

## SERVICE-LEARNING FOR STATISTICS STUDENTS IN THE GLOBAL HEALTH ARENA

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*Students work with World Health Organization (WHO) researchers contributing to their biostatistics knowledge and WHO's mission. Two projects involving undergraduates and WHO collaborators are described briefly. A primary charge of WHO is to evaluate the global burden of disease (GBD). Students on this first project explored theoretical scenarios to learn about potential variability in GBD estimates. Students on the second project analyzed a massive dataset from the World Health Survey to describe global trends in tobacco use. Each project explored important issues that may not have been considered without the extra assistance of the students. Every other year for the past six years, this program has demonstrated that undergraduates can contribute to the analysis of global health data.*

### BACKGROUND

This paper describes a service-learning program that integrates statistics education into the workplace where the workplace is the world, the World Health Organization (WHO). We begin by providing some background on the notion of service-learning, what it is and what it isn't. Some of the benefits of this approach are described. These ideas are in turn connected to the specific program involving the WHO. Following the program description, two different research projects performed by students are described in some detail. Both are quite different, yet both represent much of what we hope to have happen in a service-learning project in the workplace.

GAISE guidelines (<http://www.amstat.org/education/gaise/GAISECollege.htm>) are emphatic that statistics students use real data. You cannot get much more "real" than data used in a workplace where the results impact decisions and action affecting people all over the world. However a student in the workplace analyzing data is not necessarily a service-learning experience. As a participant in a session at the Joint Statistical Meetings in 2005, I learned from Eric Nordmoe's (2007) presentation what service-learning is not:

- Community service or co-curricular learning.
- A new name for internships.
- A guarantee of learning.
- A community-service add-on to a traditional course.

When speaking about service-learning in the workplace, the distinction between interns and students involved in student learning needs clarification. A professor can create learning environments to enhance learning when in the workplace. For example, students are required to read and discuss *Mountains Beyond Mountains*, Tracy Kidder's depiction of Dr. Paul Farmer's life (Kidder, 2003). At WHO, students come in contact with one approach to helping developing countries, Paul Farmer's approach is radically different. Strictly speaking, students would not need this context to function as well as they did at WHO. However, by constructing a situation where students question and struggle with their experiences and readings, where they are encouraged to discuss it, learning occurs that may not otherwise occur in an internship circumstance.

Nordmoe (2007) defined service-learning as:

*..a teaching and learning strategy that integrates meaningful community service with instruction and reflection to enrich the learning experience, teach civic responsibility, and strengthen communities.*

In her article on course design and assessment of service-learning courses, Hydorn (2007) describes factors which make for a good service-learning experience in statistics.

- Relevant community service.
- Improved understanding and appreciation of course content through critical reflection.
- Civic responsibility.
- Reciprocity where the student and the community both benefit from the service experience.

Students often spend a lot of time on self-selected projects that have no lasting value. In contrast, students are motivated to work extremely hard on service-learning projects and that is effort well spent, leaving results of lasting value at the workplace.

#### THE GENEVA PROGRAM

When thinking about workplace, we think big... the world is our workplace. Every other year 16 students from St. Olaf College travel to Geneva, Switzerland. St. Olaf College is a liberal arts college of about 3,000 students in Minnesota. Although St. Olaf is located in a rural area in north central U.S., many of the students travel abroad and global matters are not foreign to many of them. I came to St. Olaf after 7 years at the National Institutes of Health in Washington, D.C. where I worked with many domestic health problems. But as a student at Harvard School of Public Health, I had learned about the decidedly different distribution of disease around the globe. I wanted students to understand this and I wanted them to understand how valuable statistics are in global health. Coming from NIH where I was surrounded by doctoral level researchers, I had some doubts about what undergraduates could do. However the first January I was at St. Olaf, I was a mentor for the Mathematics Practicum. This program had students working on problems from off campus businesses and organizations. At the end of the month, I was astounded! The quality of the work the students performed was exceptional and they had been able to accomplish so much in such a brief period of time. It was the combination of my NIH experience and the amazing performance of the Mathematics Practicum students that convinced me that St. Olaf students were up to the challenge of going overseas and working with researchers at the WHO.

