning methods to meet the GAISE guidelines in the second business statistics course and further explores potential advantages of assigning a service-learning project as compared to the traditional statistics project assignment. For the purposes of this study, the service-learning methodology can be defined as a derivation of [Bringle and Hatcher's \(1995\)](#) as the combination of academic instruction, meaningful service, and critical reflective thinking to enhance student learning and social responsibility.

## 2. Methods

The Association to Advance Collegiate Schools of Business (AACSB) requires all undergraduate business majors to have at least two semesters of an introduction to Statistics. All students enrolled in this author's classes were required to complete a group research project at the conclusion of the second course of introduction to business statistics. All students were given the choice of doing their own research project or choosing one of two SL projects offered in the spring of 2006. Upon turning in their projects, each student was asked to fill out a questionnaire composed of three open-ended questions, three Likert scale questions and two yes/no questions. The three open-ended questions were designed to ask the student to reflect upon their experience and address three areas of SL: academic content, social responsibility and student development. The three Likert scale questions were designed to draw an overall score on 1) how successful was the experience in helping one to learn the major objectives of the course, 2) the applicability of statistics in the real world, and 3) was the experience a positive one. Finally, the student was asked 1) if they could do it over, would they make the same choice and 2) do they think their project was helpful to anyone other than their group. While this questionnaire was designed to address objectives of service-learning, the primary goal of assigning such a final project, either traditional or SL, was to give the students an experience that would promote learning and personal development. Keeping the social responsibility arm of SL allows all students to reflect on their experience and give the investigators the opportunity to see how this may affect the student's opinion of the project and consider how this exercise may contribute to their own learning.

In the case of the open-ended questions, data were collected by highlighting key words written by the students to indicate whether the student felt strongly enough about the three areas of SL. For *academic content*, students were asked to comment on how the project helped to understand the concepts of 1) designing an experiment, 2) collecting data, 3) data summarization and 4) data analyses. In the social responsibility response, key words highlighted were *benefit* to someone other than yourself and was your statistical expertise *valuable* to community partners. Key words for student development were *personal development* and perceived usefulness in *upper* level classes and in *professional life*. Key words were highlighted and recorded as a yes, if the response was positive or no, if the response was negative. If the student failed to write about a particular key word, the response was left as blank and treated as missing data. The Likert-scale question responses were: strongly agree, agree, no opinion, disagree or strongly disagree. All outcomes were summarized as proportions and compared between the two

groups.

Student scores on the project, final exam and final grade percent were used to assess student mastery of the learning objectives for the course. Two sample t-tests were used to determine any significant differences in student grades between the two groups.

### **3. Project Descriptions**

#### **3.1. A cross-section of county homeless agencies**

Administrators of a local woman's homeless shelter wanted to write a grant that would support the creation of a mentoring system designed to reduce recidivism. Before doing so, they wanted to gain information that would help determine if such a program would be embraced in the homeless community. Students were asked to prepare a survey requesting such information from both the administrators of the shelter and the homeless clients. Groups of students went to several local shelters and administered the survey. All the data was combined and individual groups of 2-4 students prepared their own summary and analyses to fulfill the group project requirements.

#### **3.2. A health insurance advocacy agency**

Administrators of this agency were interested in a statistical analysis of poverty and insurance trends over the last decade to see if significant changes had occurred in the client's level of poverty and/or insurance coverage. Participating students were HIPAA certified. Data collection required students to pour through several hundred files to retrieve information on insurance coverage and family income. After national annual poverty level adjustments were imposed, a completed dataset was made available to all participating students. Groups of 2-4 students worked together to turn in individual analyses and summary reports.

#### **3.3. Student selected traditional projects**

Students choosing to participate in the traditional assignment were asked to turn in a proposal midway through the semester and were permitted to collect data upon acceptance of the proposal. The types of projects students turned in included: baseball statistics comparison between pre and post 'steroid' era, differences in mean sleep between college and high school students, church attendance between residence and commuters at a Catholic University and differences in exercise habits between male and female college students.

## **4. Results**

### **4.1 Analysis of student reflection questionnaire:**

Of the 104 students registered in three classes, 54 chose to participate in one of the two SL projects and 50 students chose the traditional class assignment. Effective meeting of the GAISE guidelines is evidenced by the responses given to questions asking how the project reinforced specific learning objectives, the degree to which it gave a real world experience, and the degree to which it was a positive experience. Both groups responded very positively (agree or strongly agree); 96.15% learning objectives, 98.08% applied to the real world, and 84.62% positive experience. Although it was not statistically significant, 89% in the SL group as compared to 80% in the

traditional group reported that it was a positive experience. Sample sizes per group were too small to detect a statistically significant difference of 10% between groups.

