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Tan, Edna & Calabrese Barton, Angela with Turner, Erin & Varley Gutiérrez, Maura. (2012). *Empowering Science & Mathematics Education in Urban Schools*. Chicago, Illinois: The University of Chicago Press.

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In *Empowering Science & Mathematics Education in Urban Schools*, Edna Tan and Angela Calabrese Barton, with contributing authors Erin E. Turner and Maura Varley Gutiérrez, (2012) examine ways to address the disadvantages for urban students in science and mathematics education. They argue that one solution is through the creation of *third spaces*—hybrid spaces that merge the world of the students with the world of science and math—inside and outside of school. An important contribution of this book is that the authors strive to

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provide the reader with vivid and real examples of what these third spaces look like in practice. Early on in the book, Tan and Calabrese Barton help to orient the reader by explicitly stating their research questions. These questions are "What do empowering learning environments in urban math and science look like, and what meaning do they carry for urban youth and their teachers?", "How are such environments constructed inside and outside of the school building?", "In what ways are empowering learning environments made possible through the hybridization of youth's Discourses and funds of knowledge alongside the Discourse and culture of schooling as well as the disciplines of math and science?", and "How do these empowering learning environments help students cultivate a sense of critical math and science agency?" (p. 15). To answer these questions, each chapter brings the reader inside a third space in an actual classroom or after school program.

I will begin by summarizing the authors' rationale for investigating this problem and writing the book, and highlighting the primary claims made by the authors. I will then discuss several strengths and weaknesses of the book, including the authors' demonstration that science and math education can be situated in problems that are real for students and their communities, and the possible obstacles in creating third spaces.

Tan and Calabrese Barton effectively provide rationales for this work on two levels: identifying the problems with urban math and science education and advocating for the creation of third spaces to address these problems. They explain that schools play a significant role in constructing opportunities to access to math and science, yet schools often exclude certain students from these fields. Urban schools are the focus of this book because "urban education is marked by layers of inequalities from how schools are staffed and funded to the kinds of courses and resources available to students" and "the analysis and transformation of inequalities is particularly important in urban science education research" (p. 15). The authors believe that third spaces are crucial venues for reducing the inequalities in math and science education. In the words of Tan and Calabrese Barton,

> We believe that using the framing lens of a transformative third space challenges how we think about the sociocultural-physical space of science and math classrooms as well as how that space mediates learning. Such a critical orientation to the transformation of the spaces of learning offers a mechanism for resisting the binary between home and school, formal and informal...learning science or math is an *embodied* activity—one that takes place within context and involves not only coming to know but also coming to be. Learning science or math, in short, involves learning the content of the discipline, how to participate within the negotiated boundaries of the discipline, and how to take a stance through discourse and action within the discipline. (p. 30)

Here, the authors encourage the reader to rethink the construction of spaces in which students learn science and mathematics. Further, they recognize that the existing literature lacks specific examples of what these reconstructed spaces look like. In this book, they strive to provide these examples. Readers are shown detailed accounts of several third spaces, including a lesson on healthy eating during which the teacher cooked for the students (Chapter 1), a weather unit that had students creating their own digital stories (Chapter 2), a bilingual math club that visited actual businesses, such as an auto shop, to discuss their use of math (Chapter 2), an in-class math project that investigated overcrowding in the school (Chapter 3), the use of storytelling to engage students in a nutrition lesson (Chapter 4), a voluntary community club that investigated urban heat islands (Chapter 5), and an afterschool math club for minority girls that conducted an investigation which eventually played a part in preventing their school from closing (Chapter 6).

The authors' primary claims fall into two categories: how the authors believe science and math should be taught and how to accomplish this teaching. Tan and Calabrese Barton caution against the belief that science and math "for all" means that all students must be trained as passive receivers of the discipline in its traditional form. Instead, they believe that science and math education should be tailored to the individual needs, interests, and concerns of

the students and their community, and, ultimately, not only engage learners, but go further to *empower* learners. In their words, "science and math education should aim for critical literacy in ways that account for the sociopolitical dimensions of learning, for what it means to use science and math to engage one's life and the world in empowering terms, and for the students' development of a sense of efficacy in the classroom and in society" (p. 11). The alternative requires forced enculturation into a math and science world that is discontinuous with the students' own world. Rather than imposing this world onto students in a way that may cause disengagement, the authors take a stance that third spaces can actually help empower students to see math and science as valuable and relevant subjects that can be used to productively transform their own community.

