Collaborative Development and Benefits of a Science Inquiry Service-Learning Course

BY JOSEPH A. MASER

Abstract

Portland State University is using a collaborative research program developed with the City of Portland to teach science, the scientific method, and the value of citizen participation to non-science majors. Students have been collecting and analyzing bicycle use data for four years. The City gets information regarding the effectiveness of its bicycle program in relieving downtown traffic. The students learn about science by doing science and about citizenship by being active participants in their community.

Although student citizenship has been an essential goal of American higher education, this goal has not been consistently stressed or achieved throughout history (Sax 2000). In establishing one of the first universities in America, Thomas Jefferson's aim was to produce civic leaders (Boyte and Kari 2000). This goal continued through the beginning of the twentieth century when American universities had as their mission service to the community (Boyte and Kari 2000). A shift in emphasis from developing citizens towards developing students who could advance technical progress and expand the middle class occurred with the expansion of higher education after World War II (Sullivan 2000). This trend has continued for the last sixty years with institutions of higher education being viewed as technical training grounds rather than forums in which to develop fully rounded student citizens.

Recently there has been a re-emphasis on the development of citizens as a primary goal of higher education (Sax 2000). The 1998 conference of university presidents, provosts, deans, and faculty members reviewed the decline of citizen training in universities and declared that institutions of higher education should re-focus on their civic purpose. The conference outlined numerous steps to accomplish this goal, including:

> ...preparing students for engaged citizenship through multiple opportunities to do the work of citizenship; ...teaching that includes community-based learning and undergraduate action research that strengthens social responsibility; ...and stakeholders in universities define institutional work as a whole in ways that highlight civic mission broadly.... (Boyte and Hollander 1998)

At the local level, numerous colleges and universities have revised their missions to develop students as both citizens and technically proficient persons ready to enter the work force. An example of this is the recently revised mission of Portland State University (PSU), which includes:

- Promotion of student learning, research, and community involvement relevant to contemporary society;
- Integration of teaching, research, and community outreach;
- Preparation of responsible citizens, attuned to community, regional, national, and international needs; and
- Utilization of its urban setting (Portland) for student and faculty learning beyond the traditional classroom.

Curricular Context of Course

One aspect of Portland State University's endeavor to develop student citizenship is the University's general education program. In 1992, the Provost formed a faculty committee in response to overall concerns about the general education program. The committee found that the existing distribution requirements were not based on articulated goals or anticipated learning outcomes, and they did little to engage students in their education (White 1994). Based largely on research at other universities, the committee recommended that the purpose of general education should be to facilitate lifelong learning.

In 1994, PSU changed its general program from traditional distribution requirements to an integrated program that provides components of study throughout the students' tenure in the University (Figure 1). This program, called University Studies, has four main goals:

- Inquiry and critical thinking;
- Communication;
- The variety of human experience; and
- Ethical issues and social responsibility (PSU 1997).

All the courses associated with University Studies are centered on the goals of the program, but some courses may emphasize one goal more than another. The program is designed such that every student will be exposed to all the goals by the time he/she graduates. Similar to all general education programs, the University Studies courses are taken in addition to the normal requirements of the students' majors.