[Table 1](#) summarizes the analyses of the open-ended question on academic content and the first Likert scale question with the responses "agree" and "strongly agree" collapsed. The results showed no statistically significant differences between groups in the proportions responding that individual learning objectives were met. The experimental design learning objective received the lowest response from both groups. While not statistically significant, only 46% in the SL group (compared to 60% in the traditional) indicated that the project helped them understand experimental design. This could be that the instructor provided more guidance on experimental design in the two SL groups. Similarly in the opposite direction, while not statistically significant, more students in the SL group (87% compared to 76%) reported that the project helped them understand statistical inference.

**Table 1: Did working on this project help to meet the stated learning objectives?**

	SL Group N = 54	Traditional Grp N = 50	Combined	p-value
Likert scale	50 /	48 /	98 /	
LO met?	96.15%	96%	94.23%	0.938
Experimental Design	25 /	30 /	55 /	
	46.3%	60%	52.88%	0.158
Data Collection	50 /	47 /	97 /	
	96.15%	94%	93.27%	0.774
Summary/ Descriptive Stat	40 /	34 /	74 /	
	74.1%	78%	71.15%	0.495
Inference/ CI, Hypothesis Test	47 /	38 /	85 /	
	87.04%	76%	81.73%	0.145

All p-values were calculated using the two-sample proportions test in Minitab™.

Further analysis of the survey reflections ([Table 2](#)) revealed that the SL students were able to write more deeply about the impact of dealing with real world data. Although all students were asked to comment on working with 'real-world' data in the open-ended questions, significantly more students in the SL group ( $p = 0.019$ ) felt strongly enough to actually write about the benefits of experience with real world data. When asked to comment on the potential benefit of their research to someone else, 72.2% of the SL group ( $p = 0.00$  using Fisher's Exact due to zero cell in the traditional group) felt strongly that their project benefited others. However, when asked to comment, 84% of those in the traditional group did offer that their study 'may' benefit someone other than themselves. When the condition was relaxed to include '*may* benefit', no statistical difference persisted between the two groups. Finally, significantly more ( $p=0.005$ ) SL students felt that the experience fostered student development. These differences suggest that the students in the SL group revealed an enhanced learning

experience that included elements of social responsibility and student empowerment.

**Table 2: Written reflection comments compared**

Reflection written comments	SL Group N = 54	Traditional Grp N = 50	p-value
Real World Experience	33 / 61.11%	19 / 38%	0.019*
Positive Experience	48 / 88.89%	40 / 80%	0.105
Benefit to Others	39 / 72.22%	0 / 0%	0.000**
'May' benefit others	48 / 88.89%	42 / 84%	0.233
Student development	47 / 87.04%	33 / 66%	0.005*
Help in upper level classes	24 / 44.44%	25 / 50%	0.715
Help in Professional life	33 / 61.11%	29 / 58%	0.373

\* p-value calculated using the two-sample proportions test in Minitab™.

\*\* p-value calculated using Fisher's Exact test in Minitab™.

## 4.2 Comparison of student performance:

[Table 3](#) displays the results of student scores between the two groups for the course. Although the data in this table show no remarkable statistical difference between the two groups as observed by student grades, the sample sizes are not that large and the SL group showed a slight trend toward higher grades. Of course one might argue that this could be self-selection, those students who care more about helping others may tend to care more about higher grades as well. Furthermore, no pre-test was obtained to assess the student's aptitude of statistics before taking the course.

**Table 3: Student assessment**

Assessment	Group (N <sub>SL</sub> =54, N <sub>T</sub> =52)	Mean ± SE	Pvalue
<b>Project 1</b>	SL	43.30 1.16	
	Traditional	41.46 1.40	0.313
<b>Final Project</b>	SL	44.57 0.96	
	Traditional	44.37 1.16	0.890
<b>Final Exam</b>	SL	76.93 2.30	
	Traditional	75.60 2.67	0.706
<b>Total Grade</b>	SL	82.43 1.53	
<b>Percent</b>	Traditional	80.73 1.90	0.485

## 5. Discussion

The present study found that both groups were able to effectively support the GAISE guidelines but that participation in the SL option offered an enhanced learning experience that included elements of social responsibility and personal growth. The experience was perceived more enjoyable and relevant to the real world adding elements of student empowerment while assisting a local agency in need of statistical expertise. This suggests that one can reap positive learning benefits by introducing service-learning pedagogy into a non-majors statistics course.

