

**Mathematics and Civic Engagement:
New Opportunities for Students in the 21st Century**

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Abstract

Middlesex Community College (MCC), with campuses in Lowell and Bedford, Massachusetts formed an innovative partnership with both Lowell National Historical Park and Minute Man National Historical Park through the support of a Learn and Serve Grant. The purpose of this partnership, known as The Lowell Civic Collaborative, was to design civic engagement opportunities for students and the surrounding communities. The collaborations provided students the chance to raise their awareness about various aspects of their community while learning course content. Mathematics professors from MCC were challenged to use this opportunity to infuse civic engagement topics into developmental through college-level math courses.

Introduction

Middlesex Community College (MCC), with campuses in Lowell and Bedford, Massachusetts formed an innovative partnership with both Lowell National Historical Park and Minute Man National Historical Park through the support of a Learn and Serve Grant. The purpose of this partnership, known as The Lowell Civic Collaborative, was to design civic engagement opportunities for students and the surrounding communities. The collaborations provided students the chance to raise their awareness about various aspects of their community while learning course content. Mathematics professors from MCC were challenged to use this opportunity to infuse civic engagement topics into developmental through college-level math courses. Interested in making a difference in the engagement of young adults in the decisions that shape their lives, these professors worked with the partnerships to develop projects that were interesting and meaningful. Concepts in mathematics often seem abstract to students. Confined to the four walls of the classroom, students fail to see the connection of these concepts to the real world. Being able to apply and utilize knowledge gained in the classroom to address community needs is a highly valuable skill: one all students should possess. This article will explore how the needs of the park were matched with math courses of different levels and content and explain the results of these collaborations.

In 2003, the Service Learning Program, part of the Division of Social Sciences/Human Services at MCC, received a Learn and Serve Grant. The idea was not only to build enduring relationships among the three organizations above, but also to embed civic engagement knowledge and skills into courses at the college. The overall goals were to increase communication about civic engagement with faculty, staff, students, and the community population; involve more students in civic engagement and service learning opportunities; engage students and faculty in civic dialogues, and

incorporate community residents in planning and implementing projects related to their needs. To quote from the grant, one goal is, “To increase the capacity of Middlesex Community College and Lowell National Historical Park to assist community organizations in meeting the needs of their constituents by providing college-age youth, 18-25 years old, with an understanding of the value of civic engagement and an opportunity to practice the skills of civic engagement through participation in a diverse range of initiatives that encourage citizenship and service.”

Statistics

In a college level elementary statistics course, the goals were to teach the statistical content, increase the students’ critical and writing skills, and incorporate civic engagement throughout the course. These goals were accomplished by assigning three short projects and three tests that used data from the students’ first partner, The Center for Lowell History. The data from The Center for Lowell History worked best on projects and tests that had to do with descriptive statistics. The capstone project in this course, a five page research paper, culminates in combining all aspects of the curriculum. Students develop a hypothesis or claim about an aspect of the community or civic engagement, then gather their own data and test this claim. The goal is to have students apply their statistical knowledge to real world applications while at the same time helping the community and learning more about the community in which they live and work. Not only will the students learn the course content, but they will also help meet the needs of the community. Examples of some applications include claims made by Lowell National Historical Park regarding the flow rate of the Merrimack River (which runs through the park), the proportion of visitors to the park during the summer months who visited particular exhibits, and the proportion of empty seats on canal-boat tours. Interpreters at the park need this information in order to determine if a canal-boat tour can operate at all, and if so, what package deals could be offered to make the most money. Other claims involved issues related to civic engagement that were of interest to students. They researched such topics as the percentage of Vietnamese people who were repatriated through the United Nations High Commissioner for Refugees, the mean number of students in elementary classrooms in the Lowell Public Schools, and the percentage of students of various ethnic backgrounds at MCC as compared to the national percentage at all colleges in the U.S. This project is assigned two to three weeks before the semester ends, and it takes the place of a final exam. Students present their project to the rest of the class. Students learn the statistics necessary to complete this project in class, but work on the paper outside of class.

Math Modeling

Math Modeling is a survey course designed to provide liberal arts students with exposure to practical applications of mathematics. One of the topics covered in the course is descriptive statistics. The students learn how to collect, describe, and do elementary analysis of data.

For instance, the students were given raw data about the effect of grazing by sheep on non-native invasive species in the Minute Man National Historical Park in Bedford, Massachusetts. MCC students in a botany class collected the data during a previous semester. Each student was given data about the effect of grazing on a particular species of nonnative invasive plants. The data contained measurements such as number of stems, number of leaves, percent of cover for both before the sheep were allowed to graze and after they were allowed to graze. Initially, the students were asked to graph the data in whatever way they thought would be the best way to make sense of the data. The class then had a discussion about which graphs were more effective. Then the students were assigned specific graphs to be made using Excel. The students also calculated the mean and standard deviation for the data used in their graphs. The students were then asked to write a brief analysis of their data. All of them were surprised to learn that the park was concerned about the growth of non-native invasive species in the park. The project also gave them the opportunity to work with real-life data.

