CASE STUDY: USING COVID-19 DATA IN A COMMUNITY-ENGAGED ELEMENTARY STATISTICS CLASS

Jana L. Asher and Amanda Goodrick
Slippery Rock University of Pennsylvania, United States of America
jana.asher@sru.edu

Because it utilizes a combination of high impact practices—a collaborative project, service learning, and undergraduate research—the use of a community-engaged framework within an undergraduate introductory statistics course can improve educational outcomes for distance learners. During the Fall of 2020, because the usual community-engaged approach of having students partner with a community organization to collect and analyze data was not feasible, we used a recently released dataset on coping mechanisms during the COVID-19 pandemic. Students participated in an analysis of those data to inform policymaking within the university regarding support for students. Similar outcomes in terms of improved understanding of and attitudes toward statistics were achieved through this approach as had been achieved through community-engaged projects in previous semesters.

INTRODUCTION

Community-engaged (service) learning—that is, the utilization of field-based experiences in partnership with community organizations as one aspect of the educational experience offered by a course—is an understood high-impact practice in the undergraduate setting (Kuh 2008). At Slippery Rock University (SRU), the Office for Community-Engaged Learning (OCEL) is tasked with training faculty on the characteristics of community-engaged learning, designating specific courses as service-learning courses, providing funding to support designated courses, and monitoring civics-related learning outcomes achieved through designated courses.

Instructors at SRU must demonstrate competency in the OCEL's service-learning taxonomy, derived from Hatcher et al. (2016), before their coursework can be service-learning designated. This taxonomy contains six attributes:

1) Reciprocal partnership between campus and community are present in both community activities and course design.
2) Activities based within the community are integrated into the academic content and course design.
3) Civic learning through knowledge acquisition, attitudinal transformation, and/or skills practice are integrated into student learning.
4) Diversity of interactions and dialog across difference are incorporated regularly into the course.
5) Critical reflection on the community activities and their connection to the course learning goals is integrated into student learning.
6) Assessment of achievement of service-learning related outcomes and of course quality is used to allow for continuous course improvement.

Currently, two members of the SRU Department of Mathematics and Statistics have been designated as service-learning practitioners; multiple sections of our undergraduate elementary statistics course have been taught as service-learning courses commencing with the Fall 2019 semester. To date, the number of participating students has ranged from 35 to over 100, depending on the semester.

Service-Learning Project Format

Although the community partner is different in each semester, the general format of the service-learning project involves collaboration with the partner in the design of a questionnaire regarding community research required or desired by that partner. Students in the course are responsible for the administration of the survey, data entry (if required), analysis of the resulting data, and presentation of the results of the survey to the partner during their final examination period. Because the students are new to statistical inference, the instructor guides the analysis through the creation of multiple research questions, each centered around the responses to one or two survey questions. Typically, each research question requires either the calculation of confidence intervals for the responses to a specific survey question, or the completion of two-population hypothesis test regarding the responses to a specific survey question using demographic characteristics of interest to the community partner. Together, the research questions span all survey questions. Each student

In: R Helenius, E Falck (Eds.), *Statistics Education in the Era of Data Science*
Proceedings of the Satellite conference of the International Association for Statistical Education (IASE),
Aug-Sept 2021, Online conference. iase-web.org/Conference_Proceedings.php

creates a paper and presentation for one of the research questions; when possible, students are given the opportunity to choose a research question of interest to them. When the final presentations are made, each student is given one to three minutes to discuss their research question. Together, they provide a complete analysis of the survey data.

Students are given multiple opportunities over the course of the semester to reflect on their experience collecting and analyzing data as part of the service-learning project. However, their strongest and most impactful reflection occurs at the end of the course as part of the final paper for the semester. Students are asked to write a reflection to answer the following three sets of questions:

1) This project was done to help <INSERT COMMUNITY ORGANIZATION NAME HERE> to <INSERT COMMUNITY ORGANIZATION GOAL HERE>. Think about your role in this process. What did you learn about the public purpose of the field of statistics?
2) You will be asked to view your classmates' presentations over the final exam week. Do you understand what your classmates have presented? Does this surprise you?
3) Is what you learned in this course of use to you in your career and your life? Did your opinion about statistics change because of this course? How?

The first set of reflection questions, regarding the public purpose of statistics, relates to attribute three of the OCEL taxonomy. Students are introduced to the concept of statistics providing a foundation for the healthy functioning of democracy and society in the syllabus for the course, and that concept is reinforced throughout the semester. The responses students provide to this set of reflection questions allow for the assessment of the efficacy of the civic learning elements of the course. The second set of reflection questions addresses attribute two of the OCEL taxonomy, as it allows the student to determine how their participation in the service-learning has cemented their knowledge of the course material. The final set of reflection questions allows the assessment of student attitudes toward statistics as a field as the course is completed.

