SUCCESSFUL SERVICE-LEARNING FOR STATISTICS STUDENTS STUDYING SURVEY SAMPLING

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ABSTRACT

This paper explores the implementation of service-learning projects in a survey sampling statistics course. In these projects, students worked with a community partner to develop and administer a survey, analyze the data collected, and present the results. A study with 23 participants was conducted to investigate whether students' attitudes towards community service changed after involvement in a statistical consulting-based service-learning project with a local non-profit organization. Results from administering the Community Service Attitudes Scale (Shiarella, McCarthy, & Tucker, 2000) before and after the project indicated significant changes in several aspects of attitudes towards service. Qualitative information is also provided on themes from student reflection assignments. Project details and recommendations for instructors administering this type of service-learning project are discussed.

Keywords: *Statistics education research, Community Service Attitudes Scale, Statistical consulting, Statistics project*

1. INTRODUCTION

Sigmon (1997) defines service-learning (SL) as an experience comprised of equal parts learning and serving, where all individuals involved are considered to be both educators and learners. However, a broader description of SL entails a deliberate connection between service and academics (Eyler & Giles, 1999). The benefits of SL are encouraging. Eyler and Giles affirm that most students who take part in SL feel that their learning is greater and that they employ more effort in SL classes compared to those that do not involve SL. Also, SL experiences which incorporate purposeful reflection facilitate students' development into independent learners (Heffernan, 2001).

Numerous American Statistical Association (ASA) leaders have encouraged statistical service to help both students and non-statisticians become aware of the importance of statistics as a discipline. In his presidential address, the 2012 ASA president, Robert Rodriguez, urged statisticians in a professional capacity to serve the public (see Rodriguez, 2013). Although most students are not at the level of a professional statistician, he believed there was a need to set a good example of serving society in a statistical capacity while still pursuing an undergraduate degree. Rodriguez also encouraged statisticians to serve humanity and follow the example of Eric Liddell, an athlete and missionary, who devoted himself to encouraging and helping others. An opportunity to serve society can be provided to student statisticians in a well-crafted SL experience, and this is one way to carry out the recommendation of Rodriguez. Hydorn (2007, p. 2) states that "Civic responsibility, in particular, is not generally connected with statistics education." One response to this is that maybe it should be, at least in some statistics courses. Hydorn also notes that through involvement in SL experiences where students become cognizant about the intentions and operations of community agencies, a student's sense of civic responsibility can be nurtured.

Multiple SL resources discuss general research and information applicable to numerous disciplines (Battistoni, 2002; Clayton, Bringle, & Hatcher, 2012; Eyler & Giles, 1999; Jacoby, 2015). Information on how to effectively design a course involving SL is discussed by Heffernan (2001), who also provides examples of SL projects in dozens of different disciplines. Examples include mathematics students participating in tutoring and statistics students making reports based on data collected by students in

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other disciplines. The volume of literature that explores SL exclusively in statistics courses pales in comparison to the research and resources available to a general SL audience. I am presently unaware of any research that specifically addresses SL experiences in a survey sampling course, which is a common course among Statistics Departments, joint Mathematics and Statistics Departments, and some programs in the social sciences.

In this paper, I examine results from the Community Service Attitudes Scale (Schwartz, 1977; Shiarella, McCarthy, & Tucker, 2000). Although numerous scales exist to measure SL outcomes (Bringle, Phillips, & Hudson, 2004), I have been unable to identify any SL research in the field of statistics that has utilized an inventory such as the Community Service Attitudes Scale (CSAS). The importance of feelings, attitudes, and thoughts regarding service and the application of discipline-based knowledge is evident because instructors of any course that uses SL likely want their students to have a positive attitude towards service and a beneficial SL experience. Also, examining student attitudes towards service could help in assessing the success of an SL project and provide information on whether SL activities should be modified for future use. McCarthy and Tucker (1999) argue that more industries have job descriptions which include service to the community, and this is another reason why it is beneficial to understand how students think about service.

Past research shows that community service in high school, even if the school mandates the service, is associated with higher rates of both voting and participating in service as an adult (Hart, Donnelly, Youniss, & Atkins, 2007). The same might be true for students participating in service at the college level. Involvement in service during college "substantially enhances the student's academic development, life skill development, and sense of civic responsibility" (Astin & Sax, 1998, p. 262). Therefore, being able to improve attitudes and views towards service could be linked to being a more active citizen. Overall few publications exist related to the use of SL in statistics courses, and of the ones that exist, most of them do not offer any quantitative results related to student perceptions or attitudes towards service.

A discussion of the literature related to using service to increase discipline awareness in statistics, SL in statistics courses, general SL benefits, and the CSAS is presented in the next section. Details of the SL project administered are provided in Section 3, and methodology information associated with this research is given in Section 4. Results from the surveys administered and the reflections completed are available in Section 5. Section 6 is a discussion section which reviews study results and tips for instructors administering similar SL projects. The paper ends with a conclusion in Section 7.

2. LITERATURE REVIEW

2.1. USING SERVICE TO INCREASE THE VISIBILITY OF STATISTICS

In his 2012 ASA Presidential Address, Rodriguez (2013, p. 5) said that "Purpose-driven statisticians do better science, they transform business, they inform public policy, and they empower students." Students in a statistics course are not blind to the uses of statistics, but seeing and partaking in a focused application of statistics can make the importance of the discipline even more clear. Rodriguez also advocated that statisticians have an opportunity to assist others. Taking part in an SL project is one way for students to be inspired by the power of statistics while providing practical support to others. Marie Davidian, in her 2013 ASA Presidential Address, encouraged everyone to "raise awareness of statistics and its importance to science, to data science, and to the public, and to get involved" (Davidian, 2013, p. 1146). Again, by working with public organizations through involvement in SL, students are doing their own part to increase awareness.

Another ASA President, Jessica Utts, urged statistics instructors to "start incorporating stories, especially ones that will help students become educated consumers of statistical information" (Utts, 2016, p. 1380). Although this message was directed at introductory statistics instructors, including statistical narratives at any level can be useful in further showcasing the significance of statistics. Through SL projects like the one discussed here, students can become more familiar with the story of their partner organization and add more chapters to the narrative through data collection and analysis. Utts also advocated that citizens should be informed about how to consume statistics. The SL experience discussed in this paper involves students communicating statistical understanding to the

public, which consists of individuals that often need to be statistical consumers without any prior statistical background.

The SL projects assigned can help students not only to become better aware of the inherent value of service to others, but also to increase students' positive feelings regarding real world uses of data and statistics. Students involved in this type of SL have the opportunity to realize that their statistical understanding and training has great worth to community partners. Through intentional and carefully planned SL experiences in a statistics course, the visibility of statistics can increase for both students and their community partners.

2.2. SERVICE-LEARNING IN STATISTICS COURSES

Hydorn (2007) discusses various options to include SL experiences in the statistics curriculum. These options include community-based SL projects, capstone courses, and service internships. Anderson and Sungur (1999) described several SL projects in statistics related to analyzing data in Multivariate Statistical Analysis, Categorical Data Analysis, Design of Experiments, and Data Analysis courses. These courses are all second courses in statistics, much like a survey sampling course. However, unlike the project assignment discussed in this paper, the projects considered by Anderson and Sungur dealt with analyzing data that was already available. Duke (1999) discussed SL experiences which involved analysis of existing data and data that had been collected by students using different survey sampling methods. It was reported by Duke that after several semesters of doing SL projects with a specific community partner, that community organization began to approach the introductory statistics instructor directly when it needed statistical help.

