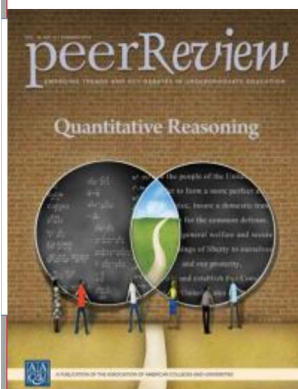




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Peer Review

## Service Learning in a Quantitative Reasoning Course

By: Allison Henrich and Jeffrey Anderson

One of my earliest memories from my experiences with math is from when I was in second grade. We were counting by twos as a class and my teacher singled me out for not knowing them—I was just saying random numbers. I remember he laughed and the entire class also erupted in laughter. From then on I knew I would never be good at math."

This is a quote from a student's math autobiography in a recent quantitative reasoning course at Seattle University. While the details of students' mathematical histories vary from person to person, a traumatic mathematical experience from childhood that has had persistent negative effects is common amongst students enrolled in this course.

It is apparent that if we are to effectively teach quantitative reasoning, one of our fundamental goals needs to be to help our students reduce their mathematical anxiety and improve their attitudes toward math. Ashcraft (2002) confirms that students with high levels of math anxiety are likely to avoid math whenever possible. As a result, people with math anxiety perform poorly on mathematical tasks not only as a direct consequence of anxiety, but also as a consequence of the fact that their anxiety has led them to avoid learning math and quantitative reasoning skills in the first place. If we are to effectively teach students math, we must reduce the students' math aversion. There are a number of techniques that can be used to address this issue. Here, we will focus on one in particular: service learning.

Since 2010, the first author has regularly taught quantitative reasoning with a service-learning component. As part of this course, university students are required to tutor elementary school children in math for two hours each week for roughly eight weeks. They primarily tutor elementary school students who struggle with math.

Before their service-learning experience begins, tutors are provided training that helps them to develop basic cultural competencies (such as avoiding making judgments regarding the children's academic abilities based on their ethnic background or economic status) while emphasizing that a positive attitude is of utmost importance when working with young learners. They see firsthand that having a poor attitude themselves will translate into low motivation and interest on the part of the children they are working with. So our tutors often employ a "fake it 'til you make it" strategy, manufacturing an infectious mathematical enthusiasm. It is common for students to express the following sentiment.

"I was pretty surprised that this quarter I've been feeling so much more positive toward math and I can't help but think that tutoring played a major role in that."

During their service-learning experience, many university tutors see themselves in the children they are working with. This third-person perspective on math anxiety and avoidance helps tutors work through their own aversions and boosts their confidence. In his final tutoring reflection, a tutor commented on this insight:

"I have been able to better understand the traditional troubles surrounding math, why and how these troubles occur and how they can create an irreversible (or practically irreversible) hatred of math."

The tutor quoted above seems to recognize that, while most math-anxious people in our society never get past their fears and 'hatred of math,' it is possible to turn these attitudes around. Indeed, in our ongoing research into the effects of this course, we are seeing a statistically significant increase in students' confidence in their mathematical abilities and a positive shift in their attitudes towards math, as measured by the Fennema-Sherman Scales (Fennema and Sherman 1976).

Now that we have a glimpse into the benefits of a quantitative reasoning course with service learning in particular, we will take a brief look at the history, rationale, and benefits of service learning in general.

### **An Overview of Service Learning**

Over the past two decades higher education in the United States has witnessed a dramatic growth in the use of service learning as a pedagogy to enhance students' academic learning and civic engagement while simultaneously working with the larger community to address unmet social needs.

A few facts regarding service learning in the United States highlight this growth:

- More than 1,100 institutions are now members of the Campus Compact, a national organization formed to support the growth of service learning and community engagement in higher education and 91 percent of those institutions offer service-learning courses (Campus Compact 2012).
- Service learning has been identified as a high-impact practice and one of only four practices that have a positive impact on retention of students in higher education (the other three are study abroad, undergraduate research, and living-learning communities) (Kuh 2008).
- A growing number of departments and universities are requiring students to complete service learning experiences as a requirement for graduation (Butin 2010).
- Students are increasingly recognizing the importance of contributing to the larger community as a core component of their education (Clayton, Bringle & Hatcher 2013).

Service learning is not just a recent phenomenon or an educational fad; it has a rich history rooted in the transformative, progressive educational and social ideals of reformers such as John Dewey and Jane Addams. One reason for the recent continuing growth of service learning is that most students like it. They appreciate the way in which service

learning allows them to explore connections between the theoretical realm of the classroom and the practical needs of the community. It provides them with the opportunity to test facts and skills learned in the classroom, refine their problem-solving abilities, and work collaboratively with diverse groups of people.

