Journal of Urban Mathematics Education
December 2013, Vol. 6, No. 2, pp. 81–85

BOOK REVIEW

The Standards for Mathematical Practice and Hybrid Spaces: A Review of *Empowering Science and Mathematics Education in Urban Schools*[1]

James Ewing
Syracuse University

Empowering Science and Mathematics Education in Urban Schools by Edna Tan and Angela Calabrese Barton with Erin Turner and Maura Varley Gutiérrez (2012) is a useful and timely book for a broad range of educators. Tan and Calabrese Barton have backgrounds in science education, while mathematics teaching and learning is included with contributions from Turner and Varley Gutierrez, who both have backgrounds in mathematics education. Throughout the book, the authors discuss how teachers might provide equitable access for "urban" students in mathematics and science by creating hybrid spaces—spaces where schools connect with students' personal and home lives. The authors' main argument woven throughout the book: to achieve social justice in mathematics and science it is necessary to focus on equity (not equality) and empowerment. Tan and Calabrese Barton intentionally use the phrase "empowering learning environments" as a means to envision an education that engages youth in learning and using mathematics and science not only as a tool but also a means for change (p. 14). In each of the chapters, there are different iterations of the argument that literacy in mathematics and science should aim for more than mere functional literacy but also, and perhaps more importantly, critical literacy. They support their argument with four practical studies described as "hybrid spaces in action" (p. 17). Collectively, the studies are grounded in critical ethnography—a methodological approach intended to expose injustices and break down or blur the researcher/researched binary.

As an elementary school teacher in Spain for 24 years, and now as a current doctoral student and future teacher educator and researcher who has research interests in elementary mathematics education and English language learners, the

[1] Tan, E., Calabrese Barton, A., Turner, E. E., & Varley Gutiérrez, M. (2012). *Empowering science and mathematics education in urban schools.* Chicago, IL: The University of Chicago Press. pp. 224, $29.00 (paper), ISBN 978-0226037981
http://press.uchicago.edu/ucp/books/book/chicago/E/bo13181197.html

JAMES S. EWING is a fourth-year doctoral student in Teaching and Curriculum at the Graduate School of Education at Syracuse University, 150 Huntington Hall, Syracuse, NY 13244; email: jsewing@syr.edu. He taught elementary school in Spain for 24 years. His research interests include elementary mathematics education, English language learners, and pre-service teachers.

title of the book alone caught my interest. Many of the pre-service teachers (PSTs) whom I have taught in my elementary mathematics methods courses are from the suburbs. During their field and student teaching placements in urban schools, they struggle to provide environments that nurture their urban students' empowerment. Furthermore, many of the PSTs have shared that their own elementary mathematics learning experiences were disconnected from their personal and home lives. Therefore, I seek out literature that offers suggestions on how teachers might connect mathematics teaching and learning to students' lives as well as how teachers might create learning environments that fill students with a sense of (self) empowerment. During my methods course, PSTs are assigned literature to read which they are to connect to the eight Standards for Mathematical Practice as outlined by the Common Core State Standards Initiative (CCSS).[2] These practices are used as an overall guiding framework for the methods course. Here, I use the standards throughout the review to illustrate both the usefulness and timeliness of the book as well as how mathematics classroom that are hybrid spaces might assist in achieving the objectives of the Standards for Mathematical Practice.

CCSS for Mathematical Practice

MP1 – Make sense of problems and persevere in solving them
MP2 – Reason abstractly and quantitatively
MP3 – Construct viable arguments and critique the reasoning of others
MP4 – Model with mathematics
MP5 – Use appropriate tools strategically
MP6 – Attend to precision
MP7 – Look for and make use of structure
MP8 – Look for and express regularity in repeated reasoning

Chapters 1 and 2 – Setting the Stage

To set the stage, Tan and Calabrese Barton (2012) begin by providing vignettes about two science teachers who changed the suggested district curriculum in order to develop and teach lessons that connected to students' lives. They show that students were empowered by the lessons because they were allowed to discover science for themselves rather than "practicing the routines of knowledgeable others" (p. 12). Tan and Calabrese Barton contend that the discourse of mathematics (and science) f*or all* "needs to be recast to be emergent of the interest,

[2] For complete details of the eight Standards for Mathematical Practice, see http://www.corestandards.org/math/practice.

needs, concerns, locations, and conditions of those who participate" (p. 11). Rather than stripping students' lived experiences from these "technical" discourses, Tan and Calabrese Barton suggest making the discourses accessible to all by infusing students' lives into the discourse as a "process of cultural production" (p. 10). In these hybrid spaces of learning the lines that too often separate schooling from the lived experiences of students (and teachers) are blurred if not altogether erased—and yes, even within the technical discourses of mathematics and science.

Curriculum changes made by the teachers described in the vignettes were in alignment to MP1: *Make sense of problems and persevere in solving them*. Many of the PSTs that I have observed misinterpret this practice to mean that it is their role to explain the mathematical tasks to their students over and over until they "make sense" of them. During these well-intended efforts, teachers tend to offer too much support and decrease the rigor of the mathematics. If students become too dependent on the teacher, they often do not persevere in solving the problems. In contrast, Tan and Barton's (2012) equitable approach of empowering students by connecting the discourses of mathematics and science to students' lives encourages them to make sense of problems *and* persevere. When students' lives become part of the mathematics and science discourse, students are more willing to persist with problems until they are solved.