The Impact of COVID-19 and the Spring 2020 and Fall 2020 Service-Learning Projects

Despite an interruption in face-to-face instruction during the Spring 2020 semester, our service-learning designated sections were able to complete a service-learning project centered around the creation of a white paper arguing that the Pennsylvania State System of Higher Education (PASSHE) should commit to a zero-carbon footprint across all fourteen campuses (Asher et al., 2020). The process by which the project was converted to be achievable in a distance learning environment is outlined in Asher (2020). Students were able to design the questionnaire for the survey, but no face-to-face data collection occurred. Because we were unable to meet directly with our community partners during our final exam period, students instead prepared voice-over-PowerPoint presentations regarding their research questions. The instructor then combined those presentations into a single video file.

For the Fall 2020 semester, the planned project was a count of local area homeless youth in partnership with the community network Continuum of Care, a coalition of governmental and non-governmental organizations dedicated to ending homelessness in Western Pennsylvania. Because no face-to-face interactions would be allowed due to COVID-19, a snowball sampling (Johnson 2014) process was attempted but failed. Serendipitously, in October of 2020 Professor Guanglei Hong of the University of Chicago announced a newly available dataset centered around coping mechanisms and mental health during the COVID-19 pandemic. The data were collected by her undergraduate Human Development Research Designs students during the Spring 2020 semester and prepared for public release during Summer 2020. By October, a quantitative dataset, as well as qualitative interview data and a user's manual, had been posted to voices.uchicago.edu/humdevcovid/. At SRU, we quickly determined that a new service-learning project for the students could be created using these data; our community partner became the SRU administration, who could use the results of our work to create policy regarding supportive services for students during the ongoing pandemic. Students were informed of the failure of the snowball sampling effort and provided with research questions related to the newly acquired dataset. Using those data, students prepared their final voice-over-PowerPoint presentations and papers.

Assessing Student Outcomes of Service-Learning Across the Two Semesters

A small body of literature currently exists regarding community-engaged learning in elementary statistics classes. In the authors' experience, the best review of existing research on community engagement in statistics coursework is provided by Doehler (2018), and we refer the reader to this resource for a complete analysis of the current literature. However, to our knowledge, no study has been completed as to the effect of excluding a data collection step within a service-learning project on student learning and attitude in a service-learning elementary statistics course.

This paper will use pre- and post-assessment data related to statistical concepts, as well as student reflections given in their final papers, to compare the educational outcomes of the Spring 2020 SRU Service-Learning Elementary Statistics cohort to the Fall 2020 SRU Service-Learning Elementary Statistics cohort.

METHOD

Student learning of statistical concepts is assessed across all elementary statistics classes at SRU through pre- and post-assessment surveys based on the fourth version of the Comprehensive Assessment of Outcomes in Statistics Test described in delMas et al. (2007). Individual faculty are given the option to assign these surveys as homework (for participation credit) or as extra credit assignments. Students are asked to skip questions they do not know how to respond to during the pre-assessment. To score the assessments for the analysis presented here, each correct response was assigned one point, yielding a possible score of zero to forty points. The differences between pre- and post-assessment scores were then compared across the two semesters.

To assess student attitudes toward statistics, student reflections were coded along two dimensions: understanding of the public purpose of statistics and current level of appreciation of statistics. Along the first dimension, students were given one point if they recognized the purpose of the service-learning project for the community partner, one point if they were able to articulate how statistics contributes to the development of public policy, and one point if they were able to articulate the importance of statistics across multiple dimensions of society (e.g., for public policy, for scientific research, across different occupational fields, etc.), yielding a total score of zero to three points. Along the second dimension, students were given a point for indicating that their appreciation of the field of statistics had grown due to the class/service-learning project (whether they "liked" statistics), a point for indicating positive feelings for statistics, and a point if they indicated the belief that statistics will benefit their future career or life, also yielding a total score of zero to three points. Student scores were then compared across the two semesters.

RESULTS

The results of the analysis of student learning of statistical concepts are given in Table 1. Please note that the Spring 2020 cohort started with greater conceptual knowledge, scoring two points higher on average during the pre-assessment. Although the post-assessment average was higher for the Spring 2020 cohort than the Fall 2020 cohort, the average post- minus pre-assessment score is over two times larger for the Fall 2020 cohort (0.48) than the Spring 2020 cohort (0.21). Across both cohorts and both assessments, the standard deviation hovers around 3-5 points.

