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A Little Change Can Make a Big Difference

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Abstract

The opportunity to teach mathematics through service learning projects provides a relevant and connected experience that encourages concept development and problem solving proficiency while also developing students' feelings of generosity and altruism. In this article I describe a prior project that helped my students, many of whom struggled with mathematics, become engaged in mathematical thinking and reasoning. Additional specific connections are made toward extended projects surrounding current events, as well as state and national standards.

While the saying, "It takes a village to raise a child" is a prominent cliché in educational jargon, one of the most influential ideas I subscribed to in my teaching years was not related to how the community could impact the students in my classroom, but how my students could have a positive impact on our community. Each year I dedicated a portion of my planning time to develop project-based activities in which my students could "pay it forward", or find a way to give back to their community. While we had successful projects in the past, none made a more substantial impact on the way I approached teaching mathematical ideas through community service than after the devastating Hurricane Katrina hit in 2005. In this article I describe how my fifth graders, and their families, worked together with members of the local community to support the needs of people affected by a catastrophic hurricane. In light of the recent flooding disaster that impacted the state of South Carolina, the opportunity to engage students in service learning presented itself again. Thus, this reflection also extends the implications of the Katrina learning experience to more recent events as valuable opportunities to apply mathematical learning in conjunction with developing students' feelings of generosity and altruism.

Following the aftermath of a devastating hurricane in the fall of 2005, my Florida students came to school with an extraordinary amount of questions about the causes of the hurricane and what would happen if the tragedy struck closer to home—a fear that was realized in the flood ravaged areas of South Carolina ten years later. These questions stimulated a number of discussions and hypotheses from the group, however, one question seemed to be more powerful than the rest, "What happens to the people who were in the shelters? Can they stay there forever? Where do they go?" From this point our conversations took a detour. It was no longer about the extreme weather, but my students' attention turned to the effects of nature's wrath and the plight of the affected families. As a result, that fall of 2005 we began devising a plan that could provide support and resources to the victims of the catastrophe in the most effective way possible. By the end of our project we determined a both telling and appropriate name, "A little change can make a big difference".

Gathering Data

To begin our project, my students collected information about the hurricane from newspapers, magazines, and other news reports. They were fascinated by the wind speed, the amount of rainfall, the number of sandbags used, the sheer area of the region, and the estimated number of people who were impacted by the hurricane. I invited a professor from the local university to speak to my students and answer questions about the hurricane. Their "homework" was to go home and discuss potential options with their families, listen to news reports, and return with ideas that would be feasible for a group of elementary students and their families. It was important for us to consider potential ideas in the context of whether it would be realistic for us to collect donations—supplies or money—or develop respective materials with the resources we had. After our discussion we developed a survey, which included three viable options: (a) helping animal shelters, (b) creating hurricane safety packets for our Florida community, and (c) donating to the American Red Cross. As homework for the next evening, my students conducted the survey with members of their family and recorded their family's vote indicating how they would like to contribute to those suffering from the after effects.

My students tallied our class votes and represented the information through both a bar and a circle graph. With 22 students in the class, it was not a simple process to translate the data from the bar to the circle graph. To begin constructing the circle graph we used a clock model, a visual reference we often utilized with fractions due to its familiarity and flexibility working with denominators of 2, 3, 4, 6, 10, 12, 15, 20, 30, and 60, which are commonly used in intermediate grades. We used an estimate of 20 total votes, a factor of 60, to generally reflect the data from our survey because the students in my class needed continuous reinforcement with fraction concepts, and even working within this multiple of 10 would effectively challenge my students' mathematical thinking and reasoning. Moreover, I recognized the opportunity to extend students' thinking by allowing those who needed an additional challenge to calculate the exact fractions and percentages to compare with our estimates. With the approximation of total votes we had to determine how we would adjust the resulting data from our survey: seven votes for the animal shelters, three for the pamphlets, and 12 for the Red Cross donations. Because we removed two from the total responses to have a "round number" of 20, my students also felt it was important to delete two from the vote distribution. The consensus was to take one vote away from the two largest groups. This left us with 6/20 for the animal shelter, 3/20 for the pamphlets, and 11/20 for the Red Cross. Then the fifth graders worked in small groups to create a clock model that would represent the fractional data (see Figure 1).

