

**CASH ACROSS THE CITY:
PARTICIPATORY MAPPING & TEACHING FOR SPATIAL JUSTICE**

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Abstract

This paper explores teaching mathematics for spatial justice (Soja, 2010), as an extension of teaching mathematics for social justice (Gutstein, 2006). The study is contextualized in a 10-session curricular module focused on the spatial justice of a city's two-tiered system of personal finance institutions (mainstream vs. alternative), piloted with two 11th/12th grade mathematics classes in a high school in a low-income neighborhood. The module includes a form of participatory action research known as participatory mapping (PM), examined here as a learning activity particularly conducive to urban settings. The study investigates learning opportunities and complexities opened up by PM for students. In particular, the analysis investigates how collecting narratives through PM engaged and complicated students' senses of place, whereby narratives that surfaced challenged the module's narrative about predatory lending. Findings are used to generate recommendations about ways to better support the use of PM in teaching for spatial justice.

Keywords: spatial justice, urban schools, participatory mapping, critical mathematics

Despite John Dewey's claim that "it is through what we do in and with the world that we read its meaning and measure its place" (as cited in Dworkin, 1952, p. 42), school learning primarily continues to be structured such that learning takes place inside schools, according to a model of "classroom as container" (Leander, Phillips, & Taylor, 2010). A way to break open the classroom as container is through place; here, we draw on a "critical pedagogy of place" (Gruenewald, 2003), which integrates place-based education (e.g., Smith, 2002) and its focus on place with critical pedagogy (e.g., Freire, 1970/1998) and its emphasis on social critique and agency. Students' senses of place have geographical, historical, socio-cultural, and political dimensions (Lim & Calabrese Barton, 2006) and are recruitable toward investigating a place's multiple histories and social interactions (Leander et al., 2010) as well as spatial injustices (Soja,

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2010). An emphasis on places familiar to students privileges their local knowledge, which could be significant in urban schools where teachers are typically outsiders to the school neighborhood (e.g., Milner, 2008). This article examines such an investigation and its use of participatory mapping (PM), a form of participatory action research whereby participants collaborate to gather data in place toward producing a map.

Teaching mathematics for spatial justice (Rubel, Lim, Hall-Wieckert, & Sullivan, 2016) is an extension of teaching mathematics for social justice (Gutstein, 2006). Spatial justice is defined as the right to access public services for basic needs and advantages of city life, to participate in the production of urban space, and to be free from imposed spatial segregation (Lefebvre, 1968; Soja, 2010). An extension from social to spatial is fitting since all social justice issues are inherently spatial (Soja, 2010). Mathematics, through its disciplinary foci on geometry, proportion, data science, and modeling, provides an entryway into analyzing issues of spatial justice.

The spatial justice issue described here concerns New York City's two-tiered system of financial institutions (FIs), comprised of traditional banks alongside alternative financial institutions (AFIs), like pawnshops, check cashers, and wire-transfer outlets. AFIs typically proliferate in low-income neighborhoods that are under-banked but charge higher rates than banks (e.g., Caskey, Duran, & Solo, 2006). While participation in the traditional banking system is necessary for building credit to access wider capital, overdraft charges and other bank fees make banks less accommodating to the needs of low-income people (Servon, 2014). This inherent complexity serves as the context for considering the spatial distribution of a city's FIs, relative to spatial distributions of other demographic variables, like household income.

This theme of access to a diversity of FIs was explored in a 10-session module known as *Cash City*. The module was designed for high school students by an inter-disciplinary design team comprised of educational researchers as well as urban planners and cartographers, piloted, and revised in multiple iterations as part of a larger project. As part of the module, PM complemented a study of the mathematical comparisons of rates and a spatial analysis of patterns in the locations and densities of FIs. Theorized as integral in order to offer students a zoomed-in and three-dimensional spatial exploration of the distribution of FIs in their neighborhood, PM was seen as a way to surface narratives that could contribute to students' understanding of the significance of this spatial justice issue. In this study, we focus in particular on the research question of how PM engaged and complicated students' senses of place. The discussion shares observed affordances of PM and highlights its potential for teaching and learning in urban schools amidst complexities and challenges.