The course was designed with the following objectives in mind:

- Develop an awareness of the global burden of disease and contrast it to the US.
- Understand why good health statistics are needed.
- What is the state and context of global health statistics?
- Compute and interpret some basic health measures such as Global Burden of Disease.
- Carry out a data analysis project, present your findings and write up a report.

Two specific projects taken on in the past are presented below.

#### GLOBAL BURDEN OF DISEASE

Global Burden of Disease or GBD is not an idea any of the students had heard about prior to taking this course but most students become well acquainted with it by the month's end. Specific to the WHO but now used widely, global burden of disease (GBD) provides a "consistent and comparative description of the burden of diseases and injuries and risk factors that cause disease ...is an important input to health decision-making and planning." (WHO website).

Data from countries is often fragmented and incomplete and requires statistical modeling. GBDs provide a framework in which to construct measures as close to comparable as possible. In a paper that has been submitted for publication, the students confidently describe the objective of their study.

*Objective: Because vital registration and surveillance data on etiology-specific causes of death are frequently unavailable, incomplete, or inaccurate, statistical models are commonly used to estimate burden of diseases. Such estimates will depend not only on the variance in the*

*modelled data but also on the selection of the model structure and covariates selected for inclusion in the model. We illustrate the effects of failing to account for model uncertainty in the estimated global burden of rotavirus, a diarrheal disease that infects nearly all children globally before their fifth birthday.*

Two points are worth noting. First, the students have described their work in general terms recognizing that their results might be helpful in different but similar scenarios. They illustrate their results for a particular setting, rotavirus. As it turns out, there is a rotavirus vaccine on the horizon at the time of their work so there is intense interest in its prevalence. Second, the methodology they introduce, assessing uncertainty due to model selection is novel and cutting edge in this setting. Service-learning work has pushed students to learn about a disease, rotavirus, implement work they would not see in the usual undergraduate curriculum and see the potential for generalizing their work. Indeed, their training has introduced them to random-effects models but they have not seen it applied to meta analysis nor have they used Monte Carlo Methods for error estimation.

From the abstract:

*Conclusion: Measures of uncertainty capturing the variance in the data is only a portion of the overall uncertainty in an estimate. Uncertainty reflecting the choice of model(s) should be incorporated in presentations of disease burden results.*

And their paper provides the details to account for model uncertainty.

#### GLOBAL TRENDS IN TOBACCO USE

This second project involves the preparation and initial analysis of World Health Survey (WHS) tobacco data. The WHS was designed to provide a comprehensive database of health risk factors such as alcohol and tobacco use and exposure to environmental factors from which to assess and compare the health risk profiles of many of the world's developing countries. The potential uses included monitoring health systems, informing policy makers and informing programs aimed to reduce health risks.

Three issues related to this project are worth noting.

1. Students worked with data from 32 of the world's developing countries. Students needed to gain an understanding of the perspective of people from developing countries on health risks. These perspectives differed greatly from their peers in the U.S. This cross-cultural awareness emerged as their project progressed in a way that no reading assignment in a text could provide.
2. Despite the fact that there was interest in the tobacco trend data, there were not enough staff at WHO to analyze it at this time. It is surprising how many institutions have projects they would like to see done but suffer from insufficient staff or funds to see it through. These students were providing a service to the world community that would otherwise go unanswered or at least in this case for some time.
3. Work at WHO was not always glamorous. This project required hours of data cleaning and preparation. I was extremely impressed with the students' dedication. As a professor, I would never assign such demanding work. This tedious work was apparently not a deterrent. Two of the students on this project are nearly done with their doctorates in epidemiology.

To get an idea of what was involved, data was compiled on 184,878 respondents of which only 128,631 were complete from 32 countries. The students learned about dealing with missing data. They applied some of the biostatistical ideas they had studied in books such as standardization and incidence rates. Students became intrigued as the results were tallied. Some of

the findings were perplexing and while this happens for statisticians working with data in developed countries, the students realized that they were bound by some cultural limitations when interpreting results. For example, they were surprised to see the large gender gap in smoking. In speaking with WHO researchers they learned about the impact of social acceptability bias, the lack of economic access by so many women, and religious expectations.