Tan and Calabrese Barton support this claim by providing several vignettes of classrooms and after school organizations that used math and/or science to address community concerns. One such example was a fifth-grade science unit on weather, taught by one of the authors as a guest teacher (Chapter 2). This unit was taught in a special charter school for students who had been struggling in public education. The students were asked to create digital stories about weather safety that they would later present to an audience of younger students. Rather than imposing a rigorous traditional science discourse on the students, they were allowed to infuse elements of their own discourse in their digital stories. Consequently, the students became engaged in a unit that they initially feared would be boring. Even Maurice, a particularly troublesome student who encountered several difficulties along the way, produced a digital story that merged scientific ideas with his own interests and language. This unit helped demonstrate that even students who are typically disengaged in school science can productively engage in the curriculum if elements of their own worlds are allowed to enter the classroom.

Tan and Calabrese Barton claim that the creation of third spaces will facilitate this engagement and empowerment. They argue that "an empowering science and math education is one where authentic hybrid spaces are created, which allow students to merge their worlds with the worlds of science and math education in support of

learning and agency" (p. 14). Another example of a third space was provided with an after school bilingual math club that visited several local businesses to inquire about how they use mathematics. One such business was an auto shop that did car decaling. This trip was particularly engaging for the students because they lived in a community that valued car modifications. During this trip, the students learned about the presence of math in this business, particularly through the use of scaling and proportions to transfer the workers' designs from a sketch to a full-sized car decal. This trip allowed students to see math as something relevant to their lives outside of school. This vignette, and many others in the book, helped to support Tan and Calabrese Barton's claim that third spaces can be used to engage urban students in science and mathematics.

Tan and Calabrese Barton provide many rich examples of how math and science learning can be situated in problems that are authentic and relevant to learners and that can help them transform their communities. They highlight the importance of teaching math and science through such *real* problems, stating:
critical engagements with math and science can serve as robust contexts and tools for participating in a democratic society in fair, just, and transformative ways. As a context, science and math act as a set of conditions that allow youth the space to take up new identities and practices for tackling questions normally constitutive of other people with more power. (p. 42)

The authors provide two different examples of nutrition units (Chapter 1 & Chapter 4) during which students are taught to make healthy eating decisions. Typically, all nutrition decisions would be made by parents, but the students in each of these classrooms are taught to make healthy decisions. Of course, the parents will still be making food purchases, but perhaps the students will be empowered to have some say in what is purchased and what they ultimately eat.

A powerful example of situated science learning can be found in the "Urban Heat Island" project (Chapter 5). This project was done by a voluntary science/technology/ social club for youth funded by the National Science Foundation. The club meets weekly after school at a Boys

and Girls Club in an urban area. For this project, the students in the club took to the streets to determine whether or not their city could be classified as an urban heat island. The students split into three groups, each group producing a documentary on the phenomenon. Without exception, the students in each group chose to "specifically place their scientific ideas in context and to situate the meaning of their knowledge claims, rather than to represent ideas removed from context" (p. 140). This situated project proved powerful as the students eventually presented their work to professionals—including engineers, scientists, teachers, and politicians—who they may not otherwise have had an opportunity to interact with. Readers can imagine how empowering this experience was for the students. In fact, the authors expressed that an initial goal of the project was to allow the students "the space and maneuverability to be both scientific and youthful and to feel empowered to take some action beyond themselves" (p. 143). The situated nature of this project appeared to support Tan and Calabrese Barton with meeting this goal.

Despite the powerful examples of third spaces included in *Empowering Science & Mathematics Education in Urban Schools*, I am left with questions about the challenges teachers and community leaders may face in the construction of these spaces. In the subsections that follow, I will address each of these questions.

Why were many of the lessons in this book taught by the authors themselves? The authors themselves had a hand in facilitating many of the lessons featured in this book. For instance, one of the contributing authors helped plan the school overcrowding project (Chapter 3), the weather unit was taught by one of the authors as a guest teacher (Chapter 2), and one of the contributing authors facilitated the school closing project done by the afterschool math club for minority girls (Chapter 6). It could have been more powerful if the authors provided examples of third spaces that are currently being enacted by teachers and community leaders in actual classrooms and after school clubs across the nation; perhaps this is the next stage in this work. Because the authors themselves facilitated so many of these projects, I am left wondering whether third spaces are hard to find and/or difficult to create. On the other hand, perhaps the authors intended for this book to

be more of an intervention study, during which they would enter classrooms and afterschool programs and assess the benefits of constructing third spaces. In this case, the authors could have presented the results in this way. Instead, the results were presented as a series of examples of how third spaces can look. But again, it is discouraging to see that so many of the examples were being conducted by the authors themselves, and there would have been a greater benefit in providing more examples of actual teachers and community leaders facilitating third spaces.

