

**Improving Student Retention of Business Statistics
Through Implementing a
Two-semester Service Learning Project**

Abstract/Innovation Summary

During the academic year 2010-11, students enrolled in business analytics (BA) I and II participated in a two semester service learning (SL) project with a local non-profit. This project allowed first semester BA students to investigate an applied quantitative problem, develop a data collection design, collect the data and begin data summary; and second semester BA students to apply various methods of statistical analyses. Guided assignments throughout both semesters gave students practical statistical skills to identify positive and problematic areas in the non-profits' programming and provided a starting point for the organization to begin their own process of evidence-based program assessment.

All students taking the first semester BA course participated in the data collection, data summary and one sample inferences. In BA II, students in small groups perform a complete statistical analysis from beginning to end. Students were allowed to choose to continue the SL or to select a project of their own choosing. This allowed for a comparison between the two groups.

The novelty of this innovation is three fold. SL is only beginning to be introduced as classroom pedagogy in a non-majors statistics courses, it is generally perceived too difficult for a first course and I have not yet seen it implemented in a two-semester non-majors, required business statistics curriculum. Additionally, the timing of this innovation coincided with a critical review of the two-sequence BA curriculum and assessment in upper level courses for long-term retention, therefore we have empirical data that supports increased retention in the group that participated in the SL project.

Results: Students in the SL group scored significantly higher on the comprehensive final exam but no difference was found in the final course grades. Thus both groups appear to be performing equally successful while taking the two-semester business statistics sequence; however, after returning to classes in the fall, students scored on average 17% higher than those self-selecting to do their own statistics project from a barely passing grade of 62% to a near B grade of 79%. The retention exam consisted of 12 multiple choice questions designed to assess key learning objectives from both BA courses and two word problems requiring the students to interpret Excel outputs from a two independent sample t-test and a simple linear regression problem.

Detail Section

Topic or problem toward which my approach was focused:

Faculty in upper level Business courses have repeatedly expressed concerns that students are not retaining critical problem solving and statistical analyses techniques. Recent research advocates strongly the use of real life data to improve statistical literacy and written communication of study results. The current environment of higher education at many institutions like ours is to promote community engagement and many large corporations are trying to implement creative ideas that promote and emphasize social responsibility through community activities. Experiential learning is a well documented successful pedagogy and literature on SL supports deeper learning and personal growth from projects that directly affect their community (refer to my section on *relevant literature*). SL appears to be in near perfect alignment to foster longer term retention of key statistics learning objectives to bridge the elapsed time between the required two-course BA sequence and upper level Business courses. Therefore, the present innovation was implemented to improve retention of fundamental statistical concepts to be taken into upper level Business courses. And frankly, given its propensity for effectiveness, it is a win-win; a great learning opportunity for students and a tremendous social benefit for a non-profit with limited funds and/or expertise in quantitative analysis.

Level of students toward which my approach focused: The required two-course Business Analytics sequence is scheduled in our sophomore core Business curriculum.

Number of students with which the approach has been used: I have used SL projects in my second BA class since 2006. This particular year I had 94 students participate in the SL project in the first semester and 35 of 80 students elected to continue with the assessment project in the second semester.

Major educational objectives of your approach:

Fundamental to both BA I and BA II: The student will acquire a foundation of knowledge to become a critical thinker about the collection of information for the purpose of making inferential business decisions. Fundamental to all learning objectives below, the student will be able to use technical writing skills to summarize, describe and make statistical inferences based on sampled data in the context of their measurement to make sound business conclusions and decisions.