#### REFLECTION & ASSESSMENT

Service-learning is defined as more than simply performing a needed analysis. Student “learning” comes in part from reflecting on their experiences in systematic way. On the WHO interim, reflection was an integral part of each day. Our first activity every morning was to have a “check in.” Every student was required to talk and no student was allowed to dominate the discussion. The topic could be some intellectual musing on yesterday’s experience or a report on a great new restaurant discovered. With so many different personalities, it is possible that a handful of students rarely would get heard. And initially some students found sharing with the group a little painful. But as the month progressed, it was clear that everyone was becoming more comfortable with the morning “check in.” As the comfort level rose, students tended to share deeper kinds of thinking with respect to the activities of the previous days. Establishing trust among all of the students was critical.

While many meaty issues came into the informal “check in” conversations, several activities were planned for the class period to promote reflection. In addition to the thought provoking conversations about Tracy Kidder’s *Mountains Beyond Mountains* and global public health, the students explore the controversial role of drugs in global public health from ethical issues related to clinical trials in developing countries to vaccine acceptability to the effects drug resistant TB. In addition to readings, they hear from public health professionals who at times take issue with the pharmaceutical industry and researchers from pharmaceutical companies have visited and shared their views with the students. Students also encounter the clash between the United Nations (UN) efforts and other Non-governmental Organizations (NGOs). The UN is the brunt of a lot of criticisms in many spheres and as part of the UN, WHO also is subject to similar criticism. The students struggle with ideas such as what is the best way to manage and deliver health care across the globe. They become aware of the fact that all of the 190 plus countries own and to some extent have a say in how things are administered in contrast to smaller more well endowed NGOs. An interesting contrast was a visit to the Red Cross where the students learned about their long history and dedication to helping those in need around the world. They learned about the Red Cross’s commitment to help in any circumstance without getting involved in the politics. This neutrality provided the Red Cross access in nearly any place where they were needed. To be neutral, the Red Cross does not report what they witness. We also visited Medecins sans Frontieres (MSF) (Doctors without Borders) in Geneva. Their practice is decidedly different from the Red Cross philosophy. MSF reports on what they observe which at times results in their prohibition in some circumstances. Which is the “best” way? By confronting these kinds of controversies, students struggle and develop a view of this world that is not black and white. The relevance to service-learning in the workplace is multifold. All of the professionals with whom the students worked were acutely aware of these issues. By exposing these issues to the students, they develop an understanding of the context in which the professionals are working. The students repeatedly came in contact with decisions and approaches to their work which were colored by this context.

#### STUDENT COMMENTS

This section could be subtitled “Or only things students could discover through service-learning in the workplace.” Excerpted from students’ journals:

##### *Comments on work on the WHS Tobacco Project*

“...I loved the project. Such a great opportunity to get to do real work with real numbers and to produce results that were going to be used for real programs... I emphasize real because so often as a student I feel like I am working on senseless, useless projects...no one knew how the results would turn out.”

*From a student analyzing vaccine data*

“...I also think the presentation brings up a good point. As statisticians we have to know the context of where the data is coming from...that is why statisticians can't just be number crunchers, we have to learn about the issues of the data that we are looking at (medical, cultural, etc.)...”

*Following a visit with Dr. Lara Wolfson, a statistician at WHO*

“...how exciting that the Gates Foundation donated \$750 million to help the vaccination cause!...It's encouraging to know that a statistician is one of the key people in getting that money. You could really feel like you're helping. It's also amazing the scope of jobs that Lara does – statistician, consultant, policy advisor, etc....Yet another example of the many ways a statistician can contribute to global health.”

*Following Dr. Claudia Stein's farewell talk*

“...Dr. Stein's [WHO]...passion for her work was contagious, her optimism was exactly what I needed to hear after a month of ever-building evidence of the political, money-driven aspects of public health....She re-kindled my excitement for epidemiology...The question that had been nagging me all month – whether epidemiologists or any public health workers who spend years and years on projects without getting to see immediate positive results find their work to be less satisfying – finally received a reassuring answer: it's the small victories, the milestones along the way that keep you going and the knowledge that the work you do really does trickle down to individuals who need your help...”