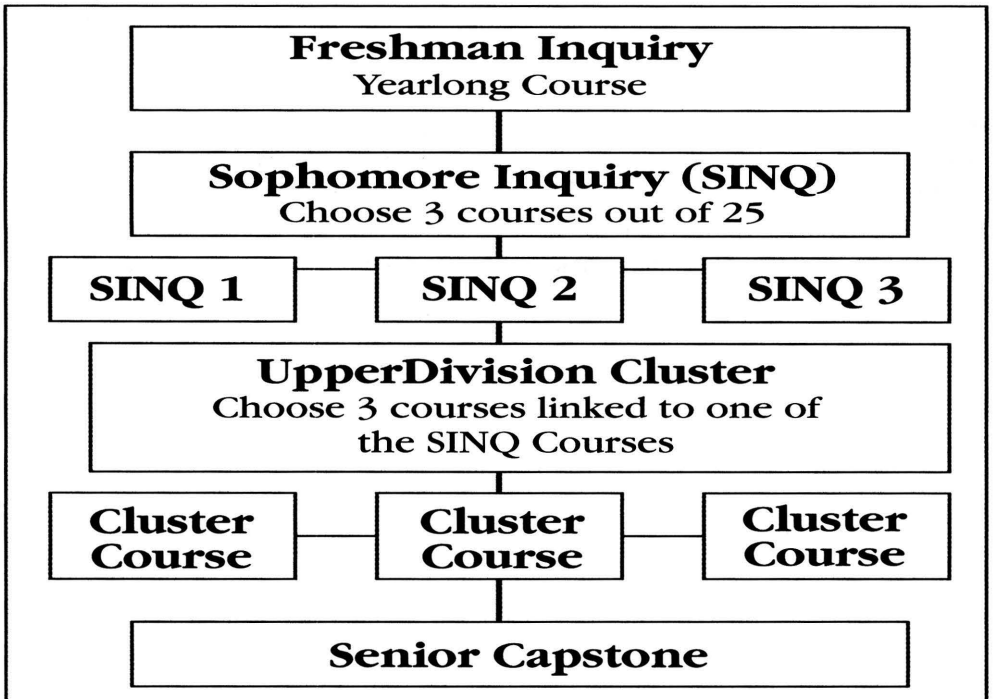

Figure 1. University Studies Program

When a student enters PSU he or she is required to take a University Studies' Freshman Inquiry courses. This course lasts the entire year and explores a topic from an interdisciplinary perspective. The course is taught by a team of faculty members from different departments. The course helps students develop the skills necessary to succeed at the university and in life beyond the university. In addition, participating in a yearlong educational experience with the same faculty and fellow students, the students are able to establish a network of peers and faculty connections.

An example of a Freshman Inquiry course is the Columbia River Basin. This course teaches critical thinking skills, basic writing and verbal skills in context of the subject matter. It also has student assignments that introduce the others goals of the University Studies Program.

During their second year at PSU, students take three different Sophomore Inquiry courses, which act as gateway courses to different topic areas. There are 25 topic areas in the University Studies Program. The Sophomore Inquiry courses introduce the topic areas and prepare the students to take University Studies upper division courses associated with that topic area. An example of a Sophomore Inquiry course is the Environmental Sustainability, which stresses ethical issues and social responsibility in the

context of reviewing environmental systems and resources and how human actions affect the earth.

At the beginning of their junior year, students decide which one of the topic areas they are going to pursue further. Students in their junior year are required to take three University Studies upper division courses that are thematically linked to the Sophomore Inquiry course. There are 12 to 25 upper division courses associated with each topic area. These courses are content rich, reinforcing the principals introduced in the Sophomore Inquiry course of that topic. An example of a University Studies upper division course is Fundamentals of Environmental Design, which is offered by the Architecture Department. This course is thematically linked with the Sophomore Inquiry course, Environmental Sustainability. The course examines how architecture designs for sustainability and stresses the University Studies' goal of personal and social responsibility.

In their senior year, students are required to participate in a Senior Capstone course. The Senior Capstone is a community-based learning opportunity, which allows the students to apply the knowledge they have gained from their major, as well as from their cluster, to a real-world issue. Students work within interdisciplinary teams, with each student applying his or her own knowledge and skills to the collaborative effort. The Senior Capstone stresses diversity (the variety of human experience), ethical issues and social responsibility by having the students work with community organizations.

An example of a Senior Capstone is All Women's Health Services Capstone. This capstone addressed the education and outreach program needs of the All Women's Health Services (AWHS), an organization providing comprehensive health care services to women. In conjunction with AWHS staff, students assessed the agency's needs around its existing educational curriculum; identified program goals; researched curricula options available for inclusion in AWHS's program; and made recommendations to the staff for program expansion. The students' final product was a presentation (oral and written) of these recommendations to AWHS staff.

I teach two Sophomore Inquiry courses which emphasize different goals—the Environmental Sustainability course mentioned above and a Natural Science Inquiry course that stresses critical thinking and effective communication. The remainder of this paper will describe the revision of the Natural Science Inquiry course into a service-learning course, which stresses social responsibility in addition to other goals.

Collaborative Course Development

In the University Studies Program, most students' exposure to real-world situations and community service is limited to their Senior Capstone experience. Having taught Natural Science Inquiry for approximately a year, I felt something was missing in the course I had developed. While the course was meeting the goals of critical thinking and communications, it was not achieving all of its potential of having the students make a

difference in their community. The University was promoting community engagement and this course was not engaging the students in the community. As a result, I chose to introduce community engagement in my Sophomore Inquiry course through service-learning.

Service-learning is defined as "the integration of community service and academic study" (Yerkes 1998). Service-learning is not volunteer work, but rather the opportunity to satisfy multiple needs—the students' theoretical study is grounded in a real-world experience and a community's need is met (Sax and Astin 1997). In addition, service-learning has been shown to have significant positive effects on a student's cognitive complexity, social interaction, and confidence to work with others (Osborne et al. 1998).