A growing body of research (Clayton, Bringle, and Hatcher 2013; Eyler and Giles 1999) indicates that participation in well-designed service learning can result in a wide array of positive outcomes for students, including

- **cognitive growth** (intellectual development, critical thinking, problem solving, and application of knowledge and skills across settings)
- **academic learning** (higher essay exam grades, deeper understanding of subject matter, student self-reports of greater learning)
- **civic learning** (enhanced civic knowledge, skills, and values)
- **personal development** (self-efficacy, identity, moral development, spiritual growth, and career development)
- **intercultural competence** (building cross-group relationships, disrupting stereotypes, gaining awareness of community resources and problems, increased sense of teaching efficacy with diverse youth)

#### **Our Students' Service-Learning Experiences**

In order to achieve the desired outcomes for students and the community, faculty must intentionally design service-learning courses to focus on those goals. Both research and the experiences of knowledgeable service-learning faculty indicate that successful service-learning courses share certain common characteristics. We describe these characteristics and consider how they emerge in our own quantitative reasoning course with service learning.

#### ***Meaningful Service—students engage in personally relevant service activities, students see their actions as having positive consequences***

It is common for students in the quantitative reasoning course with service learning to express the belief that they are making a difference in the children's lives, both mathematically and on a more personal level. One reflection essay described such an experience:

"I remember a student came up to me and just spilled his life story about how he only lived with his mom and sisters... I remember him saying, 'I like having you around.' And I feel like since then, I had a little reality check and needed to remind myself that just being there to talk with him makes a big difference."

At the end of her reflection, this student expressed an interest in continuing her tutoring after the quarter was over. Each time this class is taught, about half of the students report that they plan to continue volunteering beyond the end of the academic term because they feel like their service is important.

In 2010, when Seattle University began to implement various math and science outreach programs (including our service-learning course), the percentage of fourth graders at our local elementary school proficient in math as measured by their performance on the Measurements of Student Progress test was

33 percent. By the 2011–12 academic year, 59 percent of the fourth graders achieved proficiency, and in 2012–13, 60 percent reached this level.

**Sufficient Duration and Intensity—*the service lasts long enough to achieve learning and community goals and is seen by students as a significant aspect of the course***

Through reading the reflections of the students in the quantitative reasoning course throughout the quarter, it is clear that many students' attitudes undergo a transformation. One student had this to say about her experience:

"If I'm being completely honest, I was pretty skeptical about the service-learning part of this class. My first reaction was, how could I possibly tutor anyone in math?! I'll probably need a tutor, but I could never BE a tutor. Even though it's kids and it's counting and addition, etc., I don't speak math. I can't explain numbers to anyone. I was pretty nervous, but I figured if I stayed positive and pretended to be confident, I could do it... So far I have really enjoyed working with the kids. The anxiety of screwing up or not being able to help has gone way down. I've found that I can usually (though sometimes it's harder than others) answer questions, and it's not the end of the world if I can't. I am excited to see the kids grow and progress in the short time I will be working with them."

Change in attitudes doesn't happen overnight, both for the university students and for the children they are working with. Several months of consistent tutoring are needed for them to build relationships and to build their own confidence in their mathematical abilities. While eight weeks is enough time to build an impactful service relationship, it is certainly a limitation of this course for the learning of both the tutors and the children that they do not have a longer period of time to work together.

As mentioned above, many students elect to continue tutoring beyond the end of the quarter to deepen their relationships with the children and teachers they work with. Our Center for Service and Community Engagement does an excellent job facilitating placements for those who decide to continue their service. The students' willingness to volunteer their time, together with the institutional support for volunteering in the community, lessens the issues surrounding the short duration of the course.

**Strong Connections between the Curriculum and Service Activities—*transparent links between course content and service allow students to make explicit connections***

What is unusual about the service-learning experience that our students have is that it is not designed primarily to reinforce the specific mathematical topics that are taught in the course. In the quantitative reasoning course, students learn about voting theory, financial math, and statistics, among other things. When they tutor, however, they often help kids with basic arithmetic.

Instead, the tutoring experience is designed to increase students' interaction with mathematical ideas and to help them see how much more sophisticated their mathematical abilities have become. Tutoring invites students to think about basic mathematical algorithms that they have long taken for granted in a different way. The curriculum that is used in Seattle Public Schools employs nontraditional techniques and algorithms for teaching basic arithmetic. Here is one student's reflection on the curriculum:

"Tutoring has helped me understand arithmetic better because the kids at Bailey Gatzert have numerous ways to learn it. There are fact triangles, math boxes, and dice games—fun yet functional ways to learn and practice math."

Students in the service-learning course often find themselves wondering if the way the kids are taught to perform a computation today is equivalent to the way they were taught as kids. In effect, students become more curious about math and feel like they are capable of getting to the bottom of these issues and understanding simple concepts at a deeper level.