Chapters 3, 4, 5, and 6 – Reporting Four Studies

In chapter three, Turner (2012) discusses findings from her study of predominately African American sixth graders from an overcrowded school. In a class discussion, students complained that their school's facilities were inferior to a magnet school located in the same building with a high population of white students. The teacher and students designed and completed mathematical projects to support their hypothesis that the resources in their part of the building were inferior. These projects were examples of "critical mathematical agency" (p. 53): students not only learning a deep understanding of mathematics but also applying mathematics to right an injustice. One student's project posited that the girls' bathroom shared among students and adults was too small to meet their needs. She used mathematical concepts such as area, ratios, and fractions to support her hypothesis. Turner also provides an example of when critical mathematical agency was not possible because it did not fit the guidelines of being mathematically rigorous (i.e., critical mathematics is *not* less rigorous mathematics). Two boys wanted their project to focus on the idea that there were too many poles where they played basketball. Although this problem tied into their personal lives and was an act of social injustice—other schools have more space to play basketball—counting poles was not a rigorous mathematical approach for sixth graders.

Turner's explanation of critical mathematical agency aligns with MP4: *Model with mathematics*.

In chapter four, Tan and Calabrese Barton (2012) report on how a seventh-grade science teacher told stories, referred to as narrative pedagogy, to capture her students' interests. They make the point that in "traditional" science classes the textbook (and/or teacher) is typically the authority, whereas storytelling introduces students to multiple points of view. Thus narrative pedagogy encourages students to be more critical as they determine which of the stories might be the most accurate. Tan and Calabrese Barton find that storytelling builds stronger ties between and among the teacher, the students, and the content. Here, the teacher initiates a story and students are able to critique her (or his) story and construct their own stories using the discourses of mathematics and science. Tan and Calabrese Barton contend that students are empowered "when individual narratives are woven into the educational content of the curriculum" (p. 81). The focus of this chapter, narrative pedagogy, aligns with MP3: *Construct viable arguments and critique the reasoning of others*.

In chapter five, Tan and Calabrese Barton (2012) provide details of another example in which students are empowered through hybrid spaces. A community club allowed youth to use "slang" and music in their science video projects. As opposed to traditional classes where the teacher is the expert and students listen passively these students acquired an expertise in their projects as a result of the teacher linking science to the students' lives. As previously noted, being empowered in hybrid spaces has implications for MP1: *Make sense of problems and persevere in solving them*. It stands to reason that students cannot make sense of problems and persevere if their culture is not considered. Thus the argument by Tan and Calabrese Barton that teachers should consider urban students' culture is both appropriate and consistent with MP1.

In chapter six, Varley Gutiérrez (2012) discusses her findings from a study about fifth-grade girls who protested the closing of their school in which they calculated the time and money it would take for students to travel to the new school. The students constructed a persuasive argument to convince the school board to change their decision. In order to do so, the girls had to understand the board's argument at a deep level to develop counter arguments. The mathematical activities described in this chapter align with several of the MPs. For example, being able to understand the school board's point of view and developing a viable argument to convince them not to close the school aligns with MP3: *Construct viable arguments and critique the reasoning of others* as well as MP4: *Model with mathematics*.

Chapter 7 – Summarizing the Book

Tan and Calabrese Barton (2012) conclude the book by summarizing the importance of empowering youth by creating hybrid spaces in mathematics and science classrooms. According to them, there has been recent attention in the literature about such spaces (see, e.g., Gutiérrez, Baquedano-Lopez, & Tejeda, 1999), especially as a proposed solution for closing the so called "achievement gap" between white students and students of color. Nonetheless, Tan and Calabrese Barton claim that their book is one of the few that goes beyond explanations and offers concrete examples of students actually engaged in hybrid spaces in mathematics and science.

Concluding Thoughts

I have shown how the mathematics (and science) activities and learning environments (in school and out of school) discussed throughout *Empowering Science and Mathematics Education in Urban Schools* might be aligned with some of the Standards for Mathematical Practice. Here, I have highlighted only a few such cases; in truth, a close reading of the book reveals that hybrid mathematics (and science) classrooms align with all eight of the standards. But these hybrid spaces go beyond the standards in an important way: hybrid spaces can/do facilitate students (and teachers) empowerment. For example, the use of tools in mathematics is discussed in MP5: *Use appropriate tools strategically*. The students (and teachers) described throughout the book did indeed use tools appropriately and strategically. But the authors illustrate how students (and teachers) might go deeper; students (and teachers) not only use tools, mathematics and science becomes a tool. In the end, empowering mathematics and science hybrid learning spaces are those that engage youth in learning and using mathematics and science as both a tool and a context for social change (p. 14). I strongly recommend this book to teachers, teacher educators, parents, and anyone interested in looking for ways to (self) empower youth in and through the discourses of mathematics and science.

References

Gutiérrez, K., Baquedano-Lopez, P., & Tejeda, C. (1999). Rethinking diversity: Hybridity and hybrid language practices in the hybrid space. *Mind, Culture, & Activity: An International Journal, 6, 286–303.*

Tan, E., Calabrese Barton, A., Turner, E. E., & Varley Gutierrez, M. (2012). *Empowering science and mathematics education in urban schools.* Chicago, IL: The University of Chicago Press.