

**International Service-Learning for Preservice Teachers:
Strengthening Mathematical Literacy in West Africa**

**Angela Hare
Messiah College
Grantham, PA
AHare@messiah.edu**

**with Messiah College students
Katherine Patton ('09)
Brittany Williams ('09)
Kristen Wilt ('09)
illustrator Greg Snader ('08)**

Abstract

This article describes the benefits of service-learning for undergraduate preservice teachers, specifically through the example of an international partnership between education students at a liberal arts college in central Pennsylvania and primary school teachers of children with disabilities in the country of Burkina Faso, West Africa. Four undergraduate college students studying mathematics, education, statistics, and art wrote and illustrated a children's counting book that is culturally appropriate in a French West African context. Through this project, the student team learned firsthand about issues of language, culture, mathematics, literacy, and special education. The partnership, which has since expanded in scope and involvement to school library development and robotics, is rich in connections to diverse learning environments and provides meaningful resources and motivation for preservice teachers on multiple levels.

Introduction

An undergraduate service-learning project may be defined as a project that enhances curricular material for undergraduates while meeting a real client need in the broader community (Hadlock, 2005, p. 2). At the first author's institution, the Mathematical Sciences Department seeks to prepare future elementary teachers for educating diverse learners, from a variety of cultures and with challenging and unique needs. As the National Council of Teachers of Mathematics (2000) observes, teaching is a complex practice, and strong teachers draw on knowledge from several domains (p. 22).

To develop these capacities, some students at the author's four-year liberal arts college are working in an international context through an ongoing partnership with the Christian international development organization Serving in Mission (SIM: www.sim.org) in the West African country of Burkina Faso. The educational goals of this partnership are to strengthen literacy, numeracy and abstract thinking skills in a population of children with disabilities at the Center for the Advancement of the Handicapped (CAH) in the Burkinabè village of Mahadaga, and also to provide rich professional development experiences for preservice teachers. This article describes the first project in this educational partnership, which was completed by Messiah College students in 2007-2008. The author also discusses the benefits of international civic engagement for preservice teachers and the cross-disciplinary projects that have grown out of the initial project and the long term student-client relationship.

The Project Goal

After an initial site visit by the author to the village of Mahadaga in 2006, and after conversation with Burkinabè SIM primary school teachers, the following goal was chosen for the first service-learning project in this educational partnership:

Goal: To design and produce a counting book that builds abstract thinking skills in Burkinabè children with disabilities.

Project background:

Literacy and numeracy skills are vital for effective daily living in all cultures, yet children in developing countries learn these skills in a unique and complex learning environment. In many places throughout the world such as the country of Burkina Faso,

children grow up with very few written symbols around them. They do not have books in the home, board games, pictures on the wall, or toys that use letters and numbers. This lack of early experience with abstract images affects not only children's reading and writing literacy but also the development of mathematical understanding. Children build their foundation for mathematical learning in their early years, through exploration and informal experience, as discussed in NCTM (2000). Many children in developing countries lack the rich environment that promotes abstract thinking. They may also struggle with disabilities that compromise effective learning in the traditional classroom.

The Center for the Advancement of the Handicapped in the village of Mahadaga includes a primary school for two hundred children with disabilities. The center provides physical rehabilitation and education to children whose physical disabilities include blindness, deafness, and cerebral palsy, due primarily to malaria fevers, meningitis, and polio. SIM and Messiah College have a decade-long partnership, connecting undergraduate students to applied projects at the CAH, in fields such as solar power, wheelchair design, and water purification.

During a preliminary visit in 2006, the author learned that mathematics is the most difficult subject for Burkinabè children attending the CAH School to grasp and that for many of them, the lack of proficiency in arithmetic and problem-solving is a hindrance to entering an apprenticeship or trade. In addition, the literacy rate in the country of Burkina Faso is startlingly low: only 29% of Burkinabè adults are literate in the national language of French (UNICEF, 2009, Basic Indicators sidebar). These observations sparked the idea that undergraduate mathematics education students could create a book to help these children develop a better understanding of numbers and

pre-number concepts and to support literacy efforts at the village school. Such a project could have a significant impact on the education of these children and could also become a useful tool for the local teachers and families.

