Book Review

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Tan, E., Barton, A. C., Turner, E., & Gutiérrez, M. V. (2012). *Empowering science and mathematics education in urban schools*. Chicago, IL: University of Chicago Press. ISBN: 978-0-226-03798-1, $25.00.

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Careers in math and science carry prestige and power in American society. For urban students, though, that prestige and power are often out of reach (p. 5). Students in urban schools traditionally have less access to math and science materials, equipment, and high-quality instruction; do not perform well on standardized tests of science and math; and are tracked out of advanced science and math opportunities at the high school level (p. 7). Such unequal access to rigorous math and science education leads to inequality in post–high school careers.

However, *Empowering Science and Mathematics Education in Urban Schools* questions whether having equal access to math and science would produce equal outcomes for students. As currently practiced, math and science curricula assert that knowledge is objective and universal and ignore the social, political, and economic realities of students' lives. The authors propose that science and math knowledge be embedded within the realities of students' lives to empower urban students to change their communities. To reach this goal, teachers and students need to enter a third space where the knowledge of the home and community can interact with the practices and concepts of formal science and math to create a new discourse that incorporates science and math as problem-solving tools.

Both Edna Tan, an assistant professor of teacher education at the University of North Carolina, and Angela Calabrese Barton, a professor of teacher education at Michigan State University, focus on urban middle school girls in science. Contributors Erin Turner and Maura Varley Gutiérrez have researched urban math education.

In the seven chapters of the book, the authors produce an extended case study of urban middle school students using math and science knowledge to engage in authentic problem solving. Chapter 1 sets forth the argument that

discourse around science and math for every student needs to abandon the current assumption that equal input will produce equal outcomes for students. Equal access alone will not result in equal outcomes because the traditional approach to common science and math curricula includes academic discourse and practices unlike the everyday discourse and practices of urban students from nondominant backgrounds. Empowering students to use science and math problem solving in authentic ways can merge their everyday worlds with the worlds of science and math. Through their participation, students gain agency to mediate the gap between their cultural worlds and the traditional science and math worlds. Engaging urban students in critical discourse about the social, political, and economic inequalities that surround them can result in their appropriation of the tools of science and math to advocate for change.

In Chapter 2, the authors develop the theoretical framework. One lens of the framework is the use of transformative third spaces (Gutiérrez, 2008) as a way for productively negotiating the space between what is known and understood in the disciplines of science and math (the script of dominant cultural values) and what is known and understood in the community (the counterscript of students' own cultural values). Transformative third spaces allow students room not only to participate within curricular disciplines but also to take a stance within the disciplines. Students become empowered as legitimate experts in the science and math communities when they use knowledge from their own lives as resources. For instance, in Chapter 2, a student creating a digital story to teach younger students about weather safety on the playground used his knowledge about the students' multimedia preferences to capture their attention and reinforce his message about safety. He was empowered to use his community knowledge to create an appealing presentation that communicated scientific concepts.

The theoretical framework of this book also considers science and math education through critical literacy for social justice. Students must have *equitable* science and math classrooms with highly qualified instructors and rigorous curriculum and *empowering* science and math classrooms that recognize students' own ways of knowing and promote critical math and science literacy. Then students can use math and science knowledge to transform their lives and communities. In other words, equal access to science and math opportunities is critical but not sufficient to produce equal outcomes; equity needs to be supplemented with empowering environments where transformative third spaces can occur.

For readers who have read previous work by Tan and Barton, the first two chapters will feel familiar, because the authors have been writing about these concepts for several years. However, if the concepts of transformative third

spaces, equitable science and math, empowering science and math, and critical math and science literacy are new to the reader, the first two chapters of this book may prove challenging. The chapters presume that readers have some background knowledge of urban schooling and current research on working with students from nondominant backgrounds. To make the concepts of the first chapters more comprehensible, the authors weave in illustrative narratives of classroom events.

Chapters 3 to 6 present four separate, and sometimes previously published, examples of middle school students engaged in using critical literacy in science and math to empower themselves as advocates for change. The four case studies serve as models for engaging middle school students in accessing their everyday knowledge to solve authentic problems using traditional math and science practices. The projects are clearly site-specific, so teachers who wish to emulate the process would need to identify local issues that their students could address. Because of schedules, curriculum, and school practices, teachers may have limited opportunities to create transformative third spaces in their classrooms for studying local issues. For this reason, projects like the models in this book may be more successful in science and math clubs or summer programs that have more flexibility.