**CONCLUSION**

What do students gain from this experience? They learn about the role of statisticians globally and they discover the need for statisticians in that arena. They observe role models and gain confidence that they, too, could contribute. They feel heard; after her group's presentation, one student exclaimed, “They were so interested!” It is gratifying that our students have an opportunity to believe that once in awhile someone really is interested in what they have to say. Students in the global workplace see the familiar approach to modeling played out in this foreign setting. They need to work with researchers to formulate a research question so it is critical that they learn about the subject area and understand the context in which they work. They grapple with the difficult issue of understanding and preparing the data. Their only texts are the WHO researchers and statistics mentors. The tobacco group had a tremendous amount of data that was in dire need of cleaning. To do that effectively it was imperative they understood the WHS and learn new epidemiological constructs. The students grew to own this data, becoming the experts with the professor as only an external consultant. The actual analysis may be straightforward, like the tobacco group or there may be room for creativity. Much of creative aspects done on the rotavirus paper were student initiated. Their work was admirably elegant, germane to the rotavirus problem at hand while also being general enough to apply to many other situations. They learned and used statistical methods that were new to them (and that would be new to many statisticians). They mastered computing software to allow them to carry out simulations – something beyond what we had been doing in class up to that point (we cover simulations in class now). The theme here is that approaches to the research problem are student led and implemented. Unlike course work in a classroom, here the students spearhead formulating the research question, exploring statistical and computational methods and carrying out a study that addresses the question. Rather than the source of assignments and exams, professors become resources and the final product serves as the exam which will ultimately not be graded by the professor but by those WHO researchers with whom they have worked. A not so well kept secret is that the professor can also find the setting fascinating and model intellectual curiosity and love of statistics quite naturally.

Another less tangible benefit is learning about the culture of a research environment. Students experience the need for flexibility while carrying out research. There are times avenues of research do not pan out and you need to rethink your approach. It is helpful for undergraduates to see that this is the norm and that if they choose to pursue research in graduate school or as a career such reversals should be expected at times. This is particularly true for women and students from

underrepresented groups where there is sometimes a self-imposed need to always be right to avoid criticism.

In the workplace, the importance of communication is evident. Students communicate in order to understand the area of research and formulate a research question. Some of the results of the work of the tobacco group are communicated on the WHO. A manuscript has been prepared and submitted by the rotavirus group. Even the experience of working in the WHO worksite was the subject of an article by two of the participants, Steff Halberstadt and Stacy Wood (2006).

There is a particular set of challenges specific to this program. The time period is incredibly short. We are in Geneva for only the month of January. By planning ahead we are able to get started on a project prior to our arrival, nonetheless there remains much to do. The presentations are critical and practice presentations need to begin the last week in January to benefit from suggestions and critiques. The short time requires selecting an appropriate project, doable in short time period. As with the other service-learning experiences, the preceptors/researchers in the workplace are absolutely critical to the success. The students of the St. Olaf Interims are indebted to Dr. Claudia Stein and Anthony Burton of WHO.

Nordmoe's definition of service-learning suggests that it be "meaningful." The projects described here are meaningful each in their own way. The WHS tobacco analysis was not due to be done because of staff limitations. With the St. Olaf students' help, the analysis could be completed in a timely fashion and used to target intervention efforts. The emergence of rotavirus vaccine deemed the rotavirus project of immediate importance. The manner in which the analysis was performed would allow it to be useful for nearly every GBD calculated at WHO. The definition includes the notion of "civic responsibility." Exposure to the world of global public health impresses students with their responsibility to use their statistical skills in service to public health. Exposure to the controversies warns students that there are many players on the global stage and this responsibility requires this awareness. Finally it is recommended that service-learning "strengthen communities." While the students' experiences directly impacted the global public health communities, they ultimately benefited people in the countries with pressing needs.

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WHO website Global Burden of Disease [http://www.who.int/topics/global\\_burden\\_of\\_disease/en/](http://www.who.int/topics/global_burden_of_disease/en/)