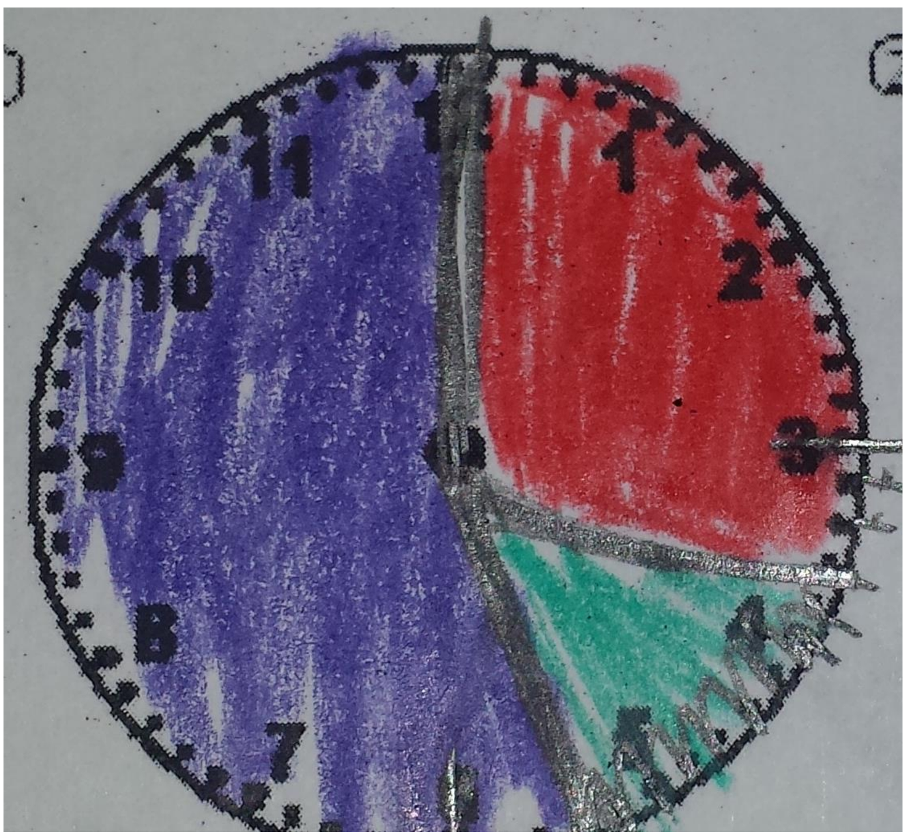

***Figure 1.* Clock model to represent fractional survey data.**

In the subsequent discussion during that class period students shared strategies for finding equivalent fractions with 60 as the denominator to represent the total number of minute marks on the clock model. At that point we were ready to place our vote totals on the circle graph. We began with the results for the animal shelter. Here, some students set up equivalent fractions such as 6/20 = x/60 and then multiplied by 3/3 to calculate the equivalent fraction 18/60. In slight contrast, a few other students took a more concrete approach "fitting", or iterating, 6/20 on the clock as many times as possible. The members of the group explained that they realized it would work because, “You can count by 20s. 20, 40, 60. So then we checked and you can put 6/20 on the clock three times” (see Figure 2).

