

PUBLIC STORIES OF MATHEMATICS EDUCATORS

The Pen Pal Partnership Project: Connecting Theory to Practice

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In this public story, we describe the design and implementation of an interdisciplinary pen pal project that pairs university students¹ taking a mathematics course for prospective teachers with local elementary children. In its first 2 years, the project involved pairing students with children in a rural school district and, in subsequent years, it has included children in an urban school district. The geographical location of the children appears to have had little effect on the goals of the project; the students and their pen pals have enriched, learning experiences each time they get together. Broad support and enthusiasm for the project in the urban schools, however, have produced some remarkable and somewhat unexpected effects. While the project focuses on supporting the learning of mathematics, it also offers social development opportunities for children. The children have the opportunity to practice writing a letter to an actual person and many are exposed to college for the first time. Through the project, children in urban (and rural) schools are also connected to mathematics learning in ways that supplement what the public system is able to consistently offer. In addition, the university students apply and enhance their language arts skills as they extend their own mathematics learning to include teaching and learning mathematics by and with children. In the story that follows, we detail how my (Virginia's) plan for enhancing students' learning of mathematics initiated a community-based partnership that continues to flourish today.

¹ Throughout this article, the word *student* refers to college-age students and the word *children* refers to students in pre-kindergarten to grade eight, unless a part of a quote.

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The Pen Pal Partnership Project

What began as a fairly simple alternative assessment for students in a Mathematics for Prospective Elementary Teachers course has grown to offer many enhanced learning opportunities for children, students, classroom teachers, and me, Virginia (a university professor). One of the projects I assign is to create a children's book based on the mathematical principles studied in the course and to share these books with local school children. I was working at a rural university; therefore, the local schools the students and I visited were also rural schools for which there were few extra services or opportunities for children to interact with college students. The school visits became the highlight of the course for my students. I found the visits well worth the effort as the students benefitted from opportunities to see and hear how the children understood and responded to their books. Students gained a much better sense of how important clear communication of mathematical ideas is in order for children to be able to make sense of them.

When I moved to my current position at the University of Dayton (an urban university), I wanted to continue using the book-creation assignment. In our teacher education program, students majoring in early childhood education and intervention services (special education) take two courses in mathematics for prospective teachers, often with the same instructor. In my course sections, I continue to use the children's book assignment. In the first course, students create a book related to learning how to meaningfully count. They visit a local preschool, read their books to preschoolers, and, in the process, learn more about what it means to count and how young children make sense of the counting process. As the preschool is associated with the university, many of the students have spent time in the facility prior to the course and are comfortable in the setting. In the second course, students create a children's book that focuses on geometric concepts and is suitable for a first or second grader that focuses on geometric concepts. Students again visit children at local schools to see first hand how their books address the needs of young learners of mathematics.

As I began to familiarize myself with the University of Dayton, I discovered that there is an organization on campus, the Fitz Center for Leadership in Community,² whose focus is building and supporting partnerships in the Dayton community. One arm of this mission involves strong connections to a set of urban schools through the development of neighborhood school centers with site liaisons. Thus, when I began looking to develop relationships in local schools and to find teachers who would be willing to participate in a university-school partnership, I contacted the Fitz Center. Their staff distributed a request to partnership schools inviting those interested in engaging in a pen pal project with a university

² See <http://www.udayton.edu/artssciences/fitzcenter/>.

mathematics class for prospective elementary teachers. Two of the site liaisons, including my co-author (Amber), responded quickly and the three of us began conversations about how we might carry out the project. As a way to build a relationship between my students and the children, I suggested that I have my students write two pen pal letters with mathematics activities or questions included. The letters would add another medium for exhibiting the students' understanding of both the mathematics being studied in our class and the appropriate level of questioning for children at the elementary level. Thus the Pen Pal Partnership Project was born. Logistical issues such as transportation to the school sites are handled through the Fitz Center while the site liaisons deliver the letters and arrange the visits.

The two schools that participate in this project are Neighborhood School Centers, part of a move back to neighborhood schools in Dayton that expands the role of the school to that of neighborhood community center. The site liaisons serve the school centers under the auspices of the University of Dayton, the Salvation Army of the Greater Dayton Area, and the YMCA of Greater Dayton. Both of these Pre-K–8 facilities receive Title I funds and serve a diverse urban population.