This will require the student to be able to combine the objectives below to:

- 1) Clearly state a research hypothesis in the context of a business question (BA I)
- 2) Examine the distribution of a characteristic(s) of a population. (BA I, LO1 below)
- 3) Estimate the value(s) of characteristic(s) under study (BA I, LO2 below)
- 4) Perform the appropriate test of statistical evidence (BA II)
- 5) Interpret results to make clear business decisions (BA I & II)
- 6) Be able to draw a clear and concise written conclusion. (BA I & II)

BA I: The student will:

1. be able to numerically and graphically summarize single variables and the relationships of two variables in the context of an applied business problem
2. be able to construct confidence interval estimates and to perform tests of hypotheses for difference between two independent means and two independent proportions

BA II: The student will be able to use technology to analyze data requiring a

1. two-sample t-test and interpret the results in the context of the data.
2. simple/multiple linear regression and interpret the results in the context of the data.
3. a Chi-square test of Independence and interpret the results in the context of the data.
4. an analysis of variance test and interpret the results in the context of the data.

Innovative and unique features of your approach:

While community engagement and service learning have made a growing presence in the higher education classroom, their roots are more embedded in the social sciences. Our institution began campaigning for service learning in 2005 visiting each school within the university individually to promote the pedagogy. When I walked into the school of business presentation, the room was aghast with the notion of using ‘service’ learning in a statistics class. Fortunately for me, I passionately defended my position and knew I was in the right place. This is a near perfect opportunity to teach students statistics, give them an appreciation for the importance and power of statistics and give back to the community. However, even at that time, very little was reported in the statistics education literature. What was reported looked more like statistical consulting and most applications were attempted in classes offered to

statistics majors. In our school of business, the SL pedagogy was originally investigated by those teaching business ethics, business management, entrepreneurship and marketing.

The innovation and unique features of this application are three fold:

1. It's use in a business statistics course which is not a statistics major curriculum.
2. It's use in a first course of a non-majors statistics curriculum
3. The sustainability of the project to span over a two-course sequence in a non-majors statistics curriculum.

Relevant Literature

The Statistical reform movement of the 1990's expressed concern about students' grasp of statistical reasoning and their ability to interpret statistical conclusions in writing using understandable terminology. Reform focused primarily on the introductory or service/core courses in statistics (Cobb, 1992, 1993; Hoaglin & Moore 1992; Hogg 1991, 1992; Moore 1991; MSEB, 1993, NCTM 1993). Suggestions for improving classroom pedagogy included using real data, experiential learning, and use of technology and increased writing assignments (Archbald and Newmann 1988, Angelo and Cross, 1993, Crowley 1993, Garfield, 1994 & Chance 1997). 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 and Georgetown Universities, the Campus Compact website now documents a membership of over 1,100 college presidents and chancellors (www.campuscompact.org). In 1990, The National Community Service Act drew upon movements to increase social and community responsibility and allocated \$275 million toward SL projects from kindergarten through higher education.

In parallel activity, the fruits of intense labor in statistical education reform produced the GAISE guidelines in 2005 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) support the added benefits of SL reporting that students were motivated to work harder in their service-learning classes, demonstrated 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. Frequently cited statistical education papers describing SL experiences are often applied in consulting-type classes (Jersky, 2002) or involve more advanced students in the natural sciences (Anderson and Sungur, 1999). Other cited studies focus on anecdotal evidence without a detailed description of the level of the course. These studies offer supporting evidence that

service projects affect social cognitive development (Sperling et al, 2003) and improve students' attitudes toward a course (Evangelopolis et al, 2003 and Gordon, 2004). Applying SL in a truly beginner, non-major statistics class appears problematic. Having students at this level gather their own data may seem too time-consuming and overwhelming to fit into a single semester, especially with beginner students with little or no statistics background. However, it can be done and preliminary research indicates that SL in an introductory business statistics may foster deeper learning and personal development (Phelps, 2008).

Innovation

While statistics courses were not traditionally considered for SL, statisticians have been urged in recent years by leaders in the professional statistical community (Sheuren, JSM 2006) to get involved with non-profit organizations that are in great need of this support. In defense to the repeated question, "When will I ever use this?" getting students out into the community only seemed natural. I have always required my students to submit a final project in which they must perform a complete statistical analysis from research question, through data collection and statistical analysis but they still came away from my course believing they would never use statistics.