Phelps (2012) gave advice on how to successfully incorporate SL in two sequential statistics courses for business majors and in an introductory statistics class for non-majors who will likely not pursue further statistical coursework. Example projects discussed by Phelps involve data collection by students, either in the form of collecting survey results or gathering data from available client information.

Other researchers such as Nordmoe (2007) focused on SL applications in only introductory courses. In the projects discussed by Nordmoe, students participated in data collection and each group of students was assigned something specific to examine in the data, such as the association between two specified variables. Root and Thorme (2001) described an optional SL project that is also for students taking an elementary statistics course.

Applications of SL at the graduate level have been discussed in the literature as well. Gunaratna, Johnson, and Stevens (2007) examined the Statistics in the Community (STATCOM) consulting center which provides free statistical consulting, mostly by graduate students, in Purdue University's Statistics Department. Like the SL project that is the focus of this paper, STATCOM's projects often involve the development of a survey and analysis of the results. Thompson and Davis (2013) considered completion of community engagement projects involving statistics by graduate education students. SL statistics projects completed by students in a masters of public administration program were examined by Lowery (2007). Well (2006) considered statistics course SL projects for graduate social work students involving entering and analyzing data for a community agency.

Some research has compared SL projects to an alternate assignment. For example, Phelps and Dostilio (2008) discussed a second course in business statistics where students had the option of completing an SL project or a traditional non-SL project. After completing these projects, students completed a short survey at the end of the semester to gauge how they felt that their project had helped them to meet specific course goals. Evangelopoulos, Sidorova, and Riolli (2003) carried out another study which considered undergraduate business statistics courses, where students again had an option to complete an SL project or an alternative research project involving the analysis of publicly available data. SL projects have also been compared to business case study assignments by Hiedemann and Jones (2010). In their study, four introductory business statistics courses received an SL project assignment and two sections completed business case studies.

Administration of pre- and postsurveys related to attitudes towards community service or SL can successfully measure the impact of an SL experience. Of the research articles discussed in this section, only a few mentioned that a pretest was given before the SL experience. Anderson and Sungur (1999) referenced a pre-SL survey and a post-SL assessment without discussion of the associated results.

Evangelopoulos et al. (2003) administered a pre- and posttest unrelated to SL; instead, the data collected contained items from a Course Acceptance Survey to support the theoretical Course Acceptance Model introduced by the researchers.

Hiedemann and Jones (2010) administered the Survey of Attitudes Toward Statistics (SATS) (Schau, Stevens, Dauphinee, & Del Vecchio, 1995) at the beginning and end of a semester in which students had the option to complete either an SL project or a business case study. The main interest of these authors involved the responses to two items about the importance of statistics in students' professional lives. Paired differences in scores on these two items were not considered, but for each of the two pretest items of interest, Hiedemann and Jones reported that there was not a significant difference in scores between students who completed an SL project and those who completed a business case study. Only responses from the post-SATS items of interest were considered to gauge how effective the two types of projects were in influencing student attitudes.

A pre/post study was also completed by Thompson (2009), who considered Community Action Projects for Students Utilizing Leadership and E-based Statistics (CAPSULES). These are team-based experiences involving quantitative analysis of data. Students who took part in CAPSULES showed improvements in numerous categories such as leadership skills, positive attitudes towards using statistical computing tools, and the perception of usefulness of the course in preparing the student for a future dissertation or thesis. Although Thompson administered a pre- and posttest regarding SL attitudes, it is unknown from the information provided if the noted changes in attitudes are statistically significant as neither numeric data nor statistical results were given.

Hiedemann and Jones (2010) have pointed out that in many research studies related to SL in statistics, a choice is given to students about whether to carry out an SL project or an alternative assignment (Evangelopoulos et al., 2003; Phelps & Dostilio, 2008; Root & Thorme, 2001). Therefore, the positive student attitudes towards the statistics discipline or other benefits observed from students who carried out SL projects may be due to self-selection bias. This could imply that observed results are attributable to the type of student who self-selects an SL project and not the project itself.

The SL research introduced in this paper does not have issues with selection bias. Unlike many similar studies, this research examines whether paired data results from a pre/post SL experience in statistics are statistically significant. Additionally, the reflection assignments examined in this paper provide abundant information related to student attitudes towards the SL project and their perception of this learning experience.

2.3. BENEFITS OF SERVICE-LEARNING AND COMMUNITY SERVICE

Simons and Cleary (2006) examined the effects of SL in psychology courses where students volunteered 16 hours in an elementary school or after-school program once they had received training related to mentoring and tutoring. Study outcomes included positive changes in diversity awareness, political understanding, and learning of academic content. Simons and Cleary also mentioned that multiple studies (Rockquemore & Harwell Shaffer, 2000; Root, Callahan, & Sepanski, 2002) have reported a decrease in stereotyping as another advantage of SL. Rockquemore and Harwell Shaffer (2000) studied the effects of SL placements in a non-profit community agency on students taking a course named "The Call to Serve" or a Religion or Sociology class. Root et al. (2002) considered SL completed by students in teacher education programs.

Researchers in the field of education who believe in the importance of SL reflection have declared that participating in SL encourages students to expand their knowledge and supports students in becoming more active citizens (Eyler, Giles, & Schmeide, 1996). An analysis done by Wilson (2011) showed statistically significant evidence that students who did not carry out SL in a Marriage and Family course were less likely to display empathy in reflection assignments than students who did take part in an SL experience. SL projects in the Marriage and Family course involved 15 hours of volunteering at a community agency.

When considering the discipline of statistics, a post-SL project survey of Nordmoe (2007) indicated that almost all students believed the project was beneficial in helping them to observe how real-life problems can be solved with statistics. Root and Thorme (2001) suggested that SL projects helped students to see the importance of the statistical methods covered in their coursework. Gaining practical and statistical skills while carrying out a meaningful SL project is supported by Wells (2006). Phelps

(2012) maintained that SL statistics projects reinforce recommendations in the GAISE report (Carver et al., 2016). Phelps and Dostilio (2008) ascertained that although both the SL and non-SL projects they administered supported GAISE guidelines, students that participated in the SL projects were possibly more empowered with a better sense of social responsibility. Conclusions of Evangelopoulos et al. (2003), who examined SL in a business statistics course, included the implication that students believe a course is significantly more useful when SL is part of the course.

Most statistics students carry out SL in the form of statistical consulting experiences. Through this consulting, students benefit from gaining experience analyzing real data and having an opportunity to practice communicating statistical information with non-statisticians. Statistical consulting opportunities can also enhance job and graduate school opportunities (Jersky, 2002). Gunaratna et al. (2007) believe that SL projects involving statistical consulting experiences can help cultivate students' leadership abilities and facilitate their ability to communicate effectively. An obvious benefit of consulting-based SL is that service is provided to local organizations. In many cases, it would be difficult or impossible for community partners to obtain these services if funding was required (Anderson & Sungur, 1999). Simultaneously, the college or university that is offering their statistical services is promoting a positive image in the surrounding community.

When Hiedemann and Jones (2010) analyzed results from including SL projects in some course sections and business case studies in other sections, there was evidence that students carrying out SL projects were significantly less likely to agree that statistics will not be applied in their profession. Therefore, statistics students who have experience in SL seem to believe that their future employment prospects will require statistical knowledge. Furthermore, Anderson and Sungur (1999) argued that benefits of SL extend to instructors as well. When faculty integrate projects involving SL, they may enhance their teaching and gain future consulting or research opportunities.