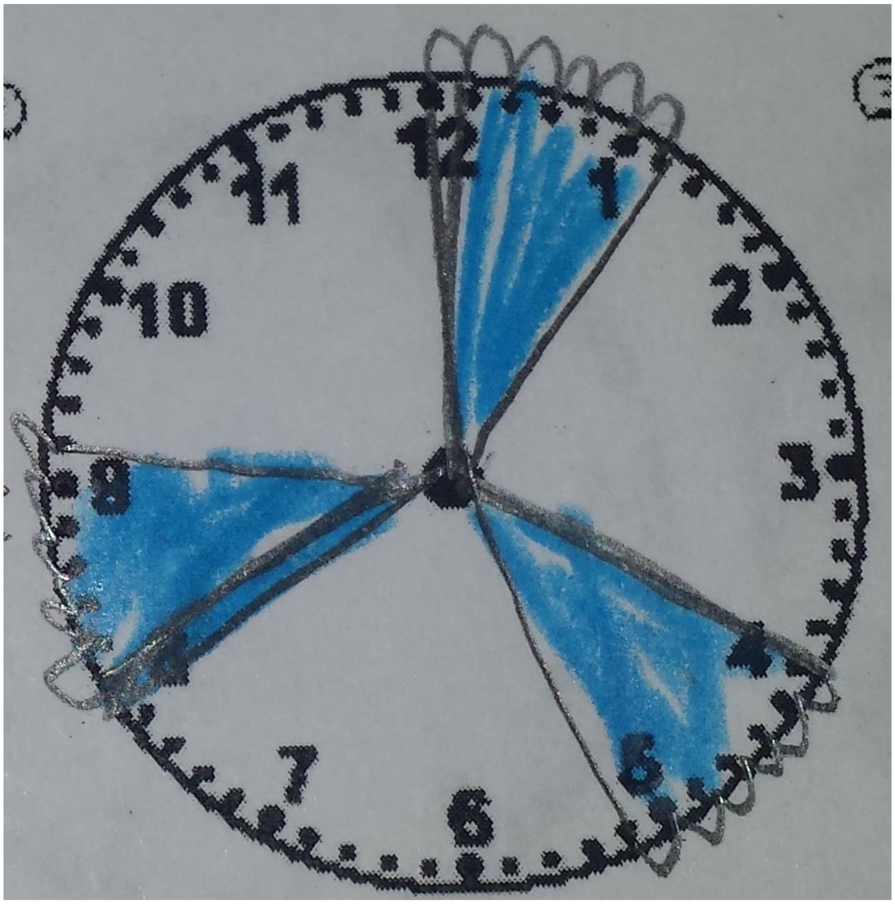

Figure 2. **Demonstration of finding 6/20 of the clock model.**

Next, the class decided to focus on the section representing the Red Cross. One student noted it should be more than half of the clock because 11/20 was more than half, “two tens make twenty so ten is half and eleven is one more than ten”. We used that justification to guide our thinking as we multiplied by 3/3, or one whole, to determine the equivalent fraction of 33/60. The following step proved to be a bit trickier as we had to determine how we would include that portion on the clock model since we had just put the animal shelter portion on the graph starting at the “0” point. One student said that we could count the minute marks “backwards” (counterclockwise) from the 12 on the clock, “and we can see it will be more than half because thirty would be at the six ‘cause we started at the top and then we count three more”.

When the students shared their ideas for calculating the fractional part of the circle graph representing the pamphlets, one student recognized that the number of votes for the pamphlets (3) was half of the number of votes for the shelters (6). Therefore, he explained to the class that if the votes for the pamphlets were half of the votes for the animal shelter then the size of the graph piece should also be half. With this realization, several students in the group began to comment, with one student specifically articulating the numeric relationship, “Yes! So if the minutes on our clock for the shelters is 18 then the pamphlets should be half of that”. Although some students argued that three votes was not exactly half of the seven actual votes, they agreed to estimate as long as the group included the caveat that “the smallest piece for the pamphlets would be almost half of the middle piece for the animal shelters”.

The discussion of equivalent fractions on the clock model led our class into a new exploration during the following math period. The next day I introduced the word percent as “per hundred”. I had the students recall strategies from the previous day and then apply number knowledge to approximate the percentages of our data. The students worked together, helping various groups calculate the percentages—again setting equivalent fractions—by both hand and with the aid of a calculator. In addition to checking one another’s answers, I also encouraged the students to check their work against the group’s predictions to determine if the results seemed valid. For example, the students predicted that the American Red Cross should be a little more than 50% because 50% would represent half of the votes. Their final calculation, using equivalent fractions with a denominator of 100 resulted in 55% (11/20 = 55/100). Finally, after two days of constructing the circle graph to represent our survey data, the fifth graders came to a consensus to collect donations for the leader with the greatest percentage of votes—the American Red Cross—and then began outlining how we could organize possible contributions.

Setting Goals: Fill the classroom!

Our first decision was to begin collecting items to donate: non-perishable food, household items, first aid supplies, clothing, blankets, and toys. My fifth graders created posters and signs that were displayed around the school, and they also designed newsletters that could be sent home in students’ Friday folders. They were determined to “fill up our classroom” with donated goods and excitedly brought in items each day, or helped to sort and count the different categories. During this process one parent informed me that the Red Cross may not take donations of some items we collected, however, they knew of a church in the community that was collecting items such as these. She offered to take the items we collected to her church after they were boxed.

To help my students understand the sheer, and literal, volume of their contributions in one week—and to compare their actual collection to their goal of “filling the classroom”—we found the approximate volume of each of the categories of items. Using donated boxes from families, local grocery stores, and other stores we packaged our items as tightly as possible and calculated the approximate total volume of individual categories as well as the combined total. Then we used calculators to find the total volume of the room, and noted the difference between the room and the total volume of our donations. I asked the students to predict how many days they thought it would take to fill up the room if we kept the same “collection pace”.