The implementation of a community service project allows the student to actually practice in real-time and reinforce what they are concurrently learning in the classroom. Although I have used SL in my BA II classes since 2006, I too believed like those before me that it could only be done after students have some background and expertise in statistical concepts. In doing so, I realized that students were re-enforcing learning objectives from BA I to fully implement the projects in BA II; study design, data collection and data summarization. Why not begin the project in BA I and carry it through to BA II? Furthermore, it takes the community partner (CP)

through a learning process of their own, allowing us time to understand the data and the problem first (BA I) and develop more complex models and answers second (BA II).

Implementation

All students enrolled in my fall 2010 BA I classes (n=94) participated in one of two selected service learning projects. I met with administrators at both organizations over the summer to understand their organization, their needs and what skills beginner statistics students could offer that matched their needs our curriculum. Prior to classes beginning, I presented both organizations with a proposal that mapped a tentative schedule of expectations from the students and expectations of the organization to meet reciprocity of the SL project (appendix). While we completed the first semester expectations for both organizations, the evolution of the project for one of the organizations did not fit the course objectives for BA II; therefore we continued the SL project for only the foster care organization in the second semester.

Adherent to the syllabus and the project proposals, assignments were embedded throughout the semester to advance the goals of the SL project. These assignments were typically aligned with bi-weekly lab assignments.

BA I embedded assignments:

1. HIPAA certification (Health Insurance Portability and Accountability Act of 1996) as data collection required students to extract personal information from client files.
2. Students assisted in the development of the survey mechanism
3. Signed up for 2-3 hours of reading files and data collection or data entry and clean up
4. Data summary: Examine the distribution of a characteristic(s) of a population
5. Single variable inference: Estimate the value(s) of characteristic(s) under study
6. ***Written/oral reporting followed by discussion of results with the CP administrators***

I then met with the administrators during the Christmas break to review the results and write a proposal for BA II activities. Traditionally, students work in groups of 2-3 to develop and

execute their own research projects. When I began to introduce SL in BA II, I opted to allow the students to choose whether they wanted to do their own project or participate in SL. My intention is for this to be a positive experience by allowing students to investigate a topic of their interest. Service or not, deeper learning should come from a more positive experience on a topic one is interested in, not forced upon. Although not random, this does however, provide an opportunity to gather empirical evidence for a comparison. Furthermore, I find that many weaker students self-select the SL project because they just do not know what other topic to pick and/or feel safer with the SL. Thus the academic aptitude is varied in both groups. Similar assignments were embedded in the BA II class. Concurrently, students opting to do their own projects had similar assignments throughout the semester to keep their projects on track and maintain equability of assignments.

Students' investment of time with the CP in BA I is estimated as time required to complete HIPAA training (1 hour), survey development (1 hour in class and out), data collection (3 hours), data analysis (4 hours), written and oral reporting (3 hours out of class, 1.25 in class). Time estimated to complete the project in BA II was similar, although additional time was necessary to perform advanced statistical modeling in BA II and to prepare the final written and oral reports for organization's administrators. The oral presentations were attended by 5 administrators from the organization, my division chair and a school staff assistant.

Students were evaluated on all embedded assignments included in the bi-weekly labs, midterm and final exams, quizzes and the final oral and written report. It was also anticipated that we would be continuing the practice of the statistics retention exam which was put in place as a result of our school's AACSB assessment plan. This would provide an added assessment measure to evaluate what students would remember following the summer break.

Effectiveness and Benefits of the learning process:

Fundamental to both BA I and BA II: The student will acquire a foundation of knowledge to become a critical thinker about the collection of information for the purpose of making inferential business decisions. Fundamental to all learning objectives above, the student will be able to use technical writing skills to summarize, describe and make statistical inferences based on sampled data in the context of their measurement to make sound business conclusions and decisions.