***Student Voices—students are provided with opportunities to play a role in designing projects and make meaningful decisions regarding their implementation***

Because of the logistical issues with connecting students with math classes or after school programs, they have less of a voice in their placement than would be ideal. In some cases, however, a student will come into the course having already developed a relationship with a group of students at a local elementary, junior high, high school, or community college through another service-learning course or volunteering opportunity. In these cases, we are usually able to place students back in their established tutoring site, as long as they can guarantee that they will be tutoring math as a part of their service.

In the future, we may consider expanding the placement options for our students. This would afford them the opportunity to work with more advanced students if they feel like they would benefit more from that experience.

***Community Voices—community partners share decision making with faculty related to identifying outcomes and implementing programs***

Seattle University math faculty work closely with our Center for Service and Community Engagement and local schools to match tutors with placements at specific school sites. Tutors are only placed in schools where there has been an expressed request from the community. Teachers at a local elementary school, Bailey Gatzert, requested tutors to help provide the following types of support:

- more adults in the classroom in order to allow teachers time to address individual student needs;
- small group and one-on-one tutoring on essential math skills and concepts;
- college students to act as role models, to plant seeds in the minds of the young students suggesting that they, too, can go to college; and
- additional relationships with caring adults.

After the tutoring sessions at Bailey Gatzert were completed, here is what several teachers have said about the involvement of Seattle University service-learning students:

"The service learning students I worked with quickly became a valuable part of our classroom community, they built positive relationships with my students and always went above and beyond."

"Honestly, I don't know what we would do without the math service-learning students. I remember back to when we didn't have them and it was so much harder in the classrooms. The



contributions they have made have been amazing."

"The service-learning students have become a critical piece to help keep our classroom running smoothly. With their help we are able to do more station activities, allowing for more small-group settings to cater to individual student needs. This has contributed a lot to our students' improvement on standardized tests."

***Diversity—in the populations involved and the types of experiences students gain***

At Bailey Gatzert, the primary placement site for tutors, 96 percent of kindergarteners qualify for free or reduced-price lunch and most students are immigrants from East Africa or Southeast Asia. Since most Seattle University tutors are white and from middle-class backgrounds, the opportunity to work with Bailey Gatzert students can expand the tutors' understanding and appreciation of human diversity.

***Critical Reflection—students participate in regular, structured oral and written activities that involve them in critically examining all aspects of their experiences in order to integrate classroom and community learning***

Every two or three weeks, students write a short reflection essay about their tutoring experience. They are prompted to make connections between the experiences of the children they are working with and their own experiences with math. They are also asked to reflect on what skills they have developed as part of their tutoring.

In addition, we have short discussions in class every few weeks where students can compare experiences. At the end of each quarter, about half of the class is asked to participate in a focus group. This is a valuable reflection experience for some students in the course.

**Conclusion**

"Tutoring has been surprisingly amazing. I never thought I would enjoy it as much as I do. I certainly didn't think delving back into my traumatic elementary math experiences could be so rewarding... I think I might be discovering my own love for math!"

This student quote sums up many of the benefits of a quantitative reasoning course with service learning. Students who enroll in quantitative reasoning courses in college often have a history of math anxiety and negative attitudes about math. Well-designed service learning can be an effective avenue for improving mathematical attitudes, achieving both our educational and our psychological goals for this population of students. Moreover, students have the opportunity to have a positive impact in their community by becoming mentors and tutors for children who face similar mathematical challenges.

Looking ahead, we plan to continue to offer our quantitative reasoning course with service learning at Seattle University, while making improvements to its structure. In the future, we may include more placement site options for students to choose from. We also aim to deepen student reflection on their experiences by including more in-class discussions, as suggested by the students in recent course evaluations.

Some of our colleagues plan to incorporate service learning into

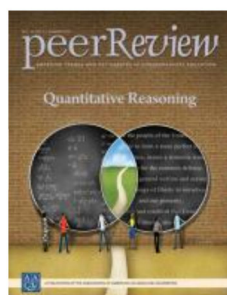
more advanced math courses during the next academic year. We are excited about this possibility and will be curious to see what types of benefits emerge both for our students and for the community in other service-learning experiences.

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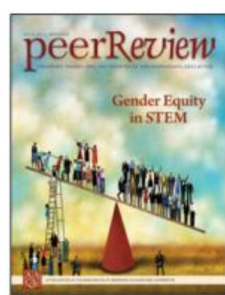
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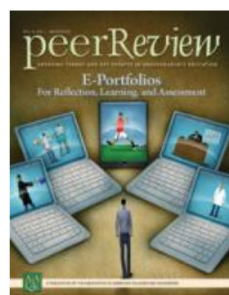
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