After realizing that it would take a large number of donations to fill the room, one of my students asked if we could “fill up” the floor with our boxes. I asked Lindsey to pose the question to the rest of the group. Many students looked at the stacks of boxes, some stacks taller than they were, and immediately hypothesized that they could fill the floor. Before I allowed the students to physically move the boxes, I asked them to work in groups and use the measurements to figure it out. A number of groups re-measured the length and width of the base of the boxes to find the area and added the areas of the different boxes. However, a few groups used calculators to divide the volume by the height of the box because they “didn’t want to have to measure again”. One group divided the total volume by a measurement of the base. This led to a wonderful discussion when we shared our results, which encouraged the group to consider what we were finding the area of when we calculated this way. From the combination of our conversation, manipulating the boxes, and drawing diagrams the fifth graders recognized that by dividing by a dimension other than the height we were finding the area of a different face of the prism (box). Moreover, they decided that this was not ideal because the new area (square footage of the side of a box) was smaller than the area of the base.

At this point, we had spent a week of our class organizing and analyzing data, constructing various representations of our results, and investigating volume and area. My fifth graders were engaged in mathematics through a community-oriented project that was relevant and meaningful to them. Most importantly, the project was initiated by their own desire to give back to those in the community. The mathematical lessons were simply a natural step in the process. However, as I soon learned, my students felt as though they could do more. A few days later, Oscar came to me with a handful of pennies—and a completely new goal.

Rollin' in the Dough

At our morning meeting the next week, Oscar asked if he could share another idea he had to help the hurricane victims. He talked about how he kept finding pennies on the ground "where ever" he went and thought that if we collected enough of these, and other coins, we could donate the money to the American Red Cross because they "did not take all of our donations [of items such as non-perishable food, household items, first aid supplies, clothing, blankets, and toys] so they still needed help [with monetary donations]". My fifth graders were excited, however, as a public school teacher who knew that many of my students' families struggled financially, I was hesitant to ask for monetary donations following our already successful collection of domestic goods. I discussed the possibility with my principal and together we devised a letter to the families informing them of the class' idea. To my surprise the following day my students brought in cups, handfuls, and bags of coins ranging from pennies to quarters, and even included some paper money. They described how they found the coins (and dollars) in their bedrooms, around the house, in the car, on the playground, or in a parking lot. While each day we gathered fewer and fewer coins, the change trickled in for another week until we stopped to count how much we had donated.

I used a three-gallon water bottle to store our donations and had students predict how much money was in the jug. Estimates ranged from $100.00 ("there's some dollars in there, too") to $23.00 ("there's a lot of pennies in there and those take up a lot of room"). We recorded the estimates and I told the students that we could not donate the money in this form. I explained that I would be taking the money to the bank, but before the bank would accept it we had to roll the coins. I showed them the various rolls: 50 cents for penny rolls, $2.00 nickel rolls, $5.00 dime rolls, and $10.00 quarter rolls. The very first question was from Taylor, "How many coins do we put in the roll?" I explained that was their job to figure out.

My students worked in small groups to determine how they would accurately fill the rolls. Not only was it a challenge for them to figure out the exact number of coins for each of the different rolls, but physically placing (and keeping) the coins in the roll was also a unique experiment. I circulated the groups to ensure that they were filling the rolls correctly and provided prompts to guide their thinking such as, "How many nickels (dimes, quarters) are in one dollar?" Following this time-consuming, but productive, event my students shared strategies such as: (a) grouping the coins into dollars and then grouping those sets by the amount on the roll, or (b) using mental math to figure out the number of coins for each roll and counting out that number [e.g., there are four quarters in a dollar and ten dollars in a roll, so that's 40 quarters], and still others either (c) skip counted by the value of the coin, or (d) thought about "hairy coins" (see Figure 3) and counted by fives.