The Pen Pal Partnership Project introduces students to urban school children in their school settings. In this urban school district, funding woes prohibit most small-group tutoring opportunities during the school day and one-on-one volunteers are in short supply. This project addresses this need as each child receives one-on-one attention while partnered with a college student who reads her or his book aloud to the child. The student can help the child read the book aloud and complete the tasks woven throughout. The service-learning component that unfolds through the project reinforces the first three of the four content areas studied in the mathematics course: statistics, probability, geometry, and measurement (in order). The students' experience of creating a written product in which they clearly present mathematical concepts and support mathematical reasoning in the form a children's book acts as an instructional tool for the students as well as the children. Adding the tasks of composing two pen pal letters not only builds connections between students and children prior to meeting but also gives the students an opportunity to practice posing problems and articulate mathematical ideas, important experiences in their mathematics teacher preparation. Pen pals are assigned with consideration for matching gender and any special needs of the child. Students prepare two letters, one while studying statistics and the other while studying probability, which are mailed to an elementary school pen pal prior to the school visit. Each letter includes a mathematical task or experiment for the pen pal to carry out.

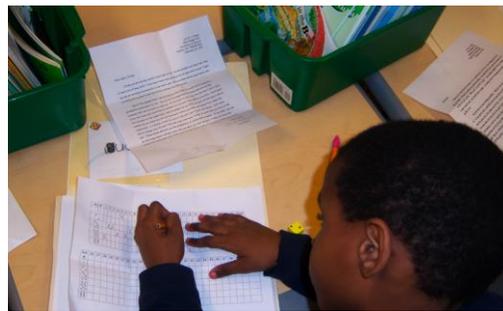
Pen Pal Letters

The students' first letter includes a brief personal introduction and a task that requires the child to collect data from her or his classmates on a question posed in the letter, such as, "What is your favorite flavor of ice cream out of vanilla, chocolate, and strawberry?" The question is multiple-choice with fewer than six choices identified for the child to keep the focus on data collection and avoid the distraction of a large number of choices. It also allows for



more reasonable graphing of the data, should the classroom teacher choose to have the children graph the results using a graphing method appropriate to their grade level, according to state standards (State Board of Education and Ohio Department of Education, 2001a, 2007). Students are also encouraged to keep the *Common Core State Standards for Mathematics (CCSSM)* (Common Core Standards Initiative [CCSI], 2010) in mind. The Grade 2 CCSI Standards include: "Draw a picture graph or a bar graph (with single-unit scale) to represent a data set with up to four categories" (p. 20). The children that participate are typically in first- and second-grade classrooms, making this connection to standards significant.

Although not a requirement of the project, classroom teachers have developed additional in-class activities motivated by the student letters and the technology available for children to vote and create graphs each week during the project. Two teachers extended the project to their language arts curriculum by having their children write letters back to their university pen pals that describe their findings using an appropriate informal letter format.



Considering the children's return letters, an important issue came to light. I realized that the children were being taught to use a standards-based informal letter-writing format but the college students were not following the same format. Knowing that my students needed to model good letter writing, I altered the assignment to include instructions for writing an informal letter in the assignment description based upon the concept of a friendly letter as outlined in the state standards (State Board of Education and Ohio Department of Education, 2001b). I

also altered the rubric so that the grading of the pen pal letters now takes students' letter-writing format into consideration. When the students introduce themselves to their pen pal in the form of a friendly letter, it reinforces the state standards and generates a positive mentor-mentee relationship. This exercise is one of the first opportunities for the prospective teachers to see standards use from the



teacher's perspective and highlights the importance of "thinking like a teacher" about the standards for various grade levels. This integration of language arts also underscores the interdisciplinary work required of the classroom teacher.

Students write the second pen pal letter while studying probability and chance. Because this letter may arrive at the school only a short time prior to our visit, the experiments they ask the children to complete can be easily done with a partner, preferably a family member. Not assuming that the children have easy access to coins, dice, or spinners, the students include the tools necessary for carrying out the experiment in the envelope with the letter. This inclusion raises an additional question that the prospective teachers often have not considered: what size coin should be included for a coin experiment? To avoid any problems in

which children are unhappy with the coin in their letter, students are asked to include only pennies for coin experiments. Creative students design experiments using cutouts and colorful objects that the children can use. Some teachers use this as an opportunity to have pairs carry out the experiments in class and record their results to share with their pen pal when they meet.