2.4. THE COMMUNITY SERVICE ATTITUDES SCALE

A collection of inventories available to measure the effects of SL is available in the book by Bringle et al. (2004). One of the many inventories from this book that is helpful in carrying out studies related to SL and service to the community is the Community Service Attitudes Scale (Shiarella et al., 2000). This scale is based on the model of Schwartz (1977) which examines altruistic behavior that benefits others. There are four phases of Schwartz's model. The first is becoming alert to the necessity for community service. The second phase is the obligation to react to a need, and is followed by the third phase which consists of an assessment of benefits and costs of providing community service. The final phase is participation in service to the community.

Shiarella et al. (2000) developed the CSAS and conducted a principal components analysis of data from the administration of the CSAS. Although this analysis resulted in a solution with only five factors, they implemented a solution with eight factors, as this result was more in line with the altruistic helping behavior model of Schwartz (1977). These factors are Normative Helping Attitudes, Connectedness, Costs, Awareness, Benefits, Seriousness, Career Benefits, and Intentions. The factor with the smallest number of items is Career Benefits, with two items, whereas the Normative Helping Attitudes factor has 11 items, the most items of any factor. The strong internal consistency of the CSAS was also verified by Perry, Osbaldiston, and Henning (2014), further endorsing this scale as a legitimate measure of community service attitudes.

Researchers from multiple disciplines have used the CSAS. As part of a Humanitarian Engineering initiative, the CSAS was completed by engineering students and faculty (Bauer, Moskal, Gosink, Lucena, & Muñoz, 2007). One of the main take-away messages from this research was that attitudes toward community service vary between faculty and students. Specifically, there was evidence that faculty attitudes are better. The CSAS was also administered to senior dental students (Coe et al., 2015) in the form of a posttest followed by a retrospective pretest after the posttest. Results indicated significantly higher posttest scores on numerous factors of the CSAS. Beatty, Meadows, SwamiNathan, and Mulvihill (2016) employed selected items from the CSAS, along with items from other inventories to compare a control group with students who participated in an alternative spring break program.

2.5. PURPOSE AND RESEARCH QUESTIONS

The area of statistics involving survey sampling topics easily lends itself to SL experiences because numerous organizations desire information from their clients, volunteers, or constituents. Also, unlike a service-learning project in an introductory statistics course, a service-learning project in a second course in statistics makes analysis involving categorical variables more realistic, and students may have significantly more statistical computational knowledge than those in a first course in statistics. The main goal of the SL project was to provide an opportunity for the students to work as statistical consultants analyzing real data by partnering with non-profit organizations in the community. The purpose of this study, which examined students' SL experience, was to answer the following questions.

1. Do students' attitudes towards community service change as the result of being involved in a statistical consulting-based service-learning project with a local non-profit organization?
2. What are students' personal reactions to working on the service-learning assignment?

3. SERVICE-LEARNING PROJECT DETAILS

The Survey Sampling Methods course is required for students pursuing a Bachelor of Arts degree in Statistics at the institution where the study took place, and optional for students pursuing a Bachelor of Science degree in statistics or a statistics minor. All students in the class had previously completed a Statistics in Application course, which is an advanced introductory course covering topics such as descriptive statistics, hypothesis tests for means, chi-squared tests, simple linear regression, and multiple linear regression. Enrollment in the advanced introductory course is permitted if a student has an SAT math score above a specified cutoff or has taken a previous introductory statistics course. The students involved in this research study also had at least some knowledge of statistical programming, as the advanced introductory course teaches students basic information regarding programming in SAS. Some students had a much higher level of statistical programming experience because they had taken a Statistical Computing course.

In 2013 and 2015, students taking the Survey Sampling Methods course completed an SL group project. In 2013 the class worked with two different community partners, with three student groups working with each community partner. Two years later, three different community partners each worked with either one or two student groups. Groups consisted of three to five students. At the institution where the study took place, all students, regardless of their major, must complete two units of experiential learning. A service-learning course is counted as an experiential learning unit if the course has an SL designation. In 2013 the sampling course had this designation. A requirement for this designation is that students spend at least 40 hours volunteering and/or working on a service project. The time logs turned in by students at the end of the 2013 semester indicated that many groups successfully completed the project without meeting the 40-hour minimum time requirement. Therefore, in 2015 the course did not have the SL designation, but students received information about the service-learning project on the first day of class.

The project goals included generating a survey for the community partner, administering the survey, and analyzing the results. Students also presented their findings to the community partner through both a presentation and a formal report. Phelps (2012) recommended adding specific SL project instructions, such as the inclusion of a regression model or hypothesis test. This advice was followed, and in the case of the survey sampling SL project, this requirement is met by the inclusion of results from either a hypothesis test or a confidence interval, even if the community partner does not specifically request this.

The GAISE recommendations supported by the SL projects discussed in this paper are 3, 4, and 5, which are to "Integrate real data with a context and purpose," "Foster active learning," and "Use technology to explore concepts and analyze data." Not only is the data that students analyze real data, but it is also data that they collected. For most students in the class, developing a suitable survey and working with a client are both new experiences. It is also the first time that most students have generated a digital version of a survey, distributed hard copies of a survey, and analyzed a large data set that is much bigger than most data sets that they had analyzed in previous coursework. By doing this project, students apply knowledge to a new situation which can help them improve their learning compared to situations where they engage in familiar problems (Garfield, 1995).

Before SL projects began, the community partners came to the class to talk about the organization they represented and goals of the survey. Students then filled out an online survey to gauge their interest in working with the specific community partners. Students rated each community partner from a one to seven scale, where one represented "Strongly prefer NOT to work with this community partner" and seven was "Strongly prefer to work with this community partner." Students could name a classmate or classmates that they preferred to work with on the project. In the last question of the survey regarding project preferences, students had the opportunity to provide any comments or concerns regarding working with any of the community partners. Based on this information, I assigned student groups to each of the community partners.

Examples of community partners that worked with the class in either 2013 or 2015 included an organization that provides day services for aging adults, an off-campus local library with an outreach program for home-bound individuals, and a nearby sustainable farm. All community partners that the class worked with are non-profit organizations. The organization offering day services desired information on additional services that people might be interested in along with public opinion regarding a possible location change. Goals of the survey administered for the local library included assessing public knowledge and program needs of the library's outreach program. Objectives of the sustainable farm included evaluating marketing methods, communication frequency, and services offered.

Each group had to turn in an initial project plan in the beginning of the semester which contained the following sections:

1. An overview of the goal(s) of the community partner organization and reasons for carrying out the study
2. A detailed description on plans for data collection
3. A tentative survey to address the questions and goals of the study
4. A timeline which included details on dates, times, and locations that each group member worked on the project.

Specific information on time commitments included travel time to and from visiting with a community partner, time meeting with the community partner, and time spent working on the project plan. The initial project plan was not shared with the community partner. However, this assignment allowed me to see whether each group understood the goals of the project, and it also provided an opportunity to give instrucotr feedback on the draft surveys. Additionally, it reminded the students of the requirement to keep track of the time they devoted to the project, as this is commonly done in a real-world consulting setting. I encouraged each group to pick one person who would communicate with the community partner by email and phone. This designated student also arranged meetings with the community partner as necessary.

Some class time was available to revise survey drafts based on instructor comments. Groups working with the same community partner had to work together to review the multiple draft surveys generated for their community partner before generating the final survey. This helped to maximize the number of responses per survey. It would have been less effective if each group working with the same community partner administered a similar but separate survey and analyzed a smaller set of responses. In many cases, multiple groups working with the same community partner had similar surveys, but decisions still had to be made about wording, order of questions, type of questions, etc. Instructor guidance is useful in this stage of the project due to the requirement of multiple versions of the draft survey before the final survey is ready.