The Process:

To start the project, a team of three undergraduate education students majoring in mathematics and education enrolled in an independent study course in which they reflected on aspects of the West African culture, special education, and mathematics education, as directly relevant to our project. The project team studied the daily lives of a small sample of families in the village of Mahadaga using a “Rapid Rural Assessment” document, a qualitative statistical tool discussed by Chambers (1983, p. 199). To help brainstorm topics for the book, the team researched animals and foods commonly found in Burkina Faso and conducted a review of available counting books in both English and French. Students found that the book *Ten Little Lady Bugs* (2001), by Melanie Gerth, provided a beneficial model. Gerth’s book focuses on subtraction – every time the page turns there is one less ladybug. The project team decided to use this same idea, but with the simpler concept of addition, by having one more insect appear on a frog’s tongue with each successive page. The project team sought to write a culturally appropriate counting book that strengthens children’s understanding of the mathematics concepts listed in

Table 1:

Recognition of numerals as connected to quantities
One-to-one correspondence between objects counted and quantity
Recognition of quantity without counting
Conservation of quantity
Cardinality: Last number counted is the same as the quantity

Table 1: Target Mathematics Concepts of the Project

To gain a better understanding of the ways that children with physical and cognitive disabilities learn mathematics, the team interviewed the mother of a child with Down syndrome and drew from the resource *Teaching Math to People With Down Syndrome and Other Hands-On Learners: Basic Survival Skills* (Horstmeier, 2004). From these sources, the team added more repetition, sensory stimulation, and involvement than other counting books the team reviewed that are set in an African context, such as *Moja Means One* (Feelings, 1971) and *One Sun Rises: an African Wildlife Counting Book* (Hartmann, 1994). It was important that the book encourage students to want to count as they move through the pages and to anticipate the number coming on the next page. Early in the writing process, the team gave a selection of published counting books to several small multi-age groups of children in the United States, to observe the characteristics that readers and non-readers find appealing. The children were anxious to read or look through books that included tactile objects on each page, and they read those books from start to finish. Since some of the children at the CAH school are blind or have poor eyesight, the project team included tactile objects, specifically embossed insects on the frog’s tongue that the children can touch as they count.

The project team commissioned a senior art major, Greg Snader, to illustrate a desert scene for the frog and to include appropriate African animals, corresponding to the counting number on each page. By the end of the first semester of the project, the team had a complete draft of the text. As a final step, four students who speak French were asked to review the text itself.

The writing process could be described by the cycle Draft – Research – Redraft. As the team learned about the culture and showed our initial ideas to children in the U.S., they modified the storyline several times. Several drafts later, the faculty advisor read the book, titled *Un, Deux, Trois* (One, Two, Three) in both French and English, to a class of eighteen first-graders in the U.S.. The children listened and watched intently during the reading in both languages, and were clearly interested in the animals on each page. They declared it to be their favorite of the three books read to them that day.

The book *Un, Deux, Trois*:

The main character in the book is a frog that catches bugs on her tongue. The first four pages are shown in Figures 1 and 2:



Figure 1

Greg Snader, Illustrator

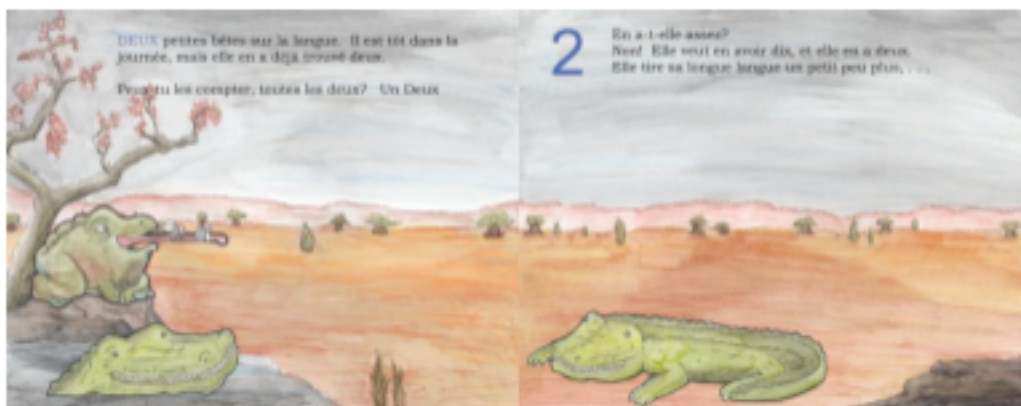


Figure 2

In these early pages, important conceptual themes are evident. Notice that the quantity and numeral for each page is represented in several ways. In Figure 1, the numeral is shown as a large symbol, in red, and with the corresponding word on the facing page, also in red. Although not shown in the figures, the raised Braille symbol for each number is also on the right page of each facing pair. The insects are embossed so that the children can touch as they count. As children read the book or have it read to them, they can make multiple sensory connections (sight, color, touch) between each quantity and its symbol and word. They also build understanding of one to one correspondence and cardinality as they count and touch the bugs along with the reader. As children read the book

repeatedly and count along with the narrator, they will begin to connect the last number they count to the quantity and may eventually recognize quantities without having to count.