Introducing children to the concepts of likelihood and uncertainty through simple experiments like tossing a coin or rolling a die several times and then asking children to make predictions or look for patterns in the results can serve to introduce them to probabilistic thinking and develop mathematical habits of mind such as predicting, conjecturing, revising, and considering alternative explanations. This process fits well with the Grades 1 and 2 Standard for Probability and Data Analysis (State Board of Education and Ohio Department of Education, 2001a, 2007). Students are encouraged to include thoughtful questions about the

possible results of the experiments that they can ask their pen pals when they visit.

Pen Pal Visit

Once the students have written their letters and completed their work in statistics and probability, they move on to develop a book based on the state standards and geometry concepts covered in the course including the extended van Hiele Theory of Geometric Reasoning that is used as the framework for the children's book on geometry.³ Students use a variety of modes for planning and creating the books, such as index cards, electronic storyboards, scrapbooking materials, and movable pieces, to make the books meaningful, content-rich, and interactive.⁴ For example, one student used magnetic sheets cut into tangram pieces with magnetic pages on which the child was to create various figures in the story. Another student included a plastic reflector in her book on symmetry. Some students use their pen pals as the central figures in their books, personalizing the books as a way to deepen their connection to the children.

After students develop their books, we take a fieldtrip to the school to meet their pen pals. The van ride to the school is a quiet one, with students silently wondering what their pen pal is like and if the pen pal will like them. They need not worry; even the most difficult child in a classroom is thrilled to see her or his college pen pal. The groundwork laid by the site liaison ensures a smooth flow through the building to the classroom. The classroom teacher beams as the children find their pen pals with the assistance of the nametags that they have provided.

Each student is matched with at least one pen pal. The noise level increases as the children and students exchange greetings and find a place for their conversation. Some prefer sitting on the floor, others find room on the class carpet. Once, we needed to spread out on the school stage; another time, we took over the school cafeteria because we had too many students and pen pals to accommodate

³ The van Hiele theory posits that students progress through levels of reasoning that can be described as: Level 0 – Pre-recognition level, where the student does not reliably distinguish between classes of figures; Level 1 – Recognition or Visual level, where the student recognizes shapes holistically; Level 2 – Analysis level, where the student can describe attributes of a figure; Level 3 – Relationship or informal deduction level, where the student recognizes interrelationships of figures and their properties; Level 4 – Deductive reasoning level, where the student can use deductive reasoning in proofs; and Level 5 – Rigor level, where the student recognizes that different axiomatic systems result in different geometries. (See van Hiele, 1959 or Clements & Battista, 1992 for description of this theory.)

⁴ See Keen (2004, 2007) for a description of the children's book assignment and examples of student work.

in a single classroom. During each visit, the classroom teachers, site liaison, and I zigzag among the groups, observing the pairs as they turn pages and explore the ideas presented on each page.

The atmosphere is always full of enthusiasm with a wide range of discussions as the students share their books with the children. The children ask, “Did you make this?” “Was it hard?” “Do you go to college?” “Would you like me to read the book?” After the book has been read and reread, some pairs exchange books with others, some visit special places in the room, and some carry out the probability experiment from the second pen pal letter.⁵

As the meeting progresses, the students begin to think about the mathematics from a different perspective, seeing it through the eyes of their pen pals. Students are encouraged to pay special attention to the ways the children demonstrate their mathematical understanding or their level of geometric reasoning.



Occasionally, the nature of the conversations surprises the students. For example, one student was talking with her pen pal about the angles in a rectangle as right angles. The child joyfully walked around the classroom identifying right angles, until she came to a “left angle.” The first grader was associating her learning of left and right, as directions, to the angles that she saw. This association was quite surprising to the student and prompted her to think about mathematics vocabulary and everyday language in a deeper way.

Departure time comes quickly; we say our goodbyes and return to the van. The trip back has a very different mood. The students excitedly share their experiences with their peers, laughing and talking about what they learned from their pen pal. They finger through their books, pointing out things that surprised or delighted them. I remind them to be sure to write about all that they discovered about how children learn and understand mathematics through the whole experience in their biweekly journal entry.

The journal entries show the significant “in-person” value of our visit. For example:

Student 1: I learned a lot while at [*] elementary school, and while constructing my children’s book. First, I learned that you have to be very simple and precise when teaching children new mathematical concepts. All of the drawings in my

⁵ For a more comprehensive visual sense of the experience, see the Book Sharing collage in Appendix A.

book had to be very accurate so not to confuse the student I was teaching these new shapes to.