Although most student groups chose to collect survey responses digitally, a couple of groups decided to collect their data using a combination of digital and in-person responses. An internal Community Partner Initiative grant was used to obtain funds for survey incentives to increase the number of responses. In 2013, this money was divided up evenly among each group, whereas in 2015 the money was divided up evenly among the three community partners. All survey respondents had the option to provide their email address or phone number if they wanted to be entered to win a gift card. In most cases the winners of the drawings were provided a $25 gift card to a national retail store.

Student groups that collected data digitally could pick an online survey platform of their choice, although all groups relied on Google Forms. Most likely students chose this survey platform because a lesson was provided on how to generate and modify Google Form surveys. Additionally, by using this platform, students knew that their instructor could help with issues arising during the process of creating

a digital survey. Google Forms are free to use and do not have a limit to the number of responses that can be collected. A brief introduction to using Google Forms along with information on advantages and disadvantages of this survey platform are discussed in Taylor and Doehler (2014). Other options for similar programs to administer surveys include Qualtrics, Survey Monkey, and Checkbox, all of which allow limited functionality without payment.

Students also completed three reflection assignments throughout the SL project. Including appropriate reflection activities is supported by many researchers such as Heffernan (2001) and Conway, Amel, and Gerwien (2009), who examined an in-depth review of SL literature. All three assignments had some reflection prompts in common. Examples of question prompts included reactions to the SL project, challenges faced in the project, knowledge learned from the experience, and recommendations to future students who pursue a similar SL project. After I graded each of these three project reflection assignments, informal class discussions took place where I discussed some of the prevalent reflection comments with students. Also, informal reflection occurred in class when I asked about how the projects were going or when class time was provided for students to work on the projects and ask questions. Figure 1 displays a diagram which illustrates the steps carried out in the project. I assigned the first reflection at the begin of the semester, when some student groups had recently begun the project and other groups had already done significant project work. The second reflection due date occurred after the groups had administered their surveys, and students submitted the final reflection once the project was completed.

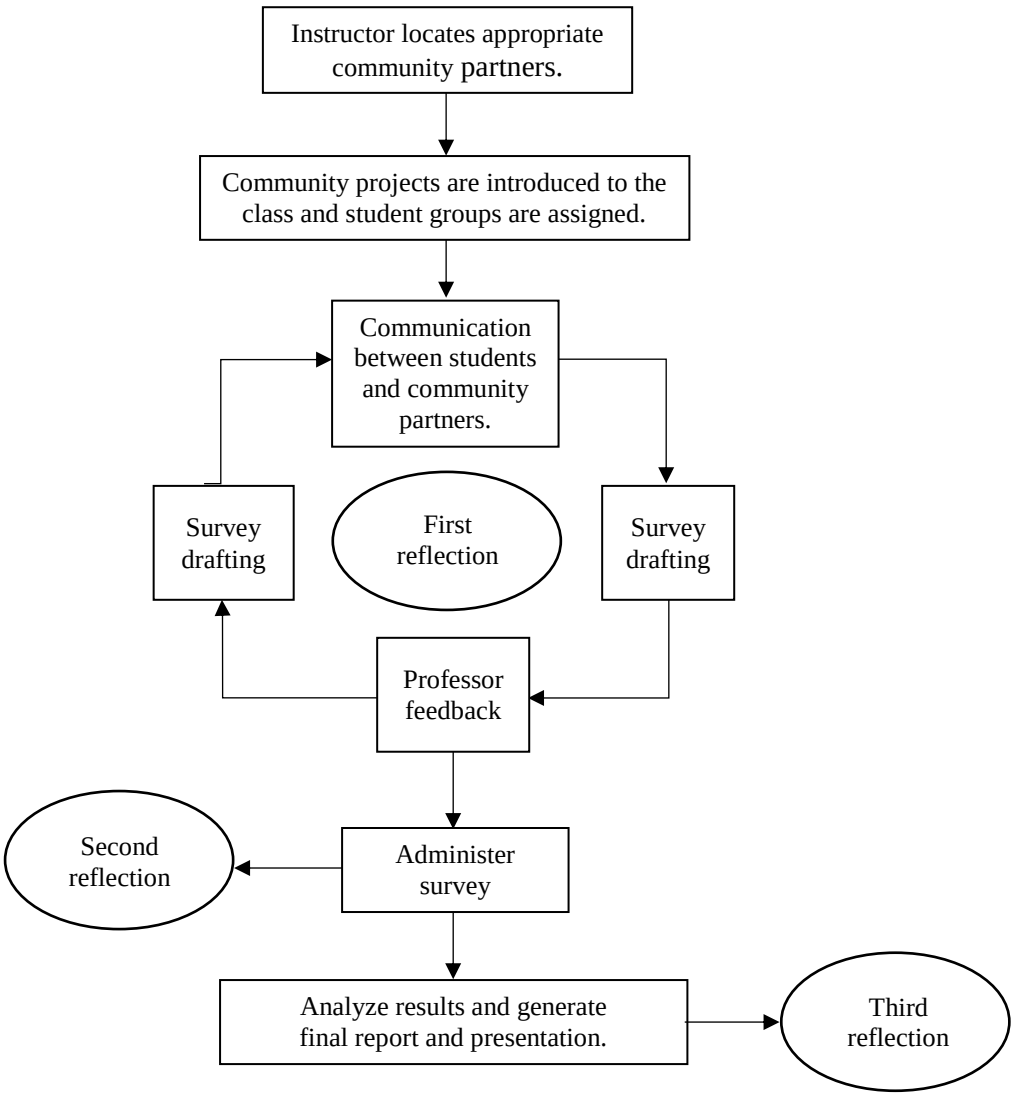

Figure 1. Diagram of service-learning project steps

Each student group prepared a presentation for their community partner to discuss sampling methods, survey results, and concluding remarks. At least one representative from each community partner watched the presentations from each student group that had worked with them. Students answered questions from community partners, who provided verbal feedback to students after the presentations. Based on their comments, the community partners all seemed very thankful to the class for the statistical help which was provided. Once the project reports had been turned in and each group completed their final presentation, students rated their contributions and those of their group members via an online survey. Excluding project reflections, which were factored into the homework and assignment portion of the course, the project was worth 20 percent of the course grade. The initial project plan, presentation, and final paper were four, six, and ten percent, respectively.

4. METHOD

4.1. DATA COLLECTION

In the summer of 2015, approval was received from the Institutional Review Board to collect data from the fall 2015 class. The first administration of the survey included demographic questions related to gender, grade point average, and year in school. There was also a question which asked whether the respondent was majoring in statistics, and if not, the follow-up question was whether the student was pursuing a statistics minor. I followed the example of the CSAS creators by including a yes/no item related to previous participation in community service (Shiarella et al., 2000). Those who answered "Yes" to this question were asked a multiple-choice question about the frequency of their prior community service. This question was the same used by Shiarella et al. with the addition of an "Other" category and the deletion of the "Not applicable" option.