Also notice in Figure 1 that in addition to one insect on the frog's tongue, there is one bush baby. In Figure 2, we see two insects, and also two crocodiles. In this way, each pair of facing pages emphasizes to children that the quantity is independent of the size or type of objects counted; this concept is known as conservation of quantity. These conceptual themes continue throughout the book, whose remaining pages are shown in Figures 3 through 10, with the text now translated for this article from French to English.

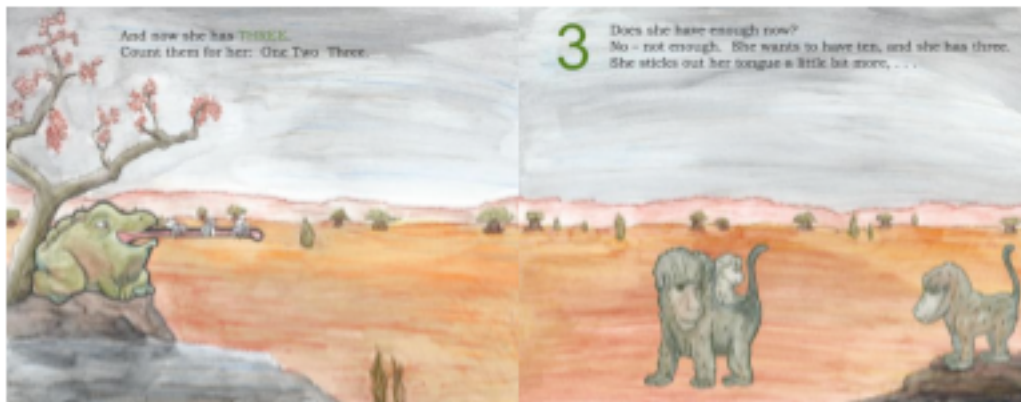


Figure 3



Figure 4



Figure 5

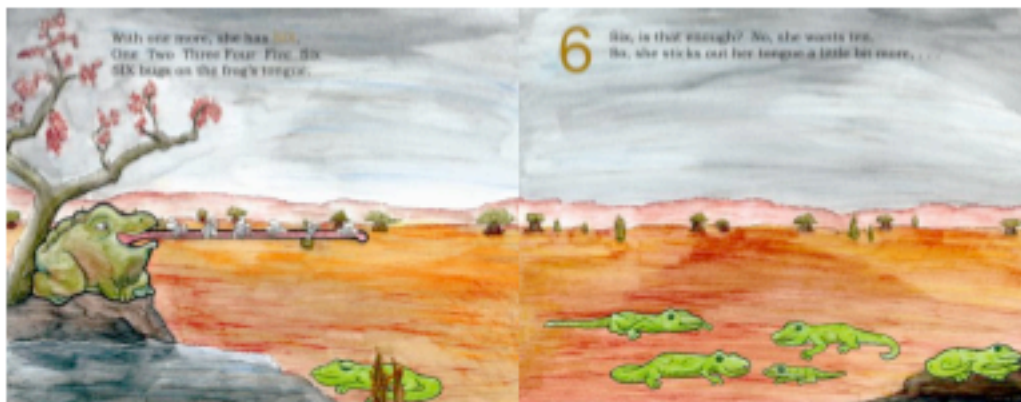


Figure 6



Figure 7



Figure 8



Figure 9



Figure 10

The goal in writing *Un, Deux, Trois* was not only to strengthen the mathematics concepts listed in Table 1 but also to promote early literacy. The team sought to write a book that would be appealing to schoolchildren and also to their younger brothers and sisters at home, building vocabulary and developing familiarity with written words and numerals. It was especially important for the book to include simple symbols and words, recognizable to children in a largely illiterate society. The book is written in simple French, with a repetitive storyline and interactive questions to help readers follow along easily.