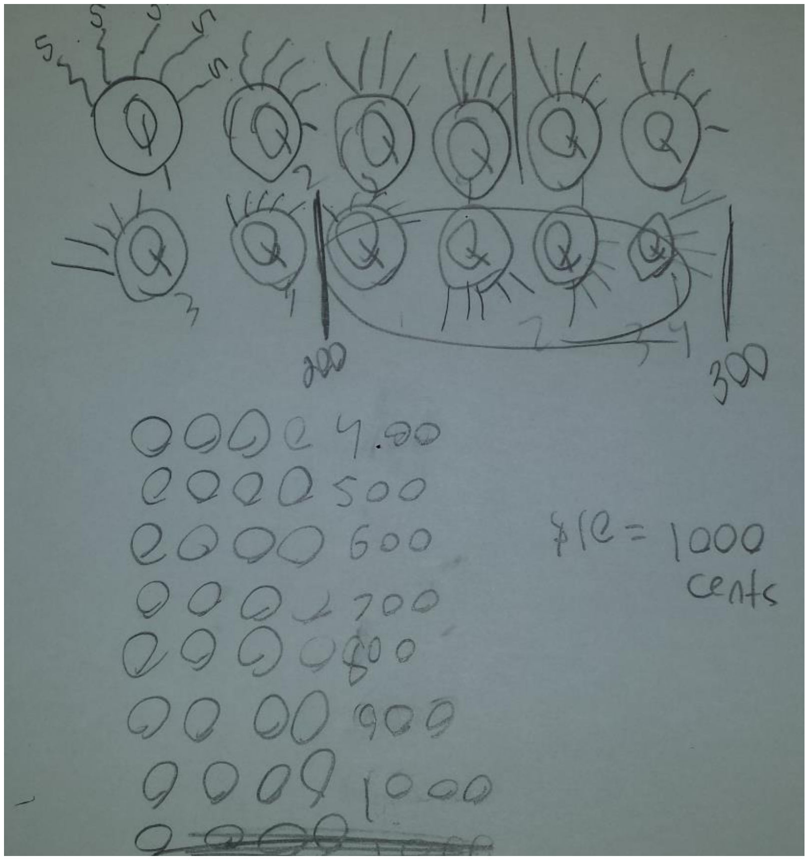

Figure 3. **Counting quarters using "hairy coin" method.**

We discussed how these strategies were similar and then checked our calculations by comparing results using the different strategies.

At this time I also re-introduced the concept of partitioning through division using the total number of cents to avoid the decimal points. In other words, we worked through examples such as first, converting $10.00 into a number represented using only cents, "$1.00 is 100 cents so $10.00 is ten groups of 100: 100, 200, 300, 400…1,000". Then using a "think aloud format" we divided 1000 cents by 25 cents in order to figure out how many quarters we would need in a roll. Finally, we totaled our collection and were happy to find that we gathered $57.64 of "spare change". I photographed myself taking the coins to the bank, and purchased a money order to send to the American Red Cross in honor of my students' selflessness.

Standards Met

Several mathematics standards were met throughout this project, which corresponded to the Sunshine State Standards my students were expected to reach. However, because the mathematics in this project is also relevant to a number of service projects for which students across the United States could advocate, the following section identifies the corresponding Common Core State Standards for Mathematics (CCSSM). Moreover, in light of the flooding devastation the residents of South Carolina recently faced, direct connections are made to the South Carolina College and Career Ready Standards (SCCCR), and are exemplified in the following bullets:

- [CCSSM 5.NBT.7; SCCCR 5.NSBT.7]: Add, subtract, multiply, and divide decimals to hundredths, using concrete area models and drawings. *When students calculated the various amounts of* *loose change they had an opportunity to apply addition or multiplication strategies with decimals to find the total amount of spare change.*

- [CCSSM 5.NBT.5; SCCCR 5.NSBT.5]: Fluently multiply multi-digit whole numbers using the standard algorithm. *As students calculated the volume and/or base area of the boxes students could compare results and apply the standard U.S. algorithm and/or other methods such as partial products, derived facts, and repeated addition.*
- [CCSSM 5.NBT.6; SCCCR 5.NSBT.6]: Divide 4-digit dividend by 2-digit divisors using strategies based on place value, properties of the operations, and relationships between addition, subtraction, multiplication, and division. *When students calculated the number of coins needed in each roll, they applied compensation strategies, converting both dividend and divisor into "cents" in order to calculate. Class discussions focused on the context of "moving the decimal point" in order to divide a number by a decimal. For instance, when dividing $10 by $0.25, one often "moves" the decimal place two places to the right in the divisor ($0.25) and also in the dividend ($10), which provides an opportunity to explore the relationship between $0.25 and $10 and 25 and 1000.*
- [CCSSM 5.MD.5.b; SCCCR 5.MDA.3]: Understand the concept of volume measurement. *When students compared the volume of the room to the volume of the donated goods, they had to recognize and apply the concept of volume for rectangular prisms (boxes) in the context of solving real world and mathematical problems.*