The CSAS, which consists of 46 items answered on a one to seven scale, was administered before the assignment of SL projects and after their completion. Because only 23 students from a single university could take part in this study, results from this inventory should be considered preliminary in nature. In twelve of the CSAS survey items, a response of one represents *Extremely unlikely* whereas a response of seven represents *Extremely likely*. For 34 items, the answers of one and seven signify *Strongly disagree* and *Strongly agree*, respectively. However, in both administrations of the CSAS, the response options for the final survey item were altered slightly. This final item was: "Would you seek out an opportunity to do community service in the next year?" This is the only CSAS item that is given in question format, as the remaining items are all statements. I believed that students would have been confused when asked to provide a Likert response to an item which was not a statement. Additionally, written answers to this open-ended question could be more informative than Likert-scale responses. Therefore, instead of having students answer on a one to seven Likert scale from Strongly disagree to Strongly agree, as it is in the original CSAS, this final item was left as an open-ended question. This means that for this research study, the total for the Intentions factor is reported as the sum of two items instead of three. The data examined included paired differences in each of the eight factors of the CSAS. Paired differences in CSAS score sums were also assessed, where a score sum represents a measure of a respondent's level of optimism towards service and the SL experience.

The data collected also included written project reflection assignments throughout the semester. Some of the reflection questions were based on the Integrative Processing Model (Kiser, 2008) that was designed to enrich students' learning by helping them think about educational experiences such as SL. Discussion in the present paper includes key themes and frequencies of selected themes emerging from the reflection submissions.

4.2. PARTICIPANTS

All individuals enrolled in the 2015 offering of the course answered both the pre- and postsurvey. Of the 23 students in the class, 16 (69.6%) were female and 7 (30.4%) were male. A race/ethnicity question was not part of the administered survey, although the majority of students at the university where the study took place are Caucasian. There were 15 students (65.2%) in the survey sampling class pursuing statistics as a major, whereas the other 8 students (34.8%) were pursuing a statistics minor. Students pursuing a minor in statistics were majoring in either human service studies, environmental

studies, or majors within business or communications. The average reported grade point average was 3.4 (*SD* = 0.3). Table 1, which shows the percentage of students in each class year, shows that over half of the students were in their fourth year of college.

Table 1. Year in school

	Frequency	Percentage
I am in my 1st year of college.	0	0.0%
I am in my 2nd year of college.	1	4.4%
I am in my 3rd year of college.	7	30.4%
I am in my 4th year of college.	14	60.9%
I have been in college for more than 4 years.	1	4.4%
Total	23	100.0%

A large percentage of the class (82.6%) had previous experience with community service. Table 2 shows results of the item which asked about the frequency of past community service. The four students who had not had previous community service experience did not answer this item. The student who chose "Other" responded that they volunteered thirty hours a semester. The "2-4 Times Per Year" category was the most common response.

Table 2. Statistics on previous service

	Frequency	Percentage
Once per year	2	10.5%
2 – 4 times per year	8	42.1%
Monthly	2	10.5%
Weekly	6	31.6%
Other	1	5.3%
Total	19	100.0%

5. RESULTS

5.1. RESULTS FROM THE COMMUNITY SERVICE ATTITUDES SCALE

Pre- and posttest score sums were computed for each student by adding up the response values of the 45 Likert scale items on the survey. The score sum represents a measure of positive attitudes regarding service. A difference in pre- and posttest score sums for each study participant was then computed to provide a measure of the change in positivity towards service. The difference (post – pre) in these score sums has a mean of 7.2 and a median of 6.5, indicating an increase in optimism. Seventeen of the individual differences were positive, indicating a higher score after the project was completed compared to before the project began. One difference was zero, and four were negative. One difference was missing due to a missing response in one item of the Awareness factor. Based on *t*-test results ($t = 2.79$, $p = 0.0109$) of difference values, there was a significant increase in the overall score sum on the Community Service Attitudes Scale.

To account for simultaneously testing eight factors of the CSAS, the Benjamini-Hochberg (B-H) approach (Benjamini & Hochberg, 1995) was used in lieu of a more conservative technique such as Bonferroni's method. The false discovery rate was set to ten percent when implementing the B-H method, where a significant result is observed in the largest *p*-value which is less than its associated B-H critical value, in addition to all smaller *p*-values. The B-H critical value is defined as $(i/m)Q$, where Q is the false discovery rate, m is the total number of tests, and i is the rank of the associated *p*-value. Table 3 shows statistics for each CSAS factor and the overall score sum, including the mean pretest score, posttest score, and difference in pre- and posttest scores. Standard errors and corresponding 95% confidence intervals are also provided in the table. For each row of the table associated with the difference in one of the eight factors, the two-sided *t*-test *p*-value and the B-H critical value are given. Two B-H critical values in Table 3 are greater than the associated *p*-value. The largest of these is from subscale one, and subscales five and six have associated *p*-values less than the *p*-value associated with

subscale 1. Therefore, based on the B-H technique, three of the eight factors examined had significantly higher posttest scores compared to the pretest scores. The factors indicating improvement were Normative Helping Attitudes, Benefits, and Seriousness. In this scenario, the B-H and *t*-test methods yield similar results. There were no significant differences between males and females.

Table 3. Paired differences in average scores among the eight factors and score sum

	LS Mean	SE	95% CI	*p*-value	B-H critical value
I. Normative Helping Attitudes					
Pretest	5.913	0.144	(5.614, 6.212)		
Posttest	6.134	0.118	(5.890, 6.379)		
Difference	-0.022	0.212	(-0.461, 0.418)	0.033*	0.038[a]
II. Connectedness					
Pretest	5.707	0.207	(5.277, 6.136)		
Posttest	5.812	0.203	(5.395, 6.236)		
Difference	-0.022	0.212	(-0.461, 0.418)	0.384	0.063
III. Costs					
Pretest	3.942	0.222	(3.481, 4.403)		
Posttest	3.920	0.248	(3.406, 4.435)		
Difference	-0.022	0.212	(-0.461, 0.418)	0.919	0.088
IV. Awareness					
Pretest	6.253	0.121	(6.002, 6.505)		
Posttest	6.344	0.107	(6.121, 6.568)		
Difference	0.091	0.081	(-0.078, 0.260)	0.275	0.050
V. Benefits					
Pretest	5.913	0.111	(5.684, 6.143)		
Posttest	6.130	0.099	(5.925, 6.336)		
Difference	0.217	0.085	(0.041, 0.394)	0.018*	0.025[a]
VI. Seriousness					
Pretest	5.157	0.221	(4.698, 5.615)		
Posttest	5.504	0.215	(5.059, 5.950)		
Difference	0.348	0.133	(0.072, 0.624)	0.016*	0.013
VII. Career Benefits					
Pretest	5.044	0.218	(4.592, 4.495)		
Posttest	5.196	0.251	(4.675, 5.716)		
Difference	0.152	0.195	(-0.252, 0.556)	0.443	0.075
VIII. Intentions[b]					
Pretest	5.630	0.189	(5.238, 6.023)		
Posttest	5.630	0.148	(5.323, 5.938)		
Difference	0.000	0.113	(-0.235, 0.235)	1.000	0.100
Score Sum					
Pretest	249.4	5.355	(238.2, 260.5)		
Posttest	256.5	4.936	(246.3, 266.8)		
Difference	7.2	2.571	(1.8,12.5)	0.011[c]	------

[a] Denotes a B-H critical value that is larger than the associated *p*-value

[b] Only two of the three items in the Intentions factor were administered with Likert scale responses

[c] Denotes a paired *t*-test *p*-value < 0.05. The B-H method was not considered using paired differences in the posttest and pretest score sums

* Denotes a paired *t*-test *p*-value < 0.05 and a significant result based on the Benjamini-Hochberg (B-H) method

The open-ended responses to the final survey question about pursuing future community service were broken up into the four main categories shown in Table 4. In both administrations of the survey, 21 students answered this question and results were similar.