The objectives of my original Natural Science Inquiry course were designed to introduce non-science majors to the scientific method, teach them how to substantiate a knowledge claim, and increase their communication skills (numeracy, written, and verbal). This project-based course focused on watersheds. The class projects were: estimating the flow of a river, hypothesizing and testing hypotheses about water current; analyzing scientific writing and writing a review paper; and analyzing long-term water quality data regarding logging practices. While the course assessments showed that the course was meeting the objectives, it was not engaging the students in their community. The students could see that clear-cutting had deleterious impacts on watershed functions, but they could not effect a change in logging practices. In addition, the timber industry has not been a dominant factor in Portland's economy for the last twenty years and lacks relevance to the students' lives. Therefore, I decided to change the course in two fundamental ways—include a service-learning component and introduce a new area of focus to the course. I chose to do this by having the students participate in a project that influences transportation policies in their community, Portland, Oregon.

Transportation is a relevant issue to most students attending PSU. PSU is an urban university located in downtown Portland and only 11 percent of the students live on campus. Approximately 25 percent of the students take the bus and 50 percent of the students drive. The remainder of the students either ride with someone else, walk, or ride a bicycle. Congestion and transportation choices are issues students face every day. Bearing this in mind, I made transportation the focal point for a new science inquiry course.

To make the course a service-learning course I approached the City of Portland's Transportation Department to see if the course objectives could serve as a conduit to meet the needs of the Department. I was directed to the City's Bicycle Program, which, as it turned out, had a need for data collection and analysis. While the Bicycle Program had data on the bicycle use at some city locations, it did not know how many people were using bicycles to get to the city's downtown corridor.

I met with the City's Bicycle Program Coordinator to discuss our respective needs. The City needed reliable data about the total number of people using bicycles as a means of

transportation into downtown, the gender of the bicycle riders, and the use of safety helmets by riders.

In order to satisfy the course objectives, I needed to provide the students with the following opportunities:

- to use the scientific method; develop questions, develop and test hypotheses, analyze data;
- to make substantiated knowledge claims;
- to communicate their findings; and
- to contribute to the community.

These respective needs set the stage for a natural collaboration between the City and my Science Inquiry course. The student would learn the scientific method by designing and performing bicycle use studies, and the City would get valuable data.

Initially, the City was concerned about the quality of the data and analysis that would be generated by sophomore, non-science major students. To overcome the apprehension of the City's Bicycle Program coordinator, I worked with her to assure the program got the data it needed. The City determined 32 key sampling sites on the perimeter of the downtown corridor that the students used to determine bicycle movements in and out of downtown. The City also designed data forms that the student used, which allowed easy collection of data the City wanted. Together we determined the protocols of data collection and analysis and the City began to trust the relationship. It was important to establish this relationship as partnership, rather than telling the City what I thought it needed.

Taking into account the City's needs and the course objectives, I re-designed the Science Inquiry course with the following major components:

- Introduction to the definition of science and the scientific method;
- Analysis of the modes of transportation around the University;
- A research paper focusing on problems with the transportation system in Portland and recommending solutions; and
- Conducting a bike count project.

In the final component of the course, the City Bike Count Project, the students used what they had learned about science, the scientific method, statistics, and substantiating knowledge claims to design, implement, and report their finding from a study of bicycle use in downtown Portland.

To introduce this portion of the course, I had the City's Bicycle Program Coordinator present the history and objectives of the program. In that presentation, the Coordinator discussed the data needs of the bicycle program and how they would use the data to shape City policies. The Coordinator stressed the importance of the data the students were to collect and analyze—this project would help revise the City's transportation policies.

In addition to the information the City wanted (total number of bicycle riders, gender of

the riders, and use of safety helmets), I asked the students to pose other questions they would like to have answered during this project. Working in teams of four or five, the students organized their efforts within certain guidelines to assure consistency of methods from year to year. Depending on the size of the class, each student observed and recorded bicycle activity at two or three points in the downtown area. As a group, the student teams then analyzed all of the data collected from a total 32 sampling sites, as well as their individual group's questions. Finally, the student teams prepared written and oral presentations of their findings. These presentations were given to the entire class, the City's Bicycle Program Coordinator, and myself.

Academic Learning and Citizenship

This course linked academic content with citizenship. Rather than the traditional classroom format of teacher lecturing and students taking notes and tests, this course allowed the students to learn and participate in their community. The students learned about science inquiry and the scientific method by formulating hypotheses and testing them. They learned about developing and following a good experimental design. They learned about the value of statistical analysis, which statistical test to use, and how to use statistics to substantiate knowledge claims. They learned how to give an effective presentation.

In addition to the academic content of the course, the students learned how part of their City government functions. They learned that City policies are not created in a vacuum, but rather they are created to satisfy a need and that need is substantiated with data (they helped the City fill an important data gap). They learned that citizenship is not limited to voting and they need to take an active role in their community if they want to make a difference. They learned that City employees are not bureaucrats, but are people deeply involved in their specialties who want to make the City a better place to live. They also learned that the University/City partnership benefits both parties.