Although the results comparing student performance in the guise of grades were inconclusive, one would not argue that there are potential confounding issues in attempting a study like this. Student self-selection to the treatment groups is a primary concern but somewhat unavoidable when dealing with human subjects in the classroom environment. Across all methods of assessment observed, the SL group tended to have higher mean scores. These students may simply be more conscientious and thus would score higher in any environment, but samples sizes were small and lack of randomization to the two groups may introduce bias. Anecdotally, those selecting their own projects tend to ask hypotheses that produce less descriptive statistics and eliminate harder statistical designs and standard error calculations. This produces an inequity in grading. One needs to create better rubrics to differentiate creativity and experimental designs in the traditionally selected student projects. Finally, these results rely heavily on student self-reporting. Although concepts that were being tested were in fact directed in the open-ended questions, many students chose not to comment providing missing data more frequently in the traditional group. Sample sizes also plagued tests of proportions. Although not significant ( $p=0.075$ ), 6/50 traditional students would have elected to do the SL (opposed to only 2/54 in SL) if given the choice to do it all over, and more SL students (89% compared to 80%,  $p=0.105$ ) chose positive experience in the Likert scale. In both cases, sample sizes in the two groups were too small to detect a significant difference of 9%.

Future studies may be designed to increase sample sizes by combining data from multiple instructors or observing successive semesters of service-learning. Removing self-selection presents a more challenging problem. The present design allows students to choose with the instructor's hope that personal investment in the project will lead to increased satisfaction and learning. Future designs could use either student GPA's or a pre-test to attempt to control for bias in student performance as measured by grades. Randomizing students to groups, while statistically

desirable, may lead to student dissatisfaction. Increasingly, more universities are developing courses that are designated service-learning to meet core requirements. According to the [2007 Campus Compact Annual Member Survey](#), 38% of responding campuses incorporate service-learning into their core curriculum. In these institutions, it might be feasible to implement a cross-over design whereby students complete two projects in which they are randomly assigned to service-learning for one and a traditional assignment for the other. This, however, may prove difficult to implement in a one semester course where the amount of time commitment to the service is dictated by the core requirements and one is not likely to cover enough inferential statistics to produce two projects spaced apart. On the other hand, if a whole statistics department bought into the service-learning pedagogy, and large numbers of students were required to take these courses, some of the design problems could be minimized.

While such courses are not usually considered for service-learning in the general community, statisticians have been urged in recent years by leaders in the professional statistical community ([Scheuren, JSM 2005](#)) to get involved with non-profit organizations that are in great need of this support. This directive coupled with the fine alignment of service-learning with recently accepted guidelines for teaching statistics serve to reinforce important learning objectives while providing a positive learning environment for students in a course that is traditionally received with apprehension and anxiety. Projects like these promote student reflection and journaling which has received support in the statistical education community through authentic assessment opportunities. Additional support for these opportunities may be found in general education research as well in which professors are urged to incorporate learning objectives that foster personal development ([Fink, 2003](#)). It is generally accepted that students empowered with the spirit of helping their local community fosters deeper learning and personal satisfaction.

Armed with theoretical and preliminary data support for using service-learning pedagogy, one may find that identifying quality service-learning projects may be difficult. [Howard \(1993\)](#) advises consulting one's volunteer services office to assist with locating suitable community-based agencies. The number of colleges and universities which have staff dedicated to volunteer, community service, or service-learning activities has grown considerably in recent years. Of Campus Compact's 2006 membership, which included 1,045 colleges and universities, 85% have at least one staff person dedicated to coordinating these activities, and 80% have at least one office dedicated to the same. Vital to the construction of a service-learning component is the choice of community partner and approach to forming a partnership that creates a successful, reciprocal project. [Howard \(1993\)](#) provides three criteria for selecting service activities: 1) the type of service site should be limited to those that work within the content area of the course; 2) the amount of time each student spends in service activities should be long enough to enable the student to meet the course learning goals; and 3) the activities and setting must provide an opportunity for students to acquire knowledge or skill relevant to the course content. [Holland & Gelmon, 1998](#) advise that it is desirable to form partnerships with community-based agencies rather than engage in random activities. In this way, service-learning courses can meet important community-identified needs while meeting course learning objectives. [Kenworthy U'ren \(2008\)](#) underscores the value of a relationship between faculty and community partner, citing the development of the partnership as key to developing learner-focused activities that meet community-identified needs.

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