

Learning from Service-Learning

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Abstract: Service-learning has the potential to change student attitudes toward a course and a subject. With this goal in mind, I have used service-learning in several courses, from introductory mathematics courses to courses for math majors, for several semesters. This article gives details on these projects as well as some ideas to extend these projects to other situations. Furthermore, some dos and don'ts for service-learning are discussed.

Keywords: Mathematics, service-learning, attitudes toward mathematics.

How do we create a community of learners? How do we engage our students, not just in their classes, but in the fields of mathematics and mathematics education? Thinking about these questions and our math majors is what originally led me to service-learning. As I learned more about service-learning and its potential, other questions occurred to me. How can we get students to take their education seriously? Where do our students fit into the community outside of our campus? What sorts of experiences might help the students mature and take more responsibility for themselves and their learning? I believe that service-learning offers us a lens to examine these questions further and, in many cases, offers interesting and surprising solutions to the problems posed. The rest of this article describes my journey through service-learning.

Before the Spring 2010 semester began, I was thinking about our math majors. While our majors are certainly intelligent and have willingly chosen a career in mathematics, we still often found that some of our majors had low motivation and low confidence in their own mathematical abilities. We found that it was difficult to instill a love of mathematics in the students who mainly wanted to get through their required math classes as painlessly as possible. Motivating students to participate in activities outside of class (activities that

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did not have a point value attached!) was also difficult. In addition, math major students still seemed to think that they were not good at math and to avoid situations where they might struggle or need to use outside resources to be successful.

With these thoughts in mind, I was interested in working to create a community of learners that would get the students engaged in the department and activities outside of class. I also wanted to give the students an opportunity to grow in their self-confidence and to brush up on mathematics which they may have forgotten or never learned. I had heard about service-learning and knew that it was being used in other departments on campus. Could the service-learning approach help us to address our problems?

At the time, using a service project as a fourth-credit option, in an already established three-credit course, was a popular model on campus. Students in the three-credit course could choose to earn a fourth credit by participating in a service project. In consultation with my department, I decided to offer a fourth-credit option for students in an Abstract Algebra course. I developed a project where math majors would mentor students in lower-level courses. I hoped that being seen as a valuable mathematics educator and as a partner in educating students in lower-level courses would help the mathematics majors to feel part of our mathematics community on campus. In addition, being seen by their peers as good at math and as respected by their instructors would, I hoped, help increase the confidence of our majors. This project would have the added benefit of offering substantial and qualified help to students in lower-level courses.

At the time, our core mathematics class (which most students took to fulfill the university mathematics requirement) was Statistics. This course was not necessarily one that our majors were comfortable tutoring. In addition, there were other courses where the math majors might need a refresher before they could consistently help students with the course material. For this reason, mentors would need to attend the lower-level class as part of the project.

I solicited instructors from my department who would like to have a mentor in a lower-level mathematics course. Before the semester began, I also started communicating with the Abstract Algebra students about the fourth-credit option. I let them know that student mentors would attend class each day and would offer review sessions outside of class. During class, student mentors would help the instructor. This help might involve working with small groups, answering questions, or presenting an example to the class.

On the first day of class, I explained the project and handed out contracts. Students who wanted to complete the fourth-credit option had to fill out and return a contract so the fourth credit could be processed. The course had around 20 students. Four students were interested in the project. Two students completed the project, one student thought the project was too much work for one additional credit, and one student was not motivated enough to fill out the

required paperwork. I was disappointed that more students were not interested, but hoped that two students would make a reasonable pilot.

Throughout the semester, the two student mentors worked hard on the project. The instructors of the mentored courses were happy with the experience and the student mentors enjoyed it. The project, however, was never really part of the course. With only two students completing the project, the work of the mentors was not discussed in class. The mentors were not given an opportunity to talk with each other about the experience. When reflecting on the project, I felt that everyone would have been better served if the project was integrated into the course. In future semesters, I achieved this integration by making the project a required part of the course, rather than an option. In conversations with the Community Service Director at my school, we agreed that integrating the service project on the syllabus as a normal part of the course helps to involve and engage the classroom community in the project.

Working through this first service project in the Abstract Algebra course, I realized another mistake that I had made: I did not incorporate any type of organized reflection into the project. As I began to learn more about service-learning and to experience working through such a project, I learned that reflection is an important part of the experience. Research literature supports the importance of reflection and gives tips for how to integrate this reflection. For example, in their study, Astin et al. [1] found that the positive effects of service-learning were increased when the service was part of a class and there were opportunities for reflection.