Math Connections

Math Connections is an Excel-based course where students develop proficiency using a spreadsheet, charts and graphs, probability and statistics, and measurement. This is a developmental course, designed as an alternative to Algebra 2, for students who are not planning on transferring to a four-year institution. In the final project, students are instructed to research a topic, write a short three-to-five page paper and make a presentation to the class. The paper and the presentation are intended to focus on the graphing skills that students have learned as well as to show their ability to work with and interpret data. This project was restructured to allow students to learn more about the city and what it offers.

With the assistance of the project liaison at Lowell National Historical Park, a list of contacts within the park and the community was developed. Rather than gathering their data from books or the internet, students are directed to staffers in the park to gather information on tourism, immigration and the park's volunteer program. In addition, they can also meet with the Executive Directors of the Lowell Festival Foundation and the Greater Merrimack Valley Convention and Visitors Bureau. Students choose a topic and, in a small group of three or four, prepare an interview and then meet with the designated contact about their topic. After gathering data, they then develop subtopics, and each student focuses on a specific part of the data. They are asked to submit reports at designated times throughout the semester indicating how they are organizing their group and their material.

Each group makes a presentation on their overall topic, with individual students highlighting each subtopic. Students are often surprised to learn that Lowell is considered a Destination City, with visitors from around the country (and sometimes from abroad) coming to see the park and learn from its history. Since a large number of MCC students are immigrants themselves, they are amazed to learn how much of the

history of the city was based on the arrival of various groups of immigrant populations, even to the present. Not only do they gather data, they also must meet and interact with various community members, which is often a new experience for them.

Precalculus

To experience modeling real life data, a precalculus class also teamed up with the Lowell National Historical Park. The park collects an extraordinary amount of data. In Lowell, daily readings of stream flow of the Merrimack River were part of this data. Its importance can be found by noting that during several months of the year, the park offers canal tours through the city of Lowell. However, if the flow rates are too high or too low the tours are cancelled. Because these tours provide revenue, determining the optimum time to give tours was of great interest to the park. To do this, the class analyzed the data to determine the best-fit model for predicting stream flow based on month and date. The data were based on years of collection. Each student was given a different day to analyze. To obtain this data, the students needed to access the park's website and download the pertinent data. Once analyzed, the data proved to be a quadratic fit, though some students took it a step further and fit a 4th degree equation to the data! To have the students go beyond what was being taught was awesome. They discussed the fit of the model, the domain and range of the function and the application of this model. In addition, they were asked to compare their model with the model of another member of the class. In May 2006, Lowell was devastated by three days of torrential rain. Many students questioned the impact of these floods on the tours and data. This new data will give students in the upcoming semesters a chance to find out effect the floods had.

Through the mathematics, the students learned about their community; through the community, the students learned the mathematics. Many stated that although they had lived in Lowell or the nearby vicinity for years, they never knew what the park had to offer, from canal tours to the history of the immigration into the city, to special events such as the Lowell Folk Festival and the Lowell Summer Music Series. These projects exposed the students to the work and purpose of the park and its historical significance, as well as also giving them the opportunity to work with real-life data. Knowing that the park was going to make decisions based on their analysis of the data, the students rose to the challenge and exceeded expectations. The knowledge that their project was being used for something other than a grade at the end of the semester, gave the projects credibility and a weighted importance. Several students gave presentations on their projects to an audience of park and college officials including the college president. Many traveled back to the college after completing finals to participate in this prestigious gathering. This recognition by the college and park emphasized to both the staff and students the importance of the projects and a continued partnership with the community.

One of the primary goals of MCC is active civic engagement. The mission statement reads, "Through partnerships with schools, businesses, the arts community, and service agencies, Middlesex participates actively in the day-to-day life and ongoing development of its communities." Even though the Learn and Serve Grant is over, the

partnerships that were created through this grant are ongoing. There is strong support from the both the National Park Service and MCC with park rangers, faculty, staff and students still continuing to work together on this collaboration. Once a project is developed, it can be repeated over again. Faculty members who have participated in the grant continue to use the resources of the park and other community organizations in their courses and have shared materials with other members of the department to ensure continuity and sustainability. In addition, projects that were used in the first years of the grant have not only been continued, but have been improved as participants become more aware of the many resources available.

There is always room for change and that is part of the whole process, to rethink a way of teaching a course you have been teaching a long time, or to develop new courses that emphasize civic engagement. The partnerships also fulfill the needs of the community organizations and that, of course, is the primary goal. The educational world and the community have many overlapping interests. One is concerned with the education of citizens and the other with insuring its citizens can think critically and hypothetically to envision the affect of their decision today on the future of tomorrow. If students are to develop into critical thinkers, the community needs to be an extension of the classroom. The partnerships developed here address both of these concerns.

Projects from faculty that were developed as part of this grant have been published in *The Lowell Civic Collaborative: A Guidebook for Projects Between Community Colleges and National Parks*. This guidebook is available on-line under Program Highlights at <http://www.middlesex.mass.edu/Service Learning/>

As the National Park Service articulates its vision for the 21st century, The Lowell Civic Collaborative serves as a significant tool in achieving those goals. Sustaining community relationships, engaging ongoing dialogue, and creating a workforce reflective of society can be attained through this collaborative. The students and faculty at MCC will assist in keeping National Parks relevant in the 21st century through the investment in intellectual and emotional energy.

About the Authors:

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