Why did many of the provided examples take place in after school programs rather than in actual classrooms? Tan and Calabrese Barton's second research question asks "How are [empowering learning environments in math and science] constructed inside and outside of the school building?" However, I am left feeling like they did not provide enough examples of third spaces *inside* the school building. Many of the examples took place in afterschool programs such as the bilingual math club visiting the auto shop (Chapter 2), the urban heat island project (Chapter 5), and the school closing project (Chapter 6). Additionally, with the exception of a school overcrowding project (Chapter 3), many of the third spaces that were constructed inside classrooms seemed, in my opinion, less powerful than those created outside of them. The after school projects all centered around community involvement, and often involved community change or improvement. These examples seemed particularly empowering for students, especially for the urban students who may have felt previously powerless in their communities. The contrast of the empowering out of school projects, during which the students frequently had the opportunity to affect changes in their community, made the in school projects seem comparatively less powerful. These in school examples include the nutrition unit with French fries (Chapter 1), the digital story weather unit (Chapter 2), and a nutrition unit during which the students brought in their own home salad recipes (Chapter 4). Although these projects were powerful on a smaller scale—teaching students to make changes on an individual level by learning to make healthy eating decisions or to practice weather safety—they lacked the rich community context of the after school examples. On the whole, the out-of-school examples seemed far more empowering than those that took place in school. Being that a driving rationale

for the creation of third spaces is that typical math and science instruction causes disengagement in many students, it seems that it would be most beneficial to prioritize the construction of third spaces *inside* of classrooms. The lack of powerful examples of this again leaves me discouraged about the feasibility of creating these spaces. Even contributing author Maura Varley Gutiérrez recognized that it is far easier to construct outside-of-school third spaces, stating "because this was an afterschool setting and because I had a relationship with the school, I was given complete curricular freedom and support from the staff and teachers" (referring to the school closing project done by the afterschool math club for minority girls, p. 151).

Fortunately, Tan and Calabrese Barton presented one powerful example of a third space that was created within a classroom. This example was provided by contributing author Erin E. Turner (Chapter 3). In this case, a third space was created in a sixth-grade math class through a project in which the students investigated overcrowding in their own school. The students constructed their own arguments to demonstrate that the school was overcrowded. They used measurement, calculation of area and volume, and ratios to illustrate the overcrowding of the hallways, bathrooms, and classrooms. Impressively, the students eventually presented their results at a district meeting, and officials chose to limit enrollment to prevent further overcrowding. This project provided a rich example of how third spaces *can* be constructed in classrooms, but the book would have benefitted from the inclusion of more examples like this.

How will the construction of third spaces in classrooms align with the current school climate of mandated curriculum and standardized testing? The reality of classroom teaching today—and in urban schools in particular—has many teachers working under imposed curricula with constantly looming standardized testing pressures. This again leaves me wondering about the feasibility of constructing third spaces within classrooms. The authors address this concern on several occasions:

- When discussing the Urban Heat Island project done by an *after school program*: "We do note that with [this program], such engagement was strongly facilitated by our freedom from pacing guides and school policy

demands, elements that would no doubt be challenges to science teachers in the classroom embarking on third-space science teaching and learning" (p. 144).

- When discussing the School Closing project done by an *after school program*: "this work took place in an afterschool setting, where there was complete curricular freedom. The reality of schools today is that classrooms are becoming more and more restricted in terms of what is taught and how" (p. 164).
- When discussing the School Overcrowding project done *in a classroom*: "Teachers at [the school] were bound by state standards, but had considerable curricular and pedagogical autonomy, which certainly facilitated the extended, project-based investigations described in this chapter. They also met frequently as a staff to discuss their practice and ways to best meet the needs of particular students, and to collaborate on curriculum design tasks" (p. 76).
- When discussing the nutrition lesson—during which students brought in their own family salad recipes—done *in a classroom*: "[the teacher] had to decide to carve out time for storytelling, which lengthened the overall time spent on the unit. Given the syllabus that she had to cover for seventh-grade science, she could not afford to engage in narrative pedagogy in this manner for every unit" (p. 108).
- When discussing standardized testing: "Achievement scores, tightly aligned with content standards, remain the gold standard for documenting the impact science and math education has on learners, allowing other potentially powerful constructions of what it means to learn science and math fall away to the side as less important" (p. 32).