Since my first semester using service-learning, I have required written reflections that make up the graded part of the service project. These reflections are turned in at the end of the semester, and the students are typically given a prompt to encourage consideration about the meaning of the experience. The research literature contains many ideas to help achieve meaningful reflection. Hatcher and Bringle [4] give recommendations and guidelines for integrating reflection with service. Effective ways to foster reflection are given in the “Four Cs” model of reflection [3] which includes making the reflection continuous, challenging, and connected to the material of the course.

I have now read close to 200 reflections on mathematics service projects and have found that the opportunity to formally reflect on the experience is important to help students see the project holistically. It is also helpful to provide opportunities for reflection in class and in small group meeting times. This time helps the students understand the goals of the project and their role.

With a lack of integration and reflection, the Abstract Algebra project could never really achieve all of my goals. While the project was successful for the two students and two courses involved, it did not help to build a community in our department. Without a larger-scale implementation, I do not believe the project could ever achieve the desired affects. We have continued to have math major students as mentors in some lower-level classes, but, as a department, we have not yet found a way to incorporate the mentoring program on a larger

scale that fits with the administration and culture of our school. As we are going through a department review and looking to restructure some aspects of the major, I believe this is an area where we will strive to make improvements.

So, while not entirely successful, I did not consider my first attempt at service-learning a complete failure. I was beginning to see the potential and ways to improve what I was doing. I did not teach a math major course in Fall 2010, so I was not able to continue with a similar sort of project. I was, however, teaching two sections of Statistics, which was, until recently, the core mathematics class that most students took to fulfill the university mathematics requirement. I was interested in using a service project in the course, but I needed to stop and consider what my goals with such a project would be and how such goals fit into service-learning in a broader sense.

I reflected that Statistics was the core math course at a liberal arts school. For this reason, the Statistics course should help to open the world of mathematics to students and to help them to see its utility and beauty. These goals are often difficult to achieve in core courses where students often have poor attitudes. With mathematics courses, this reality is often coupled with a strong dislike of mathematics. I began to think that a service project might help students to see mathematics more positively. Consulting research literature on the issue, I found that this effect was a possibility. For example, [1] performed a longitudinal study on more than 22,000 college graduates with a goal of determining the effects of service-learning. They found that participating in service has many positive outcomes for students, including better awareness of the world and more engagement in the classroom. I thought this combination could serve to affect students' views of mathematics. In addition, [5] performed a study on the effects of service-learning in mathematics classrooms on math anxiety. They concluded that "students gained confidence in their mathematical abilities, a greater interest in mathematics, and a broader sense of the importance of math literacy in modern society."

I began by working over the summer to find a community partner. Working with the Community Service Office at my school, I was put in contact with the Adams County Literacy Council, a local agency that helps adult learners who need to enter a GED program. The organization, in particular, tutors the adult learners in mathematics. I hoped that by working with such a group the students would see that understanding mathematics is important, even if they are not planning a career that uses a lot of mathematics.

When considering the wide variety of backgrounds and dispositions that would be in such as class, tutoring was not considered the best choice. Furthermore, for similar reasons, I did not want the service project to involve the class doing statistical analyses. Instead, the agency identified math textbooks as a need. We decided the class would fundraise to purchase math textbooks. The agency also asked for help with advertising. Since the project incorporated advertising which could continue to be used by the council in the future, we were able to attend to one of the major principles of service-learning:

after the project the community partner should be better able to serve others [7]. I had two Statistics courses, each with 25 students. I initially thought that each student would choose the fundraising or advertising group, depending on his or her preferences. However, when confronted with managing the project and the 50 students involved, I decided it was easier to make one class the fundraising group and the other class the advertising group.

When the semester started, I introduced the concept to the students. Many of the students had never experienced service-learning before and, it seemed from their reactions, they did not see how it fit into a math class. I was lucky to have incorporated a component of the project (under the advice of the Community Service Director at my school) that would help take care of those issues: we took a field trip to the Council, where we toured the facilities, met with the director and tutors, and heard from some of the adults who are tutored there. All of the aspects of the field trip were important and meaningful to the students: getting out of the classroom and into the “real” world, seeing the run down facilities of the organization, and seeing the hard work and dedication of the volunteers who staff the organization. But by far the most moving part of the trip was hearing the stories of the adults who need the help of the Council. Many of the students were shocked to hear the stories of adults, who ranged in age from their own age to their parents’ age. These personal tales of hardship and wrong turns certainly made an impression on my students.