Student 2: I learned a lot about math learning while I was there. I realized that you can't just show a student a picture of a shape once and expect them to know it the second time around. It takes time and practice to learn a mathematic concept. Learning mathematics isn't that easy of a task. A task that may seem easy for us is not easy for a 1st grader and that is a VERY important concept to keep in mind. (emphasis in original)

Student 3: About math learning, I learned that the proper terminology in geometry was not being taught. While reading my book, Christina kept calling an ellipse an oval. I know many kids also call kites diamonds. In my opinion, wouldn't it be easier to teach kids the proper term in the beginning instead of trying to change names in later grades?

Student 4: As a teacher, I learned that if the student can teach themselves the concept, or find their own conclusion, it is very beneficial. That is, my student was able to find that a 5-sided figure was a pentagon, because I told her Pent meant 5. Then I said if hex means 6, then what is a 6-sided figure? She was able to make her own conclusion, and these were the two new shapes she remembered the second time we went through the book.

Student comments focus on the mathematical thinking and mathematics learning of their pen pals through their interaction, which is appropriate for their journal, but the classroom visit also opens the door to the world of urban education for many of the students. The university offers an Urban Teacher Academy that



works to prepare preservice teachers to work in an urban environment. A positive first experience in an urban classroom prior to the application period for the Urban Teacher Academy increases the likelihood that a student will apply to the program. For the university, this program is a positive way to support a significant community need for future teachers. Even if the students decide not to apply to the Urban Teacher Academy, this experience offers valuable learning in an urban environment that the students may not receive through their formal placements.

The Pen Pal Partnership Project worked so well at one of the schools that the teachers in the upper grades of the school set up a second pen pal project with Black Action Thru Unity, a campus-based organization for African American students. This organization works to be a positive influence on campus and in the

community, so developing a mentor–mentee relationship through the process of being pen pals also fits their goals. Being a catalyst for this offshoot reinforces the concept that urban children are often in need of and benefit from mentor–mentee relationships and that universities can create meaningful service-learning opportunities within local school districts through interdisciplinary prospective and pre-service teacher projects.

Conclusion

Considerations for improving the Pen Pal Partnership Project include the introduction of students to children prior to their meeting to share the books. Technology opportunities that exist for teleconferencing at the school and university level are a consideration for further developing this program. The enthusiasm and support offered by site coordinators dedicated to school and community engagement allow follow-up volunteer opportunities that increase student learning while providing a valuable service to the children and school.

With the opening of The Salvation Army Ray and Joan Kroc Corps Community Center in downtown Dayton (Amber is the center’s Director of Education), we have a new site for contributing to children’s opportunities to learn mathematics through the books the students create, with some producing extra copies for the center. The Kroc Center includes an Education Center with a drop-in care facility, technology resources (including 60 laptops and 4 gaming systems), and a library of resources for families to use. An afterschool program at the Kroc Center, “Authors and Illustrators,” has used children’s enthusiasm in reading pen pal books to guide second and third graders in the creation of books for their own families.

For the college student, this project serves as their initial exposure to the world of urban education, and, in some cases, the first opportunity to develop a written lesson (in the form of the book) that also serves as a valuable piece for their professional portfolio. As their journal entries indicate, the students gain insight into the importance of representations and clear, accurate language in support of meaningful mathematics learning. For the professor, the project allows for experiential learning and real-life challenges that supplement coursework while requiring students to apply the statistics, probability, and geometry content included in the course.

The children and school reap some excellent benefits as well. Through the project, the elementary teacher is able to develop cross-curricular activities incorporating mathematics and language arts while encouraging the children’s enthusiasm about college. The children look forward to their next mathematics challenge and are proud to do the work asked of them and learn graphing techniques. Their dedication to impressing their college student pen pal is evident in their behavior

and sometimes-meticulous completion of assignments. When they write the prospective teachers, the children must answer the mathematical challenges, write and format a friendly letter, and show good penmanship for their letter to be approved by the teacher, thus reinforcing various interdisciplinary standards. Classroom teachers report that the children in the grade below theirs come to ask if they will be able to have a college pen pal the next year, indicating that children throughout the school prize the experience.

As an extension, I have presented the project at a conference with one of the teachers and students (Sally Kleiner and Kim Smethurst, respectively). I anticipate doing more of this sort of outreach beyond our partnership. The value of community partnerships for offering opportunities to build mathematical foundations for children should not be underestimated. While this is an annual, small-scale project involving two urban schools, two classes of children, two classes of college students, two classroom teachers, two school liaisons, and a college instructor, its effects are cumulative over the years, building a strong sense of collaboration and shared responsibility for the mathematics education of all children.

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APPENDIX A

Book Sharing Collage