Table 1. Results of Analysis of Pre-/Post-Assessment for the Spring 2020 and Fall 2020 semesters

	Post-Assessment Average (Standard Deviation)	Pre-Assessment Average (Standard Deviation)	Average Difference Post-Pre (Standard Deviation)
Spring 2020 (n=19)	17.84 (3.94)	17.63 (4.65)	0.21 (4.37)
Fall 2020 (n=27)	16.00 (4.53)	15.52 (3.39)	0.48 (3.60)

Table 2. Results of Analysis of Final Reflections for the Spring 2020 and Fall 2020 semesters

Understands the Public Purpose of Statistics	Spring 2020 (n=23)	Fall 2020 (n=85)	Difference	Statistics Attitude	Spring 2020 (n=23)	Fall 2020 (n=85)	Difference
In the service-learning project	87%	87%	0%	Appreciates statistics more after class/project	74%	80%	-6%
For societal good	43%	40%	3%	Expresses positive feelings about statistics	87%	78%	9%
Across multiple dimensions of society	9%	12%	-3%	Believes statistics will benefit future career	70%	65%	5%
Average	1.4	1.4	0.0	Average	2.3	2.2	0.1
Standard Deviation	0.84	0.85	0.01	Standard Deviation	0.88	0.88	0.00

Table 2 breaks down the analysis of the reflections. On the left-hand side, the three measures of understanding of the public purpose of statistics are remarkably similar across the two cohorts of students. The same percentage of students in each cohort recognized the importance of their service-learning project for the goals of our community partner, and while three percent more students in the spring semester were able to articulate the role of statistics in the development of sound public policy, three percent more students in the fall semester were able to articulate the need for statistics across multiple dimensions of society. The average score for understanding the public purpose of statistics was identical across the two cohorts, and the standard deviation was virtually identical.

On the right-hand side, the measures of attitudes toward statistics are not as clear-cut. While the students in the Fall 2020 cohort were more likely to express increased appreciation of statistics due to the class and service-learning project, they were less likely to express general positive feelings about statistics or to believe that statistics will be benefit their future career. However, the average score for attitudes toward statistics was only 0.1 different between the two cohorts, and the standard deviations are the same.

DISCUSSION

The goal of this paper is to show that the use of a pre-existing (albeit new) dataset, instead of engaging in a full data collection process, can yield similar educational outcomes in community-engaged service-learning elementary statistics classes. To do this, we are comparing the outcomes of our service-learning elementary statistics from the Spring 2020 and Fall 2020 semesters. In many ways, these two cohorts experienced very similar courses; the curriculum, homework assignments, exam formats, laboratories, lectures, textbook, and professor were the same across the two sections. However, there are several limitations to this comparison as well, the biggest of which is that students were not randomly selected into one of the two semesters. There were differences between the two student cohorts, as evidenced by the difference in pre-assessment scores between them. It is plausible that the difference seen between the two groups in terms of attitudes towards statistics is correlated with this difference in pre-assessment scores.

Despite this limitation, and perhaps notably considering it, this study provides evidence that similar learning outcomes related to statistical concepts and understanding of the public purpose of statistics can be obtained without a data collection step. Further research—ideally utilizing a true experimental design and a larger sample size—would be required to reach more definitive conclusions; however, the results of this study are very promising.

The importance of this study lies in the complexity of teaching a community-engaged elementary statistics class well. While there are multiple benefits for students provided through community-engaged learning, the benefits for instructors do not extend to a smaller workload. Administering a survey through a community-engaged class can be more difficult and time consuming than running a survey as a statistical consultant, an experience with which the authors are intimately familiar. If steps in the process can be removed without detriment to the learning objectives of the

course, the need for the faculty members to have specialized knowledge in questionnaire design and survey methods becomes less important. Inasmuch as this increases the probability that faculty will embrace community-engaged teaching in their statistics classes, student outcomes will improve in their statistics classes and their university careers.

REFERENCES

Asher, J. (2020). Saving our Community-Engaged Elementary Statistics Course: A Case Study on Preserving High-Impact Practice during the COVID-19 Crisis. In D. DiMarco, J. T. Hilton, & T. Ruppert (Eds.), *Pandemic University: Teaching and Learning in a Global Crisis* (pp. 77-88). Slippery Rock, PA: Slippery Rock University.

Asher, J., Brungard, A., Damato, N., Scanlon, P., Snow, J., & Wolf, T. (Eds.). (2020). *Listen to Your Students: PASSHE Should Lead in Higher Education Climate Change Response.*

DelMas, G., Joan, G., Ooms, A., & Chance, B. (2007). Assessing Students' Conceptual Understanding After a First Course in Statistics. *Statistics education research journal*, 6(2).

Doehler, K. (2018). Successful Service-Learning for Statistics Students Studying Survey Sampling. *Statistics Education Research Journal*, 17(2), 82-103.

Hatcher, J. A., Bringle, R. G., & Hahn, T. W. (Eds.). (2016). *Research on student civic outcomes in service learning: Conceptual frameworks and methods (Vol. 3)*. Stylus Publishing, LLC.

Johnson, T. P. (2014). Snowball sampling: introduction. *Wiley StatsRef: Statistics Reference Online*.

Kuh, G.D. (2008). *High-impact educational practices: What they are, who has access to them, and why they matter*. Washington, DC: Association of American Colleges and Universities.