This will require the student to be able to combine the objectives previously stated to:

1. Clearly state a research hypothesis in the context of a business question (BA I)
2. Examine the distribution of a characteristic(s) of a population. (BA I, LO1 above)
3. Estimate the value(s) of characteristic(s) under study (BA I, LO2 above)
4. Perform the appropriate test of statistical evidence (BA II)
5. Interpret results to make clear business decisions (BA I & II)
6. Be able to draw a clear and concise written conclusion (BA I & II)

More importantly, these summary concluding statements should be communicated in ***common terms*** understandable to one who is not well-versed in statistics; therefore the opportunity to provide a written and oral summary in the presence of the CP administrators puts this criterion to task. Additionally, our business statistics curriculum committee has been working very hard in recent years to develop curricular changes to improve ***retention of key objectives*** listed previously as students move into upper level courses. Fundamental changes in the curriculum and importance of outcomes assessment have led to the development of a statistics retention exam to track the potential successes of curriculum changes in the recent three years. Therefore, assessment results reported in this section include:

1. Project assessment on the six checkpoints by student peer assessment
2. Overall project and final exam grades
3. The CP feedback on clear and concise conclusions
4. Results of the statistics retention exam

Peer assessment results are included here as this is an additional assessment of whether the students are able to communicate research questions, analyses and conclusions in clear understandable language to a general audience. The project assignment was designed to

demonstrate proficiency in the six key areas of statistical analyses and the final exam was used as a general summative assessment of two semesters of statistical instruction. Following the in class presentations, the Executive Director from the CP commented to my division chair that “...based on the results presented by the students, our organization is making changes in how they operate and how they compile and store their records.”

Another goal of this innovation was to affect *deeper long-term retention* of key statistical concepts to be re-enforced in upper level classes. The statistics retention exam was carefully designed to address the key learning objectives listed previously. The exam consists of 12 multiple choice questions and two word problems emphasizing the interpretation of data produced by technology using a two-sample t-test and a simple linear regression (BA II, LO1 and LO2)

Results:

1) Students scored above 80% in the peer evaluations in all 6 areas with no statistically significant differences between those choosing the SL projects or traditional.

2) Students in the SL group scored significantly higher on the final exam but no difference was found in the final course grades.

While both groups appear to be performing equally while enrolled in the two-semester business statistics sequence, after returning to classes in the fall, we found very different results between the two groups as measured by the statistics retention exam!

3) Students who participated in the SL project through the second semester of Business Statistics

- a) Scored significantly higher on the retention exam by 17.3%!
- b) Correctly identified on average two more multiple choice questions
- c) Scored on average 5% higher on the two problem solving questions

The following table reports the mean scores of the different assessments observed.

	Service Learning	Traditional project	Significance
Project grade (n=80)	86.6% (n=34)	83.6% (n=46)	NS
Final Exam (n=80)	84.7% (n=34)	79.9% (n=46)	p = 0.024
Stats retention Exam, n=34	79.0% (n=13)	61.7% (n=21)	p = 0.004
MC Stats Retention (n=34)	9.6 out of 12 (n=13)	7.6 out of 12 (n=21)	p = 0.007
Problem Solving (n=34)	10.9 out of 14 (n=13)	10.2 out of 14 (n=21)	p = 0.013

Effective SL courses include meaningful reflection assignments. While it is usually suggested to have reflective assignments embedded throughout the semester (or length of the project), I only required an end-of-the-semester reflective assignment (see appendix) which consisted of six likert scale questions and three open responses to address the three key learning objectives of SL at our institution:

- 1) Academic content
- 2) Social Benefit
- 3) Student development

What the students said about this project:

Although not statistically significant due to the constraint of class size, 77.8% responded ‘agree’ or ‘strongly agree’ to the SL project being a positive experience as compared to 68.2% in the traditional group. Over the five years that I have used SL and this reflection assignment, this is a typical response to the likert scale question; however, students in the SL group tend to write more freely about a positive experience in the written reflections about student development. Both groups tend to respond positively (agree or strongly agree) to the likert scale questions on having a real world experience and helping them to learn the objectives of the course.