In addition to the content standards for fifth grade mathematics, through their participation in these project-based activities students had the opportunity to develop mathematical skills and proficiencies, which prominent researchers in mathematics and the writers of Common Core refer to as "varieties of expertise that mathematics educators at all levels should seek to develop in their students" (National Governors Association Center for Best Practices, Council of Chief State School Officers, 2010, p. 6). In the context of this project, students not only initiated problems and solutions, but made sense of and persevered while solving problems (CCSSM Standards for Mathematical Practice [SMP] 1); constructively reasoned abstractly and quantitatively (CCSSM SMP 2); and modeled with mathematics (CCSSM SMP 4). Beyond the mathematical competencies and skills my fifth graders gained from this project, most importantly they participated in mathematics that was integrated, relevant, and meaningful. They set and accomplished goals, working to help their fellow man.

This is NOT the end

It may take a community to raise children who are eager and confident about mathematics, but to truly educate a child it also includes a dedication to helping them realize they have the power to make a difference; and that they have the power to work toward change in today's society. In this community service project, fifth grade students banded together with their families, school administrators, and members of the community in order to make a positive contribution to individuals in need. This invaluable partnership provided a meaningful and applicable foundation for elementary students to improve mathematical learning.

As a result, I extend the challenge to you—the reader—and your students, teachers, or teacher candidates. With the catastrophic events that citizens in South Carolina, across the country, and across the globe have recently experienced, we—as mathematics educators—have the opportunity to demonstrate first hand how mathematics is embedded in the real world. It is imperative that our children recognize they have the knowledge, skills, creativity, and innovative spirit that can truly make a difference in the world. We must empower our students as ones who have the capacity to benefit society—particularly in times of need. Table 1 reflects possible activities that demonstrate how these same principles could be applied across all elementary and early childhood grade levels with respect to the recent flood in South Carolina, but the same lines of thinking can also be extended to address disparity or need in multiple contexts.

Table 1

Grade Level/Standard	Standard Content Overview	Suggested Activity
SCCCR K.NS4, K.NS5	*Relate numeral to quantity*	Count donated items through 20 using 1-1 correspondence
SCCCR 1.MDS.4	*Collect, organize, and represent data in up to 3 categories*	Sort donated items (e.g., clothing, food, toiletries) or coins to compare categories
SCCCR 2.NSBT.7	*Add through 999 with concrete models, drawings, or PV strategies*	Determine the total number of bottles of water with *x* cases of 12 or 24 bottles
SCCCR 3.ATO.3	*Solve real world problems involving equal grouping*	Distribute resources evenly among *x* number of families
SCCCR 4.NSF.1	*Use fraction models to explain how the number and size of parts are different even though the fractions are equivalent*	Cook meals for emergency personnel with selected unit fraction measuring devices (e.g., 1/8 tsp., ¼ cup, 1/3 cup)
SCCCR 5.G.2	*Plot and interpret points in the first quadrant of the coordinate plane system*	Apply the coordinate system to develop a map that identifies devastated areas in the affected region

At the end of the 2005 Katrina project, my students and I felt that this small bit of change (both literally and figuratively) was, in fact, going to make a big difference. This project helped my students, many of whom struggled with mathematics, see the relevance in key mathematical concepts and skills. In addition, as my students participated in this project, they were motivated to accomplish the goals and challenges they faced as they solved problems and worked toward solutions. These activities made a difference in the way they saw the world, and the way they saw their role in society. The students recognized they had the ability to make a difference, which helped them realize they had so much to give. The feeling of worth stimulated my students' passion for solving problems and persevering through difficulties; they were now more inclined to wrestle with unknowns. It is this result that makes me love teaching. And it is this spark of hope that I wish to ignite in other teacher educators, as well as the practicing and prospective teachers with whom I work and the communities in which they live.

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National Governors Association Center for Best Practices, Council of Chief State School Officers. (2010). *Common Core State Standards for Mathematics*. National Governors Association Center for Best Practices, Council of Chief State School Officers: Washington D.C.

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Dr. Buchheister has been an Assistant Professor in Early Childhood Education at the University of South Carolina since 2011. Both her research and teaching focus on developing practicing and prospective teachers' understanding of the cultural contexts of learning and constructing appropriately challenging environments that provide the greatest opportunity for all students to achieve high quality experiences.