This course has been offered in the summer quarter since 1997 and the data amassed has helped the City revise its transportation policies. Through numerous positive actions of this University/City relationship, the City has evolved from a hesitant partner to a partner who turns to the University for guidance.

An example of this maturing relationship is the development of a questionnaire created to further explore the topic of bicycle usage in downtown Portland. While the initial findings of the project were interesting and useful for City planning, the City's Bicycle Program Coordinator and I wanted to delve into bicyclist behavior and knowledge of City bike facilities. I suggested that the best way to get insight into the issue was by distributing a survey to all bicyclists during the annual bike count project. The questionnaire was designed to be mailed back to the City. The survey instrument was designed *pro bono* by one of my colleagues, a research professional. The survey was given to over 1,000 bicycle riders during the summers of 2000 and 2001. It is my intention to extend the Natural Science Inquiry course into the winter and spring

quarters and have the students analyze the data and report the findings to the City. Again, both the City and the University gain from this relationship.

Conclusions

This course is a good example of the reciprocity of service-learning—both the student and the community benefit. The students learn about the scientific method, participate in doing science rather than memorizing facts, learn the value of substantiating knowledge claims, and contribute to the community. The students also learned about citizenship by being active citizens and helping their community in a tangible way. Anecdotally, students have commented they appreciate the opportunity the course gave them to work on a project where data is being used by the City, rather than working on an exercise just for the class.

Portland, Oregon's Bicycle Program now knows how many people are using bicycles as their means of transportation into downtown. They now have data regarding gender and helmet use, and they are using that data to shape outreach efforts. Once the survey data is analyzed the City will also be in a position to evaluate the effectiveness of their street signage and publicity campaigns.

In addition, the course fulfills some of the programmatic goals of the University Studies Program: participating in inquiry and critical thinking, enhancing communication skills, and engaging the students in social responsibility.

It should be noted that while most of the objectives of my service-learning inquiry course are the same as that of a traditional inquiry course, community service is not just an added component. The entire course had to be revised to make the service activity meaningful. All of the course activities and assignments prior to the Bike Count Project were necessary preparation for this service activity. Other educators have also found similar experiences in developing their service-learning courses (Cleary 1998).

In order for this course to be a benefit to the community it was necessary to uncover the community needs and not assume I knew them. Secondly, it was important not to force-fit a service activity onto the City. The collaborative nature of this course's development and the participation of the City in the Bike Count Project led to this course's success. In addition, having the City receive and use the findings at the students' final presentation added to the legitimacy of the community service experience for the students.

References

Boyte, H. and E. Hollander, "Wingspread Declaration on Renewing the Civic Mission of the American Research University." Compilation by participants at a Wingspread Conference, Racine, Wisconsin, December 11-13, 1998.

Boyte, H. C. and N. N. Kari, "Renewing the Democratic Spirit in American Colleges and Universities" in T. Ehrlich, ed., *Civic Responsibility and Higher Education* (Phoenix: Oryx Press, 2000): 37-60.

Cleary, C., "Steps to Incorporate Service Learning into an Undergraduate Course," *The Journal of Experiential Education 21* (3, 1998): 130-133.

Osborne, R.E., S. Hammerich, and C. Hensley, "Student Effects of Service-Learning: Tracking Change Across a Semester," *Michigan Journal of Community Service Learning 5* (Fall1998): 5-13.

Portland State University, "The Advisor's Guide to University Studies," (Document of University Studies Program, 1997).

Sax, L., "Citizenship Development and the American College Student" in T. Ehrlich, ed., *Civic Responsibility and Higher Education* (Phoenix: Oryx Press, 2000): 3-18.

Sax, L.J. and A.W. Astin., "The Benefits of Service: Evidence from Undergraduates," *Educational Record 78* (3-4, 1997): 25-32.

Sullivan, W., "Institutional Identity and Social Responsibility in Higher Education" in T. Ehrlich, ed., *Civic Responsibility and Higher Education* (Phoenix: Oryx Press, 2000): 19-36.

White, C.R., "A Model for Comprehensive Reform in General Education: Portland State University," (Report to Portland State University, 1994).

Yerkes, R., "Service Learning Revisited," *The Journal of Experiential Education 21* (3, 1998): 117-118.

Acknowledgments

The author wishes to thank the City of Portland Bicycle Program Coordinators, Mia Burk and Roger Geller, for their interest and participation in this collaborative program.

Author Information

Joseph Maser, Ph.D. is an Assistant Professor at Portland State University with appointments in the Center for Science Education and the Environmental Science and Resources Program.

Portland State University
P.O. Box 751
Portland, OR 97207-0751
Telephone: 503-725-8042
Fax: 503-725-3888
E-mail: maserj@pdx.edu