After the field trip, the students were much more engaged in the project and now saw a reason to participate. Going to visit the community partner makes the project and its potential impact much more concrete to the students. Furthermore, the field trip helps remind the students that there is a world beyond the campus, and a community of which we are a part.

The students were eager to get started when we got back to campus. Each of my classes split into three groups of their own choosing. In the fundraising class, one group decided to collect change from students in the dorms. Another group organized a day at Pizza Hut where the proceeds would go to the Council. The third group decided to design and sell t-shirts with the profits going to the Council. In the marketing materials class, one group decided to make a tri-fold brochure to send to area businesses, one group decided to make a video that the council could post on their website, and the third group decided to work with the Council to set up an internship from Mount St Mary’s University.

All of the groups successfully completed their projects except for the internship group (they made some progress, but not a lot). In fact, the fundraising class ended up raising more than \$3000 for the Council (whose annual budget is around \$400). The students were proud of their work and had often been self-motivated to make the project work. Written reflections from the students were very positive. Some representative quotes are included here.

- This project has also taught me that math is applied in everything we do. Our group had to use some math skills in our project. Math is used in everything

we do and even the most basic math skills are needed. This is why most of the students at the Literacy Council are relearning math because it is an important skill in life.

- I think the event especially says a lot about the Mount, our professor, and the entire class for devoting our time to something that is so important to the people that attend the Council.

Of the 50 reflections I read, there were only two that were negative. Both students who commented negatively did not like being forced to complete a service project. It also seemed that these two students still did not view the project as an integrated part of the course. I could understand these comments. The project did not have a direct impact on any of the material in the Statistics course. Tying the project to course material is often a central tenant of service-learning. Thus, I needed to reflect on whether or not this project was worthwhile and whether or not it really was service-learning. I eventually concluded that, while the project is not perfect and certainly did not meet all the goals of a broad view of service-learning, this project was meaningful for the students. In addition, although I had not yet done anything formal to measure it, I believed that the project as a whole, and the stories of the adult learners in particular, did help change the students' views of mathematics. The adult learners were not able to make it in today's world without a solid mathematics foundation. In addition, many of the adult learners expressed that they wished they had taken their education more seriously. I believe hearing these stories was a meaningful way for the students to begin to see how a good education is a privilege and how mathematics is important to being successful in the real world. Furthermore, because the project entails meaningful service to the community that impacts student learning (through attitudes about education and mathematics), I believe that the project is service-learning.

The following semester, I decided to have my two sections of Statistics complete a similar project. Working with the Community Service Office, a different local agency working with adult learners was contacted as a partner. The project was meant to start about halfway into the semester. As the midpoint of the semester approached, I began trying to communicate with the organization. It took a while to get a response. The community organization ended up pulling out of the project because they were worried about managing the students. I was left with 50 students who were expecting a service project in the course, with only a few weeks left in the semester, and written service reflections as part of the final grade. I again worked with the Community Service Office. We developed a list of service opportunities that were already going on through the university. I asked each student to complete at least 2 hours of service at one of the activities. I also participated in the service projects.

This project was disappointing because most of the service that was completed had nothing to do with mathematics (although the project still fit into the mission of the university). However, there was one positive effect that I

found when reading the written reflections. The students were able to choose a service project that was of particular interest to them (rather than everyone working with one organization). Based on the reflections, this ability to choose a service project that they found engaging motivated some of the students to continue with similar service projects in the future.

The next semester, I once again had two sections of Statistics classes, and the Adams County Literacy Council (with whom we had had a successful experience two semesters prior) was again interested in being a partner. I was anxious to work with this organization again since the first project had gone so well. However, I was also interested in more carefully looking at the effects these projects were having on students in the course. In particular, I was wondering if the projects had an effect on student attitudes toward mathematics, service, and the course. I decided to design a research study to help answer these questions. The full details of this study can be found in Butler [2].

One section was randomly chosen to be the control section. This section did not complete a service project. The other section was the experimental section. Students in the experimental section completed the same course as the students in the control, with the addition of a service project and written reflection on the project. Pre- and post-activity surveys were written to measure attitudes and course components were also used as post-activity measures of student learning.