Turner's ethnographic study in Chapter 3 demonstrates how students in a sixth-grade math class researched overcrowding at their school and presented their research to the school board. The chapter describes how small groups of students used their knowledge about daily school life to build a mathematical inquiry. Through their project, students influenced the school board to adjust the next year's enrollment plan.

Chapter 4 describes a case study of using storytelling as a pedagogic strategy in a seventh-grade science unit on nutrition. The use of narratives—both the teacher's and students' stories—became a hybrid environment for connecting science to daily life. Through narratives, students grappled with the challenges of making healthful food choices and the possibility of adjusting family favorites to create more healthful options without making the food tasteless. Their knowledge of family tastes empowered them to decide which nutritional trade-offs would be acceptable.

A slightly different version of Chapter 5 had previously been published in *The Journal of the Learning Sciences* (Barton & Tan, 2010). The study reports on a year-round program focused on green energy technologies and conducted outside of school in a local community club. Students investigated urban heat island (UHI) effect in their urban neighborhood and produced three documentaries to teach about green technologies and UHI.

The final research project, described in Chapter 6, takes place in a fifth-grade, all-girl, after school math club. Students used their math skills and

their knowledge of the community to contest the district's proposal to close the girls' school the following year. Their research demonstrated that the closure would not be a "seamless move" for the school families and would, in fact, incur more costs than the district's plan had identified. The students' counterargument to school closure preceded community comment and framed the discussion. The school board eventually voted not to close the school.

The four chapters of examples of students' investigations of real-world problems through math and science knowledge are organized as research articles for scholarly publications. While the four middle chapters complement rather than repeat the introductory two chapters of the book, the reader quickly recognizes that each chapter contains an introduction, limited literature review, findings organized around themes, discussion, and summary.

In Chapter 7, the authors summarize the findings of the extended case study:

> A common thread runs through all the stories in these chapters: In creating these equitable and empowering environments, hybrid spaces were brokered for and sustained by the learning community, inclusive of both teachers and students. It is through the collective creation of hybrid spaces that students were able to engage in critical math and science literacies and to translate such critical knowledge into authentic, real-world action, thereby exhibiting their critical math and science agencies. (p. 166)

In addition, the authors emphasize that students willingly engaged in challenging math and science investigations, including working to develop an in-depth understanding beyond the boundaries of the curriculum.

The authors conclude that "hybrid spaces make science and math learning deeply meaningful for urban youth, and help them develop positive identities in math and science" (p. 183). The power of these experiences may allow minorities and females to become more active in science and math communities.

In all, this book is a collection and review of four research projects held together by a theoretical framework. The title, *Empowering Science and Mathematics Education in Urban Schools*, signaled an intended audience of practitioners who might be seeking meaningful ways to connect science and math to students' lives. If urban teachers are the audience, this book falls short of the goal. The design of the book as a collection of research articles lacks a teacher-friendly perspective. Busy practitioners want texts that can be read in short bursts and ideas that can be implemented quickly. While the four urban projects provide fodder for discussions about implementing critical

math and science literacy for social action, the book does not offer practical advice about how the ideas could be adapted to other urban classrooms.

The audience may, instead, be graduate students and professors in science or math education. For them, the book opens the door to understanding the problems inherent in science and math instruction as currently practiced. The theoretical framework of Chapter 2 could trigger rich discussions about equity in math and science education. In addition, each middle chapter can serve as a model for research design and scholarly writing.

Despite the limitations of this book, the models of students developing critical science and math literacy to advocate for change in their communities provide evidence that such approaches to science and math can successfully engage urban students in powerful inquiry studies. The authors argue for an approach to science and math education that goes beyond simple replication of traditional science and math practices to productively combining students' knowledge with traditional approaches as a tool for social justice. In the end, as students gain agency in science and math, they may also consider careers as scientists and mathematicians, which is, after all, a desirable and equitable outcome for urban students.

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Author Biography

Boni Hamilton is currently a doctoral student in Urban Ecologies in the School of Education and Human Development at the University of Colorado Denver. She earned an EdD in Educational Studies at the University of Northern Colorado in 2011 and is author of *IT's Elementary! Integrating Technology in the Primary Grades* (2007). Her second book, *Find Your Path: Integrating Technology in the Elementary Classroom*, will be released in early 2014.