On the first survey, one student eloquently added to their affirmative response that they would participate in community service within the next year by writing “Service provides an opportunity to gain a new perspective on certain matters and situations. I also personally believe that community service is food for the souls of those helping and being helped.” This quote, along with the high number of students that believed even at the beginning of the semester that they would participate in future

service, is evidence that community service is important to many students. Additionally, students often understand that benefits are not only for those on the receiving end, but also for individuals who provide service.

Table 4. Responses to the item "Would you seek out an opportunity to do community service in the next year?"

Category	Preproject Frequency	Postproject Frequency
Already doing community service.	3	2
Maybe	2	0
Yes	1	4
Yes, if time permitted or Yes, if opportunities were available.	15	15

5.2. RESULTS FROM PROJECT REFLECTION ASSIGNMENTS

This section addresses responses to numerous prompts from the reflection assignments. The question prompts addressed in reflections one through three are available in the Appendix (22, 23, and 23 submissions respectively).

All three reflection assignments had a prompt related to the difficulties or challenges that the group was facing or had faced in the SL project. A category was generated for any response that was present in multiple reflections within the same assignment. Table 5 shows themes and the number of students that wrote about the associated challenge in each assignment. Multiple groups in all three reflection assignments mentioned challenges with contacting or communicating with the organization contact person and entering written survey responses manually. Although a couple of students wrote that the process of entering data was tedious, in most cases the issue was in interpreting responses. Multiple students recalled that two individuals had filled out one hard copy of a survey, so there was no way to tell how the question responses from one item to the next matched up.

Table 5. Categories for difficulties or challenges faced in the SL project

Category	Frequency (Reflection 1)	Frequency (Reflection 2)	Frequency (Reflection 3)
Issues with group dynamics	-	-	7
Issues with survey that was administered	-	2	-
Difficulty in finding group meeting times	3	-	7
Communicating with partner	2	5	6
Question wording and/or survey challenges	-	-	5
Collecting enough responses or enough responses from the appropriate audience	16	-	4
Project time commitment	-	3	4
Difficulties in entering responses from written responses or in-person interviews	2	8	4
Combining multiple versions of the survey	-	-	3
Technical difficulties with SAS or Google Forms	-	-	3
Deciding on analyses and/or SAS code	-	4	2

In the first and second reflection assignments, students discussed their personal reactions to working with their community partner or to working on their SL project. Table 6 displays the number of positive and negative responses for each of the three reflections. Positive responses included statements about enjoying the project, thinking it was a good experience, feeling that the project was rewarding, or believing the project could have a positive impact. In all three negative responses from reflection two, students wrote about communication difficulties with the community partner contact.

The following is an example of a response that was not labeled as either positive or negative, but indicates that the process of developing a survey is a beneficial learning experience: "I did not realize

how much detail should be put into the wording of questions. For example, when creating scaled questions, I did not think of the fact that not everyone has the same definition of the word 'frequently,' therefore our results may not have been accurate."

Table 6. Categories of responses for the item where students were asked about their personal reactions to working with their community partner or to working on their project

Category	Frequency (Reflection 1)	Frequency (Reflection 2)	Frequency (Reflection 3)
Positive response	15	17	23
Negative response	0	3	0
Neither positive or negative response	4	0	0
No response	4	3	0

Students answered a prompt in the second reflection assignment about what they felt they had learned so far from the SL project. The final reflection included separate prompts about knowledge and experience gained that is statistical and non-statistical in nature. Table 7 provides an overview of student responses for these question items. The table displays responses provided by more than one student in a single assignment.

Table 7. Categories of responses related to what students felt they had learned or gained

Category	General learning (Reflection 2)	Statistical learning (Reflection 3)	Non-statistical learning (Reflection 3)
Information on survey construction and/or the importance of question wording	11	10	2
How time consuming it is to generate a survey or how much preplannin is required before data collection begins	7	-	-
Information about community partner	3	-	1
Refined or learned new statistical computing skills	3	9	-
Practice with chi-squared hypothesis tests	-	5	-
Experience in professional communication or communicating with non-statisticians	-	-	7
Better ability to work with others	-	-	6
Experience working with a client	-	-	4

The results in Table 7 show that two students believed survey construction knowledge was non-statistical in nature. One student demonstrated how they learned about what is involved in the data collection process by writing

> Before working on this project, I thought putting together the survey was the easier part, and analyzing the responses was where the majority of the work came in. Now, after a thorough drafting and revision process of the survey, I now understand how important it is to put in significant time upfront in carefully creating the survey.

The number of prompts in the third reflection assignment was equivalent to the combined number of prompts in the first two reflection assignments. The remaining portion of this section discusses results observed in the final reflection assignment. Students answered the question "What did you like and/or dislike about your service-learning project experience?" as part of the final reflection assignment. Tables 8 and 9 display response categories related to likes and dislikes, respectively. Again, categories in these tables represent those that had at least two student responses. Somewhat surprisingly there are only four different categories in Table 9. One student, whose response was dissimilar to any other dislikes mentioned, stated that

My only dislike in the project stemmed from how different it was from any project I have previously done because it required so many decisions to be made from the group because there were less specific guidelines for the report than I am typically used to.

Table 8: Reflection 3 categories for what students liked about the project

Category	Frequency
Helping the community	4
Working with an outside organization	4
Collaborating with group	4
Seeing a real-life application of statistics	3
Visiting the community partner on-site	2
Presenting to the community partner	2
Having project work time during class	2

Table 9: Reflection 3 categories for what students disliked about the project

Category	Frequency
Communication issues with partner	4
Time management issues or lack of time	3
Lack of in-person interaction with community partner	2
Difficulty in deciphering written responses	2

Students provided recommendations in their third reflection about how the SL project assignment could be improved. Table 10 shows themes present in more than one student's reflection. The most common response was to have more community partners. Three students stated that it would be easier if there was only one group working with each partner and one student responded that if there were additional options for community partners, then students would be more likely to work with an organization that they are passionate about. One student suggested that each group submit a time log at multiple points throughout the semester so that the instructor could be more aware of what each group was doing and how much time they had put into the project.

Table 10: Reflection 3 categories for ways to improve the SL project in the future

Category	Frequency
Have more community partners	5
Assign groups earlier	4
Make group sizes smaller	3
Require students to visit the partnering organization or have more direct contact with the community partner contacts	2

In Reflection 3, respondents offered a large amount of advice to students who work on a similar SL project in the future. The most common suggestion was related to starting and/or completing the survey as soon as possible, whereas the second most common piece of advice was to interact more with the community partner. One student again stated that all students should visit the community partner organization. Table 11 shows any piece of advice that was mentioned by multiple students.

When asked whether students would rather pursue an SL project or non-SL project in the future, eighteen students preferred an SL project, two students preferred a non-SL project, and three students either did not address this item or were unclear in their response. A student who favored a non-SL project stated "I would have gotten more out of the project if I didn't have to spend so much time organizing with someone outside of the school." Another student felt that there would be more time to analyze the data and write the report if the survey did not have to be approved by the community partner.

Table 11. Categories of responses for advice that students would give to future students pursuing a similar SL project

Category	Frequency
Start working on the survey as soon as possible and/or get the survey out as soon as possible	7
Interact a lot with the community partner	6
Stay proactive	5
Understand clearly the purpose of the survey and what the community partner wants	4
Focus on wording of survey questions	4
Keep track of who is doing what	4
Have a strong understanding of the values of the community organization	3
Obtain responses from a wide demographic	3
Understand target audience	2

As a side note, I became more aware of what statistical computing skills students lacked when data were not provided in the form of a tidy data set, where rows represent observations and columns represent variables (Wickham, 2014). Tidy data sets are often available when new course material is being covered, and students may not have experience tidying data outside of a project setting.