The students in the experimental group began the project with a field trip to the Council where they met the director of the organization and an adult learner who is tutoring by the organization. Again, I believe this field trip had a big impact on the students. I then met with the Council's director, so we could develop a project that would meet their needs. The director said the Council needed help recruiting tutors, educating the community about the organization, fundraising, and helping the tutors learn about math disabilities. I split the experimental class into two groups: one fundraising group and another education group. The fundraising group worked mainly independently. The education group split into three smaller groups, with students picking their own group. One group designed an email to send to the student body to help recruit tutors. Another group wrote a radio ad to air on the university radio station to educate the community about the organization. The third group researched math learning disabilities, with a goal of making a brochure for tutors.

In the end, the projects were largely successful. The fundraising group did a change collection and a raffle. An email was sent out to the student body and a radio ad was recorded. The group researching math disabilities did not submit the brochure, but one student in the group detailed their research in his written reflection.

When reflecting on this experience, I found that, in addition to the field trip (or instead when unable to schedule a visit), having the community partners visit class can be integral to the project. Representatives of the community

organization can answer questions that you might not be able to answer, help generate new ideas, and help you manage the groups if you have several working at once. In my Statistics class, a representative of the organization visited class and was able to work closely with the group researching math disabilities, to help generate ideas for the radio ad, and to answer questions about the organization with more detail than I could have supplied. I have also had class visits from representatives from the Community Service Office on campus, who are able to help in many of the same ways. Below are some quotes from student reflections that help emphasize the importance of these interactions with the community partners:

- I loved that we were able to go to the place in Gettysburg and hear the stories of students learning there, it was an awesome experience to see how they want to change their lives and improve their education not only for themselves but for some people, their families as well.
- A few months ago our class visited the Adams County Literacy Council. Prior to the trip I had no idea what the Adams County Literacy Council was or what they did. On that trip I learned how much of an impact, particularly in their math department, they have on helping adults pass the test to getting their high school degree.
- The speaker when we visited truly inspired me to help them and made me realize how blessed I am to be attending college. . . .

After this project, I was able to analyze the data. The full analysis is available in Butler [2]. Differences were only found between the sections on two questions on the post-activity survey. The surveys asked the students to select their level of agreement with given statements on a Likert scale with 5 being strongly agree and 1 being strongly disagree. The first difference was found on the following item: “Knowledge of mathematics is important for leading a successful life.” Students who completed the service project ($M = 4.28$, $SD = 0.61$) responded more positively than students in the control group ($M = 3.74$, $SD = 0.75$). The second question was: “Class projects integrating community service are worthwhile,” with the service section ($M = 4.16$, $SD = 0.69$) responding more positively to this question than the control section ($M = 3.52$, $SD = 0.90$).

During the Fall 2011 semester, I also taught a Geometry course for math majors. I thus had an opportunity to again try service-learning with math majors. I decided I wanted the project integrated into the course to avoid some of the pitfalls I had experienced previously. I did not think that I could require students to serve as a mentor in a lower-level mathematics course because of the time commitment required. So I decided to look for a different kind of project. Because I had been unable to design a project that fit well with the course material up until that point, I was especially interested in a project that would use geometry.

I also really wanted the project to be student-run; I wanted the students to decide what to do for the project and to make the decisions concerning the best ways to manage the project so they would have ownership of the experience. Early in the semester we began by talking about potential projects, with the students brainstorming ideas. My only requirement was that the project be related to geometry in some way. Once we had a list of ideas, the students voted to select a project.

The students decided they wanted to put together a math night for local children. They decided on an “around-the-world” theme, where the children would visit different stations and complete fun math activities, themed to different countries, at each station. The children would collect passport stamps. The geometry students were enthusiastic about the project and I was happy that it involved the whole class, involved geometry, and that it was especially applicable to the many secondary education math majors in the course.

Our next step was to talk with the Community Service Director about whom to invite. We discussed many possibilities, such as working with a class at an area school, inviting the children of those who work at the university, and working with an organization such as the Girl Scouts or Big Brothers and Sisters. Voting from a list of possible community partners provided by the Community Service Office, the geometry students chose to work with a local elementary school class. I asked the students to be in charge of working directly with the school. One student was given the contact information for the school and asked to finalize the details. Unfortunately, the student was unable to get in contact with the school. I also tried and was unsuccessful. We went back to the Community Service Office and ended up needing to switch partners. We were given several other choices of community partners, but the semester came to an end before we were able to finalize details with any partner. We were all very disappointed that we were unable to hold the math night. The students did, however, still have the experience of planning and researching their activities. Thus, the students may have gained some geometry knowledge and experience from the project, but it was certainly not a service project.