Conceptual Framework

Since place-based education is typically cast in terms of investigations of environmental features of students' physical environments (e.g., Smith, 2002), it is viewed as a natural fit for rural schools. Urban space is inherently conducive toward teaching mathematics for spatial justice (and place-based education more broadly) because of the density, traversability, and wired-ness of cities in concert with the abundance of location-based data about cities and their residents (Rubel, Lim, Hall-Wieckert, & Full, 2015). Accordingly, urban schools are uniquely positioned to harness the potential of new mobile technologies toward learning activities that rely on place. Indeed, the abundance of location-based data and availability of free mapping technologies have led to new opportunities to contextualize learning in spatial themes across an array of school disciplines, such as social studies, science, and mathematics. Often, these

investigations study place from the confines of the classroom and are restricted to analyses of broad-scale data, at the level of county, city, or neighborhood (e.g., Enyedy, Danish, & Fields, 2011; Esmonde, 2014). A focus on place from the vantage point of the classroom can be complemented by investigations outside of the classroom using a technique like PM.

Projects in the education literature that incorporate PM are trans-disciplinary and tend to capitalize on new mobile technologies that readily enable gathering, mapping, and visualizing participant-collected data (e.g., Umpruss, Ma, Hall, Taylor, & Luna, 2012). Participants can collect quantitative data or can gather and map media like photographs, audio, or text (e.g., Literat, 2013; Mitchell & Elwood, 2012; Ranieri & Bruni, 2013; So, Seow, & Looi, 2009). Data can be collected using digital, analog, or hybrid tools (e.g., Pacheco & Vélez, 2009; Santo, Ferguson, & Trippel, 2010; Van Wart, Tsai, & Parikh, 2010). In the project described in this paper, participant-collected data included photographs (of storefronts, interiors of FIs, signage, and more) and audio interviews (with pedestrians and customers or employees of FIs) using mobile technologies. PM enables students to create maps of their city with narratives that they have gathered instead of only reading maps of their neighborhoods made by others. Interviews are a means of accessing people's narratives about places, which are significant because these narratives "continuously materialize the entity we call place" (Price, 2004, p. 4 as cited by Cresswell, 2015, p. 57). Within the logic of "map or be mapped" (Meier, 2011), participation in the creation of maps can be understood as a form of digital activism, as a way for students to claim their "right to the city" (Lefebvre, 1968).

Although contextualizing mathematics in terms of local relevance is thought to facilitate engagement (e.g., Moses & Cobb, 2001), findings from emerging research indicate that prior knowledge about place can distract students from grappling with quantitative data, especially when data contradicts or challenges students' senses of place (e.g., Enyedy & Mukhopadhyay, 2007; Esmonde, 2014; Wilkerson-Jerde & Laina, 2015). This paper further adds to the literature about teaching and learning in urban schools with a focus on local issues of spatial justice. The research question pursues how PM contributed to and complicated students' learning as part of a broader mathematics for spatial justice investigation of the city's two-tiered financial system.

Overview of the Module and Research Methods

The *Cash City* module consists of four components conducted across 10 class periods. First, the mathematical concept of percent and an associated ratio table are used as tools with which to model and compare loans toward exploring critical notions of predatory lending. The second component consists of an investigation of spatial patterns in the distribution of FIs in the local city, using data-rich, interactive maps (see examples in Figures 1, 3, and 4). These maps represent the spatial locations and relative densities of FIs, layered atop statistics that report spatial distributions of other demographic variables, like median household income or relative presence of immigrants, providing additional opportunities for using mathematics to learn about place. The module's third component is the PM, in which students conduct field research in the school neighborhood to explore and document the distribution of financial institutions firsthand and to conduct interviews with people in the neighborhood about their experiences as customers or employees of these businesses. The fourth, summative component of the module is the statement and justification (using mathematics) of student opinions about this spatial justice issue. Our focus in this study is on the PM, described in further detail below.

The design team (comprised of mathematics education researchers, mappers, and urban planners who identify as White or Asian) designed a web-based PM tool to support participant-

Setting

This paper focuses on findings from the module’s second iteration of piloting, conducted at a high school in New York City. The school identifies as “project-based” and is one of five small schools on the campus of a high school that had been closed because of poor performance, located in a gentrifying neighborhood that falls towards the bottom of the city’s income distribution. The school largely serves students of color (identified by the school district as 45% Hispanic, 35% Black, 15% White, 5% or Asian or American Indian), and most (71%) students’ families are considered low income. The collaborating teacher was a White, 8th-year teacher who had participated in three training sessions exploring the module’s associated data, sociopolitical context, and technologies. She conducted the module in two sections of a class organized around financial mathematics serving 11th and 12th grade students who had not yet satisfied the school’s mathematics requirements for graduation.