Analyzing the written responses is naturally more problematic. I read the responses and look for key words to tally. I specifically ask the students to respond to how the projects helped them

learn the four key components of a statistical project; experimental design, data collection, data summary and statistical inference. Given this is the primary objective of project assignment whether the student selected the SL project or not, I am satisfied that most students responded positively in both groups, therefore, helping to support that these projects are an important learning tool.

To begin to see if enhanced learning or personal development may be an added advantage of the SL project, I compared responses from the second and third objectives above. In response to the reflective question: “Who might benefit from the results of your study”, 85.7% in the SL group compared to 53.8% in the traditional group ($p=0.002$) clearly felt the CP would benefit. In response to the question, “Consider if your statistical ‘expertise’ was valuable or not to anyone or group”, 90% in the SL group as compared to 33.3% in the traditional group ($P<0.0001$) responded positively. However, only about 1/3 of the students who elected to do their own study even bothered to comment on this question while 30 of the 36 students in the SL group did. The third written response asked the students to reflect on personal growth. Again, here almost all students responded that they believed the project helped in their student development, 42.5% wrote positively about this project being helpful in upper level classes and 58.8% felt it will be helpful professionally with no difference between the two groups.

In the students own words:

- ❖ “This project made it possible for me to contribute in a service that actually helped someone.”
- ❖ “I think it is wonderful that our class was able to give back.”
- ❖ “There is nothing better than helping out a non-profit”
- ❖ “There comes a point when you have to take the training wheels off and just let the students be free.”
- ❖ “Helped me to retain, encourages good communication skills and teamwork”

And my personal favorite:

- ❖ “My time in that class and especially on the project feels like a complete success and one day I hope to be as helpful to an organization as my professor was.”

Transferability and Implications for Educators

Our institution has elements of community engagement in its mission and SL was introduced as a core requirement in 2007. As a truly passionate believer in this pedagogy, I accepted the request to sit on the University Advisory Board to monitor and help make decisions for the advancement of this pedagogy, the effects of student learning and the advancement of scholarly work in this emerging field. Consequently I serve as the School of Business SL representative to the University. As a result of these appointments, I see first-hand how this pedagogy is widely implemented throughout the various disciplines and in a variety of creative applications. While the implementation presented in this application works well for my courses and may serve as a guideline for other courses, I can wholeheartedly attest that this pedagogy takes on many different forms and works well in all disciplines. I would encourage anyone interested to just seek out opportunities and examples in their disciplines.

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Appendix

1. Project Proposal agreement
2. End of semester project reflection assignment

Project Proposal Agreement Fall semester 2010

A service learning opportunity between Business Statistics students and a local non-profit

Students enrolled in Business Statistics I class, BA281, in the Fall of 2010 will work with administrators at XXXX to determine important information that would be helpful in characterizing XXXX's clients for the purpose of identifying successes and areas for program changes. This will require that students

- receive HIPAA training and certification
- consult with administration on what information they want to ascertain
- develop a *data information sheet*
- review client files and extract selected information for the data information sheet
- provide data entry and data summary :
 - ✓ data summarized in graphs:
pie charts, bar charts and histograms and boxplots where appropriate
 - ✓ Descriptive statistics such as means, sd's, medians and proportions where appropriate
 - ✓ Confidence Interval estimates
 - ✓ Interpretations and applications

Students will prepare a 20 presentation of the project, data summary and conclusions to be presented to administrators on the last day of scheduled classes.