This largely failed project also taught me a lot. Linking this project with the other service projects I have worked on, helped me to see some common themes. For example, choosing a community partner for a mathematics service project can be difficult. There are many benefits to working with the Community Service Office at your school. The office will have contacts and ideas that you may not have. However, working with such an office may add an extra layer of red tape to the project. I experienced students frustrated with the extra time it takes to communicate with community partners through another office.

It works well if there is a community partner that wants to work with your class. In my experience, however, I am often approaching organizations and asking if they would like to work with us. It is helpful to explain what the learning goals are for the project and how the project would be managed.

Tutoring and working with school students is often an attractive option for mathematics service projects. For example, [8] gives evidence that using math tutoring as a service course component is beneficial to students. In addition, they offer resources for including tutoring projects in mathematics courses. However, I have also run into difficulty when trying to set up partnerships with area schools. In order to work within the rules and requirements of the school, the project may need to be set up well in advance of the semester when students will be doing the work. In any case, communicating early and often with community partners can keep the project from falling apart.

For my Geometry course, the students and I generated the idea for the project and then went looking for a school or organization with which to work. In the end, the project failed. I believe we would have been much more successful if we had formed a partnership and then listened to the organization's needs. Sigmon's work on service-learning supports this idea. In his three principles that he believes are integral to service-learning, he says that those being served should control what the project entails [7].

I also learned that reflecting on failed projects is still important. In my Geometry course, when the project didn't work out, the students initially resisted reflecting on the experience. However, it was very important to me that the students still see the project as a learning experience. With some prompting, time for reflection, and discussion in class, students were able to collect ideas and insights into reflections that will guide them on future projects. I think this reflection may be especially useful for the students who will become teachers.

After the Fall 2011 semester and reflecting on my varied service-learning experiences, I realized that the student groups, especially in introductory courses, need help creating a productive working environment. In more than one semester, I have seen students left out of a group. The reasons have varied, from lack of motivation on the part of the students to a group leader that was overly aggressive and controlling. In addition, I have witnessed groups that are not able to push a project forward on their own. For this reason, I now use progress reports and class presentations to help monitor and motivate the groups. I also use *Cooperative Learning in Undergraduate Mathematics* [6] as a resource for managing the groups. Since the learning, not the service, is being graded, it can be a challenge at times to motivate the students to follow through with the service project. A project timeline, with checkpoints, can help the students feel responsible to the community partner and each other.

Finally, I realized after many semesters of service projects that service-learning has the potential to achieve much more than any of my original goals. For example, when I read my first set of written service reflections, I was happily surprised by some of the things students said. Below are some quotes that exemplify what I mean:

- Moreover, it was evident that it took a lot of courage for the Change for Change individuals to go to so many dorm rooms and repeatedly explain what we were trying to accomplish to people many of us never have met before. This is where I observed the most growth during the experience, besides having the class realize how important non-profit organizations are.
- This experience has taught me that marketing is a lot of work!
- I learned to appreciate my education and the opportunities that I am being given, which many other people don't get.
- By participating in the project I can say that it helped me to be less worried about myself and to really help others.

I noticed unexpected effects of the project such as improvements to the students' leadership, public speaking, and organizational skills. Since reading that first set of reflections, I have gone into the projects with a goal to cultivate these additional outcomes. For example, I have encouraged students to take on leadership roles at different points in the project and I have worked with students to plan and practice what they will say in public situations about the project and its goals.

Through my experiences, I have seen that service-learning has the potential to improve student attitudes, help the community, and teach students the value of education. Achieving these goals, however, takes careful planning and management of the projects. As mathematics educators, we have an opportunity to use service-learning to help tackle some of the problems facing mathematics education today. I hope to continue to grow and learn about service-learning and about how to best use service-learning for my community and my students.

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BIOGRAPHICAL SKETCH

Melanie Butler began using service-learning in Fall 2010. Since then, she has been working to incorporate service projects into both math major and service courses. Her research interests are technology in mathematics education and service-learning.

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