As evidenced above, the complications of facilitating third spaces within classrooms was ever present throughout the examples in this book.

In addition to curriculum and pacing concerns, teachers seeking to create third spaces in their classrooms must also be concerned with assessment. In the words of the authors, "these hybrid spaces also challenged what counts as rigorous evidence of mathematical and scientific knowledge and achievements" (p. 177). Rather than traditional pencil-and-paper tests, the students showcased their math and science expertise in different ways. Tan and Calabrese Barton argue that "this mode of reflecting

on their scientific and mathematical knowledge is more rigorous then taking a pen-and-paper test" (p. 177) because of the higher-level thinking that is involved. However, the authors could have helped the reader by providing specific information on how the students were assessed. For example, if rubrics were used to grade the students' projects, perhaps the authors could have provided an example for the reader. If third spaces are to be constructed in classrooms as they presently stand, teachers need to be given more information on how to facilitate these spaces under present curricular and standardized testing impositions.

What are the implications of addressing "risky" topics in third spaces? Having been a classroom teacher myself, I couldn't help but feel slightly intimidated by some of the controversial topics that were discussed in several of the third space examples. These examples included the school overcrowding project (Chapter 3) and the school closing project (Chapter 6). New teachers, in particular, may feel pressure to conform to the current state of the school, and may be fearful to face administrators to address school issues. A sad but true reality has many of us hearing stories about talented teachers being let go for standing up for what they believe in. Although these were both very powerful projects, and both eventually led to positive change within the schools, many teachers may feel that it is too risky to take-on these projects within their classrooms.

The school closing project was done by students in an afterschool math club for minority girls. After hearing that their school might be shut down, the girls decided to construct mathematical arguments to support their stance that the school should remain open. Their argument included the increased cost of bussing students and the increased walking time for students to the new school. Amazingly, the students presented their arguments to school administrators and it was decided that the school would remain open! This is an unbelievably powerful example of how students were able to use mathematics to help their own community. However, even Tan and Calabrese Barton must recognize the obstacle in facilitating such a controversial project. They state: While the girls were successful in persuading the school board to abandon the plans for school closure, they (and

by extension their teachers) had to set themselves up against the higher authority figures of the school when making their case against the school board. The highly transparent and visible manner in which the students (and their teachers) opposed the school board and refuted their arguments is likely to put both the students and teachers at risk for repercussions from the higher-ups. (p. 181) Teachers and students definitely need to weigh the risks and benefits before undertaking controversial projects such as this one. This risk of controversy provides yet another obstacle for facilitating third spaces in classrooms.

Who is the intended audience? Given the many complications of constructing third spaces within classrooms, I am left wondering about the intended audience of this book. For whom was it written? Community leaders reading this book may be in the best position to facilitate the creation of third spaces, but this leaves the problem of inequalities in urban math and science classrooms unaddressed. On the other hand, teachers reading this book may find themselves simultaneously inspired by the idea of third spaces, while also discouraged over the difficulties they will face in attempting to facilitate them. Perhaps the book is intended for administrators or politicians who will see the importance of creating third spaces, and will hence be forced to recognize that current policy hinders a teacher's ability to facilitate them?

Tan and Calabrese Barton succeeded in showing readers the importance of constructing third spaces to help engage urban youth in math and science education that is relevant to their world. So what are their recommendations in moving forward? Provide professional development for teachers? Change mandated curricula? Create more after school programs? I am eager to know how the authors believe we should proceed.

With the vivid examples provided in this book, it is difficult to argue against the creation of third spaces as a venue for empowering science and mathematics education in urban schools. However, the reader is left with lingering questions about the feasibility of implementing third spaces in math and science classrooms under the current school climate. Before third spaces can be created in actual classrooms, administrative adjustments will have

to be made—addressing curriculum and testing—and professional development will need to be provided for teachers.

Overall, *Empowering Science & Mathematics Education in Urban Schools* provides the reader an excellent introduction into how third spaces can be used to engage urban students in math and science learning. The next step is to develop and move forward with a plan to implement these spaces in classrooms everywhere.

About the Reviewer

Alison Marzocchi is a doctoral student in Mathematics Education at the University of Delaware. Her research interests include the transition to collegiate mathematics for underrepresented students and the identity development of underrepresented students in mathematics, particularly through participating in college outreach programs.

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