6. DISCUSSION

6.1. HIGHLIGHTS OF CSAS RESULTS AND STUDENT REFLECTION COMMENTS

The posttest administration of the CSAS showed significantly higher overall sum scores compared to those from before the SL project was assigned. Test results also indicated that three of the eight factors from the CSAS had increased significantly in the posttest based on both the B-H method and the unadjusted *p*-values. These factors are Normative Helping Attitudes, Benefits, and Seriousness. Results of the current study can be compared to those from research conducted by Coe et al. (2015), with 56 participants, which showed a significant increase in Normative Helping Attitudes, Benefits, Intentions, Career Benefits, and Connectedness.

Although data from the present study showed no difference in the Intentions subscale, perhaps this is not surprising, because many students at the university where the study took place are already active in volunteering. Although results showed slightly higher posttest scores for the Career Benefits scale of the CSAS, this increase was not significant. However, numerous students wrote about how the project experience could be put on their resume or be a good talking point at an interview. One reason that the Connectedness scale may not have increased significantly is because not all students had an on-site visit with the community partner, and instead relied on meeting the partner at the university.

In written reflections, numerous students mentioned issues communicating with their community partner and/or that they should have communicated more with their community partner. Additionally, some students expressed frustration that they did not fully understand what the community partner wanted in terms of statistical results. Although it may be frustrating for students to not receive specific information on what to accomplish from an instructor, this does help students to have a true consulting experience where the client and statistician must communicate frequently and clearly, and the consultant must ask appropriate questions to figure out what results would be informative for the client. Additionally, although statistics instructors may convey the importance of communication with clients, perhaps this still is not emphasized enough.

Overall there is a lot of evidence that students enjoyed the project and appreciated the learning that came with it. A primary indication of this is given in Table 8, which shows a large variety of positive personal reactions related to the project that students provided in the final reflection assignment. The third reflection also demonstrated that most students preferred an SL project over a non-SL project. Reasons for preferring an SL project included the potential to help the community, being able to use statistics in a real-life situation, and receiving a positive reaction from the community partner. Also, multiple students wrote that an SL project increases motivation towards the project, holds everyone to

a higher standard, is different from a non-SL project, is more interesting than a non-SL project, and is more rewarding.

It is very evident that students felt good about helping their community partner and the community. One student wrote that they preferred an SL project because "it is a change of pace & benefits more than my grade & there is a positive reaction from class and partners." Students also seemed to realize that the work they did was very valuable. One demonstration of this is when a student wrote that they were "surprised that a nationally known organization would trust a University statistics class to conduct survey research for them."

6.2 INSTRUCTOR RECOMMENDATIONS

For instructors using the SL project discussed in this paper or something similar, there are several things to consider before the course begins. Finding clients whose project goals fit well within the scope of the course is vital, so suitable community partners should have an interest in having survey data collected and analyzed. Fortunately, there is a Center for Service Learning and Community Engagement at the institution where the study took place, which helps in connecting community partners with faculty interested in integrating SL into their courses. If an on-campus SL office or center is not available, one option to locate community partners is for an instructor to contact non-profit establishments directly. It could be helpful to talk to colleagues who may be local to the area, as they may have much better information on local organizations that may be interested in collaborating with student groups. It is recommended that organizations be contacted at least a couple of months before the course starts, as multiple meetings or conversations between the instructor and the community organization may be necessary to see if a project would be a good fit and to obtain sufficient information on project goals. Information on steps to acquire and cultivate SL partnerships is provided by Jacoby (2015).

Potential projects should only be considered if it is reasonable for students to complete the project in the semester, quarter, or other amount of time that is available. Depending on the SL project, confidentiality regarding client information may be necessary. It is recommended that faculty members discuss this with clients before the projects begin. Some community partners could request that statements of confidentiality be signed by individuals involved in the projects. In the process of developing project directions, instructors may want to consider making an on-site visit a mandatory part of the project. This is supported by the numerous students who stated that the experience of visiting their community partner on-site was very beneficial.

When the project is assigned during class, an instructor can emphasize certain things to enhance students' project experience. For example, as most students have not had experience working with clients, it is helpful to let them know that frequent and meaningful communication with a community partner is especially beneficial at the beginning stages of a project (Leiderman, Furco, Zapf, & Goss, 2002). Students should learn as much as they can about the community organization they are working with and the goals of the community partner. A community partner might be very general about project goals, especially at the beginning of a project. This could be challenging for students, who are often accustomed to answering specifically stated questions. As statistical consultants for a client organization, students can be encouraged to ask questions to help their community client decide what results or information would be meaningful. This would also facilitate a better understanding of the project. As students do not always know exactly what questions to ask, the instructor could try a role-playing activity where they pretend to be a client with a hypothetical project, and the class can discuss a list of questions that a statistician should ask the client in the scenario. More detailed facets of statistical consulting, which students may not have previous experience with, are provided by Derr (2000).

Students also need to understand from the initial project assignment that it is very important to stay proactive with the project throughout the semester. This recommendation is also strongly supported by the student reflection comments. Meeting periodically with the community partner contact person is helpful. Students can even set up tentative future meetings with this representative, not only to hold students accountable for steady progress, but also to encourage further communication. Lastly, students should realize that they may not always receive quick feedback from their community partner contact person, who likely has numerous obligations.

The early stages of the project when students work on survey development can be challenging, but with proper instructor guidance, students can avoid pitfalls. In my class, multiple student groups originally wanted to include some open-ended survey questions. However, I warned students of the lengthy time commitment required to categorize and summarize responses from open-ended questions. Also, students generated many questions of the type "check all that apply," which in many cases were added to survey drafts after using too many open-ended questions was discouraged. Although "check all that apply" questions are appropriate in many cases, an option that could be much more informative is to ask respondents either to rank the available response options or to rate each option using a Likert scale. Instructors should provide sufficient examples to show that different types of questions are preferred in different circumstances.

Groups that wanted to collect data electronically developed the digital version of their survey once they had the survey question items finalized. Unfortunately, many groups had errors when trying to transfer the hard copy survey questions into an online survey format. Problems encountered included spelling errors and failing to make some question items required. Also, students often failed to appropriately incorporate skip logic, which is the process by which a digital survey advances to a specific question based on the response to an earlier question. All students whose group relies on results from a digital survey should be encouraged to check and recheck the digital survey multiple times so that errors do not arise from inadequate testing. Students may be less likely to introduce errors in an online version of their survey if point deductions occur when the instructor detects digital survey issues. Although I gave students many comments on their digital survey submission, this form of the survey was not graded. However, in the future, I will score these digital surveys and include them as part of the overall project grade.

Besides struggling with generating a correct digital form of a survey, time allocation was also difficult for many students. They had a hard time determining when to stop data collection to focus on obtaining statistical results and writing their final report. This challenge can still be present if discussion of project directions occurs within the first two weeks of the course. To prevent a time crunch at the end of the semester, instructors can assign one or more mid-project assignments where students must summarize the survey results that have been collected up until a specified date. Even if students have only had time to obtain ten or twenty responses, having this type of intermediary analysis assignment will force students to think more about how to analyze the data. Additionally, if they use code-based software, they will already have some of the coding completed.