Benefits of the project to undergraduate students

As undergraduate preservice teachers worked on this project, they developed important skills in interdisciplinary learning and the development of educational curricula. Creating a counting book for children with special needs in West Africa is a challenging task that takes hours of cultural research, literature review, translation, and multiple revision sessions. Teamwork improved the team's ideas and eliminated weaker aspects of the project. As students did their research, they became aware of the wealth of knowledge available to educators in professional associations such as the National Council of

Teachers of Mathematics (NCTM). In addition, they learned about the important connection between mathematics and literature - an increasingly important topic in mathematics education. Finally, students on the team learned how to work incrementally toward a worthwhile goal. For the first time in their undergraduate education, the students worked on a project that was not completed within one semester, in a partnership that would extend beyond their own years in college.

Feedback and Future Projects:

A site team of seven students and three faculty traveled to the Center for the Advancement of the Handicapped in Mahadaga in January 2008 to deliver 200 copies of the counting book, to assess the mathematical literacy of local children in several schools and to get direct feedback from teachers and children about the effectiveness of *Un, Deux, Trois* as a resource. Two of the student authors were on this site team. The team was surprised to discover that the children were so excited to be receiving such a gift that the teachers were reluctant to hand them out during a schoolday, for fear of mass misbehavior! Instead, the books were given to the teachers for use in each classroom. One particularly honest and helpful preschool teacher informed the team that the book lacks large, simple images and contrasting colors that are necessary for early readers. The site team also learned from the Burkinabè teachers that in the French system of counting, children are taught first to count from 1 to 20 rather than 1 to 10, because the French language emphasizes grouping by 20. For example, the French word for “80”, *quatre-vingt*, literally translates “four- twenty”. After reading the book to several groups of CAH schoolchildren, the team realized that the French vocabulary in the book is rather advanced for young Burkinabè readers. The feedback and constructive criticism the

team received taught them that meaningful service and learning require a commitment to ongoing modification and that developing curricula for learners with special needs is truly a complex process. The following January (in 2009), a second site team returned to the village, this time with a large wordless book of pictures of the CAH children themselves, engaged in daily life activities and taken by the prior site team. Meeting in the CAH school library, preservice teachers asked small groups of children to choose the caption for each picture, helping them write a book for their library in which they were personally invested and that they would want to read again.

The partnership between the author's institution and SIM-CAH is a long-term relationship, allowing student teams to make incremental improvements to materials they develop, to interact with local teachers meaningfully, to truly learn from local expertise, and to recognize the value of commitment to factors such as language and cultural study for preservice teachers in the undergraduate years. In a follow-up visit to Burkina Faso in 2009, one student from the first project team used knowledge from her statistics minor to conduct a statistical survey of educational levels and practices in the Mahadaga region. A new student team facilitated a professional development workshop for ten Burkinabè primary school teachers in January 2009, in which the use of games and the Beebot (<http://www.tts-group.co.uk/Bee-Bot>) were introduced as learning tools. In 2010, a team of preservice teachers will design and offer a four-week academic enrichment program for children in the CAH school library. Future projects at the author's campus include the design of appropriate technology, with electrical and computer engineering students working with preservice teachers to build classroom robots that are targeted to the culture and the learning needs of Burkinabè deaf and blind children. In all of this work,

student teams are incorporating the suggestions and feedback received from both children and teachers in the village of Mahadaga, although email communication is not yet possible and postal mail is very slow.

Conclusion

When preservice teachers are exposed to the needs, opportunities, and benefits of professional development through service-learning, they reap the rewards of stronger knowledge of educational issues, sharper teaching skills in real environments, and the satisfaction of contributing to meaningful projects as students. The students in the project team discussed in this article reported an increased appreciation for the value of teamwork, stronger understanding of the connection between mathematics and literature, and they indicated that the project prepared them for challenges they will face as teachers. The benefits are not just for students. As Julie Jensen reported to the Information Sciences Education Conference, both faculty and students benefit from the use of service-learning in the undergraduate curriculum:

“Goals of service learning projects for students are providing students an opportunity to apply classroom learning to a real-world problem, challenging students to develop their skills, enhancing students’ sense of civic engagement, and serving a need within the community. The benefits of service learning for faculty are similar, including refreshment and development of technical skills, opportunities to learn and practice skills in new areas, enrichment of teaching practices in the classroom, increase in civic engagement, and serving a community need” (Jensen, 2007, p. 1)

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