Administrators from XXXXX will agree to meet with the three BA 281 classes

1. During the second week of the semester to provide a 15 minute overview of
 - ✓ the services that XXXXX provides
 - ✓ the type of information they would like to collect and
 - ✓ how they will assist in the collection of data.
2. They will agree to be available for assistance, questions and clarifications throughout the 15-week semester.
3. XXXXX representatives will be present on the last day of scheduled classes to view the presentation at which time a project report will be given to XXXXXXX

Prospective TENTATIVE time scale:

Tuesday August 31: XXXXXXX will come on Tuesday August 31, 2010 to give a brief presentation to all three classes. We will allow for some questions and brainstorming for developing the data information sheet .

August 31 through September 14: Students will use notes from the brainstorming to develop the data information sheet. A near final draft will be submitted on Tuesday September 14 for XXXXX to make final changes.

September 21: We will propose to have the data information sheet ready for final changes and approval.

September 21-October 21: Students will be scheduled block times to go to the Service Learning office and review files, using the data information sheet to get pertinent information from client files and record it on the data information sheet.

October 21-November 5: Students will enter the data into Excel and begin the data summary and final report.

November 18: Students will have a final report and powerpoint turned in. Dr. XXXXX will make final comments and suggestions over Thanksgiving Break. Students will make final corrections.

December 4: The final project presentation will be presented in class.

Name _____

Throughout the two semesters of Statistics, it is my ultimate goal to prepare you to be able to design a data collection study formulated around a specific question or hypothesis. The final project is therefore designed to mimic a more real-life experience and meet the following learning objectives.

- **Learn how to develop a research design for testing the difference between two or more population means or proportions (or testing the relationship between two variables such as a simple linear regression would be necessary) and apply the appropriate statistical model(s) for testing a desired hypothesis.**

In order to accomplish this, students will exhibit the ability to:

- design a simple method of data collection and be able to discuss sampling bias
- structure and synthesize the information collected by using appropriate summary graphs and statistics
- apply analytical procedures for the purpose of drawing useful conclusions,
 - tests of hypotheses
 - confidence interval estimation
- draw conclusions about the sampled population
- and develop proposed solutions if necessary

On a separate piece of paper, please answer the following questions and staple it to the multiple choice questions on the back of this page. **THERE ARE NO RIGHT ANSWERS**, just a 5 point reduction in your project grade for failing to submit a response **individually**. Even if you are working in a group, each student has their own opinion and must hand in their own responses. This is not a group effort.

1. Reflection on the *academic content* of the final project assignment:

Please write a short paragraph on how doing this final project helped (or not) you to:

- 1) design an experiment following a question of interest
- 2) understand difficulties in collecting data as free from bias as possible
- 3) prepare the data for statistical summarization (using statistical software)
- 4) perform a statistical analysis including data summarization, hypothesis testing, confidence interval estimation and drawing conclusions.

Please comment on problems you did or did not expect and how you dealt with them.

2. Reflection on the *(social) benefits* to a population on doing this project:

Please write a short statement about who might benefit from this information and why this is important. For those who volunteered with the Community Partner, please consider why your statistical ‘expertise’ was valuable or not valuable for the organization.

3. Reflection on *student development*. Please comment on how completing the objectives in this final project may have furthered student development as you approach upper level classes and ultimately a professional life.

A few short multiple choice questions: (circle your response)

1. Which option did you choose to do for the final project?

- a. my own research b. SL Project

2. Overall, do you agree that the final project was helpful in achieving the learning objectives listed above:

- a. strongly agree b. agree c. no opinion d. disagree e. strongly disagree

3. Overall, do you agree that the final project was helpful in understanding how statistics can be applied in the 'real world'?

- a. strongly agree b. agree c. no opinion d. disagree e. strongly disagree

4. Personally, did you find doing the final project a positive experience?

- a. very positive b. positive c. just OK d. not positive e. a royal pain

5. Now that it is over, would you choose the same option for doing the final project?

- a. yes b. no

5a. If you answered no, what would you have chosen?

6. Do you think your final project was helpful to anyone other than your group?

- a. yes b. no