The school struggles with attendance; as reported by the teacher, 16 of the 37 students enrolled in these class sections had been classified as chronically absent the previous year. Nineteen students, a typical attendance rate, accompanied by six participant-observer adults, were organized in four groups for this iteration of PM. Groups followed distinct, prescribed routes and spent one hour in the neighborhood immediately surrounding the school to conduct PM, to learn firsthand about the role of FIs in that neighborhood in terms of where they are located, what services they offer, how they communicate their rates, as well as who seems to be engaging with the various FIs and for what reasons. The school’s neighborhood, about 0.5 square miles in size, has a diversity of financial institutions, including ten AFI and eight banks (see Figure 3a), and comprises a density of pawnshops, for example, in contrast with surrounding areas (see Figure 3b). Students participated in a teacher-led, 56-minute debrief discussion afterwards.



Figure 3. Locations and density of financial institutions near the school.

Data Analysis

To better understand student engagement with PM, we analyzed narrative field notes from each of the four PM groups as well as audio of the whole-class debrief. We looked for students’ reflections about the impact of *Cash City* and, especially, the role of PM. In addition, we categorized the media gathered by each group in terms of type of media (photographs, audio

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interviews), type of FI, and object of interview (employee or pedestrian). For this analysis, we focused specifically on the audio of the interviews conducted in the PM, looking for thematic narratives about FIs, and on the audio of the classroom debrief, looking for how students reflected about the PM. The collaborating teacher is a co-author of this paper and provided member-checking (Lincoln & Guba, 1985) about interpretations.

Results

Participatory mapping cut across the container-like boundaries of the classroom to recontextualize students' prior work in the classroom and reframe the local neighborhood from a perspective of spatial justice. Our results highlight how gathering media through PM engaged students in thinking about complex, local issues of spatial justice. Student-collected images illustrated the urban streetscape, while audio-recorded interviews with pedestrians and FI employees revealed various narratives from people in the neighborhood. Experiences through the PM included differential treatment of students at different types of financial institutions, introduced complications with regards to students' sense of place, and rendered the spatial justice issue more complex.

Media Gathered in PM

Groups contributed 46 pieces of media to the collaborative map. Thirty-three media objects were photographs, of the exterior and interior of AFIs (12) and banks (7), students (10), and street art (4). Thirteen media objects were interviews, with employees at various FIs (9), pedestrians (3), and with another teacher from the school (1). Students interviewed employees at banks (2), wire transfer stores (2), pawnshops (2), check cashers (2), and a buy-sell jewelry store that physically resembled a pawnshop (1). The interviews with employees focused on the nature of the services provided, their prices, and information about access.

Interviews with FI Employees

In general, students approached the interviews with employees at FIs more from the perspective of learning about each individual business as its own internal system, in terms of its services and fees, and less to uncover details about larger systems in which these businesses constellate, such as who owns a business, how long it has been at that location, and socio-cultural, historical, and political factors that might contribute to why it is located in that place. In some cases, students' discoveries through interviews with employees extended beyond matters of the institution as an internal system. For example, through interviews with employees and viewing signage in wire-transfer outlets, students discovered global connections by learning that people use these AFIs to send money to or pay bills for transnational family members.

Interviews with Pedestrians

Interviews with pedestrians surfaced narratives that went beyond details about the services and rates. While the classroom sessions emphasized the predatory nature of AFIs, the interviews with pedestrians cast light on greater complexity. One interviewee explained how he utilizes the neighborhood's entire array of FIs, banks and AFIs, to meet a diverse set of financial needs (Figure 4). A second interviewee related gentrification in the neighborhood in terms of the

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increased bank presence, citing that “the only thing that can afford to open over here is drug stores, banks, and condos... where there is a bank going up, I’d prefer maybe a Boys Club or something like that, but banks can afford to pay the rent.” A third interviewee contrasted the income gap between bank management, or “executives...getting billion dollar raises” with “people on the street who can’t afford to eat.” Interviews with pedestrians illuminated ways in which AFIs and banks interact with and are part of larger systems of spatial (in) justice.