Without careful planning, instructors administering a survey-based SL project can also face time pressure. My perception is that the overall amount of instructor oversight for an SL project is often greater compared to a non-SL project. Students carrying out the SL project seem to ask more questions and require more instructor input compared to a non-SL project. Instructors may want to provide more supervision to all student groups, whether they have questions or not, because the students are representing their college or university to an outside entity. Project stages where instructor guidance was needed included development of the surveys, testing digital versions of the surveys, deciding on appropriate analyses, and writing statistical software code. Not all students doing the SL project had the same amount of statistical computing knowledge, and I noticed that students who had previously taken a statistical computing course were in a better position to analyze the data than those who had not. If statistical software is available in a course where an SL statistics project is implemented, one suggestion is to review some common procedures or basic statistical software code before students get to the data analysis portion of the project. Lastly, it can save time if questions from one group are answered in front of the entire class, as different groups often have similar questions.

7. CONCLUSION

The SL project discussed in this paper has numerous benefits, although one that was not mentioned earlier is exposure to multiple phases of an analysis. The different steps in an analysis, which are crucial to a solid statistics educational experience, incorporate data collection, data cleaning, selecting appropriate methods, and communicating these results (Hardin et al., 2015). Giving students an opportunity to analyze real data with several hundred observations and dozens of columns also supports the recommendation of Horton (2015, p. 142), who believes that "students need experience analyzing larger, real world datasets."

Gordon (2004, p. 43) states that "Society endorses statistical information as scientific and useful, but to some students, statistics is neither relevant nor important." Although unrelated to the service side of the SL project, one of the main aims in assigning a consulting-based statistics project where each student group works with a client is so that students can directly observe the straightforward application and importance of statistics. This is possibly even more important in a class where students may not be statistics majors or minors. Although students in a Survey Sampling course completed the SL project discussed, this assignment or similar projects can also be utilized in other statistics courses, including those within other disciplines.

Analysis of the CSAS data indicated significant improvement in student attitudes towards service. The subscales showing improvement were Normative Helping Attitudes, Benefits, and Seriousness. Other research using the same survey instrument has also indicated improved attitudes. Based on a CSAS posttest and a retrospective pretest several weeks later, the results Coe et al. (2015) revealed significant improvement in five of the eight subscales (all except Awareness, Costs, and Seriousness). Baueret al. (2007) also administered the CSAS, but a significant improvement in student responses was only observed in the Career Benefits subscale. Although Moely, McFarland, Miron, Mercer, and Ilustre (2002) did not use the CSAS, they did compare SL and non-SL students using another questionnaire, and results indicated that only the SL students demonstrated improvement in attitudes towards community involvement.

Many student reflections demonstrated feelings of internal satisfaction about helping the community. These results align with those of Wells (2006), who provides evidence that students believe SL to be gratifying. Students also provided comments stating that the SL project was a learning experience, although it was not always clear whether the learning that took place was statistical in nature. One student emphasized internal satisfaction and learning benefits by writing "This project felt like it was about more than just our grade, which I liked because I felt like I was both learning and helping a company, instead of just analyzing data for classroom purposes." In some instances, students made it clear that non-statistical learning took place. An example of this type of response is "I didn't think I'd learn so much about the organization." Further proof of student perceptions of learning is seen by the comment that "The knowledge that I have gained from this project has been immeasurable."

Study results indicating that most students would pursue an SL project in the future could be taken as supportive evidence that students will engage as active citizens postcollege. Research by Eyler, Giles, and Schmeide (1996) also supports SL as an avenue to active citizenship. For the many reasons discussed here, it is strongly recommended that students be involved in SL, which benefits both the community and students. My hope is that SL statistics projects not only provide an avenue for students to apply statistics in a real-world setting, but that they also help students to become more informed and responsible citizens.

Limitations of this study include lack of a control group and a relatively small sample size. The inclusion of a control group would allow for direct comparisons of attitude changes and engagement levels between students pursing SL projects and those pursuing similar non-SL projects. This is especially important in classes where activities or discussions about addressing community problems could impact attitudes towards service, even if students do not taking part in an SL project. A high proportion of study participants had previous volunteer experience and planned on carrying out future service. Generalizing study results to college students in general is limiting because other students may have less service experience and be less likely to volunteer in the future. Another study limitation is that students submitted reflections for a grade, so it is possible that some students may have written responses that they thought their professor would want to read. However, the reflections themselves were only a small part of the overall course grade.

Future research could benefit from the use of other instruments such as the Civic Attitudes and Skills Questionnaire, which measures service-learning attitudes of students (Moely et al., 2002; Moely, Mercer, Ilustre, Miron, & McFarland, 2002). It could also be very informative to the instructor and students for community partners to provide written feedback about their interactions with students, possible benefits that resulted from the partnership, and suggestions for similar future experiences. Revising some reflection prompts used in the present study could be beneficial. For example, one question in the third reflection asked students what they liked or disliked about the project. Some students answered one but not both parts of this question, making responses less informative. Another question asked what students told their friends about the project, but because many students had not

discussed the project with others outside of class, it would be useful to instead ask what students would say if they discussed the SL project with a friend. If possible, it would also be advantageous in future studies to include a control group by randomly assigning an SL or a non-SL project to each student in a course. This would allow paired comparisons to be examined from students pursuing both types of projects. Finally, in a study of this nature, or in a similar study involving SL in statistics, it would be beneficial to have participation from students at multiple different institutions. This could allow for comparisons between different types of institutions and a sufficient sample size to compare results between populations with different characteristics, such as individuals with and without previous service experience.

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APPENDIX

First Reflection Assignment

Please look carefully through the survey drafts on Moodle and then address the following dot point items in a written reflection using Times New Roman 12-point font with one inch margins. Your reflection should be organized and in paragraph form.

- Discuss the ways that the survey has changed and/or improved from the initial submitted survey to the draft survey your group worked on in class to the current version of the survey.
- Discuss your personal reactions to working with your community partner or to working on your project.
- What difficulties/challenges do you think you will face with this project?
- Do you feel comfortable with the current version of the survey? If not, please explain. Also, if you find any errors/issues with the current version of the survey, please notify me right away!
- Is there anything Dr. Doehler can do at this time to help you with this project?

Second Reflection Assignment

Please address the following dot point items in a written reflection using Times New Roman 12-point font with one inch margins. Your reflection should be organized and in paragraph form.

- Discuss whether you have any personal reactions to working with your community partner or to working on your project?
- What has your group done so far to collect survey responses?
- What difficulties and/or challenges have you recently faced with this project?
- Do you feel that you have learned anything from doing this project so far? If so, what do you think that you have learned?
- What do say when talking about this class project to your friends?
- Is there anything Dr. Doehler can do at this time to help you with this project?

Third Reflection Assignment

Please address the following dot point items in a written reflection using Times New Roman 12-point font with one inch margins. Your reflection should be organized and in paragraph form.

- What are your personal reactions to working on your service-learning project throughout the semester?
- What difficulties/challenges did you face throughout the semester with your service-learning project?
- Have your thoughts about this project changed during the semester? If so, please explain.
- Was your experience with this project different than what you originally thought it would be at the beginning of the semester? If so, please explain.
- What did you like and/or dislike about your service-learning project experience?
- Do you have any recommendations about how to improve this type of service-learning project for future students?
- Now that you have completed your group service-learning project, what advice would you give other students who are pursuing a similar type of service-learning project in the future?
- What would you do differently if you were to do this type of project again?
- If you had a choice to do a service-learning (SL) project or a non-SL project in the future, which one would you choose? Please explain your reasoning.
- What statistical knowledge or experience did you gain from this project?
- What non-statistical knowledge or experience did you gain from this project?