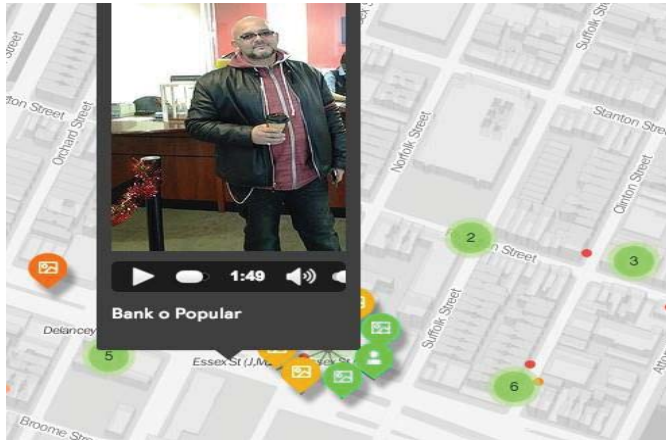


Figure 4. Audio of interview with pedestrian mapped by location.

Complexities

An unanticipated outcome of the PM was that it surfaced counter-stories that challenged the narrative of AFIs as predatory. Through the PM, students discovered that AFIs can feel welcoming, perhaps more so than banks. For example, one student shared that by visiting a pawnshop and interviewing an employee, she discovered that he “was a nice guy” and “gave discounts” (12/18/14). Even though she recognized that he might be making offers as a way for his business to ultimately profit, the student had discovered a sympathetic, approachable figure in this pawnshop representative.

In addition to experiencing comfort in some of the AFIs, some students experienced exclusion during the PM. In general, banks were less open than AFIs to students entering the business’s premises, taking photographs, or conducting interviews inside, citing that these actions violate the bank’s corporate policy. General feelings of alienation experienced by students in banks were heightened for some students who experienced racism and exclusion upon entering banks in specific locations across implicit racial boundaries. In one instance, for example, students were confronted by a bank manager who refused to speak with the students, despite an accompanying adult’s intervention. One of these students later reflected that it seemed like “she (the manager) didn’t even care” (12/18/14). The telling about this interaction in the debrief session prompted a student from another group to conclude that the bank where they had been excluded was “racist, because we all black” (12/18/14).

Discussion

Findings coincide with recommendations from the literature about the contextualization of mathematics learning with issues of local relevance. The financial literacy focus directly

motivated classroom learning about the concept of interest, and in turn, the mathematical comparisons of the costs of loans at various institutions contextualized the spatial analysis and the PM. Students were able to see firsthand the density of FIs in the school neighborhood in the physical streetscape, through a lens of their differing services and interest rates, and could experience how those interest rates are communicated differently by various FIs. The module's digital maps allowed students to observe the city-wide distribution of FIs with respect to socioeconomic demographics, but it was through PM that students became co-authors of those maps and could make connections between their lived experiences, the city-wide maps, and the associated mathematical concepts. Indeed, many students characterized the PM as a highlight of their experiences with the module.

Students reflected that they felt empowered with a sense of newfound mathematical agency with respect to negotiating future financial decisions. During the debrief, one student reported that she felt that she could calculate interest and “then tell them what I owe them instead of them telling me what I owe them” (12/18/14). Another student reflected that, “It’s going to help me in the future to make better financial decisions” (12/18/14). However, we note that students’ newfound mathematical agency was largely centered around functional mathematical literacy (Gutstein, 2006) as prospective, future consumers of these businesses rather than around systemic views about justice. In general, *Cash City* did not sufficiently support students toward an understanding of financial services as a right. Instead, students seemed to accept and at times even defend their city’s inequitable distribution of financial services as limited by a single governing principle of maximizing profit per capitalism. Since the PM was limited to one neighborhood, there was no means to compare that neighborhood with a differently resourced one. Perhaps the limited focus on a single neighborhood helps to explain why students did not readily engage with social critique or with reimagining their neighborhood as fairer to more people.

Students’ experiences of feeling welcome in AFIs or feeling excluded in banks during the PM foregrounded how spatial injustice around accessibility to FIs is constituted by and reinforces spatial injustice around race and class. In other words, experiences of exclusion or alienation from banks during the PM reflect the broader spatial patterns of underserved people being excluded by banks, a pattern that in and of itself reinforces the inaccessibility of capital and opportunity. In addition, the role of race, gender, or their intersections, was not explicitly explored in the demographic layers on the project’s digital maps and was left unstated in the framing of the PM for students in this iteration. And yet the assertion that “race—in all of its complexity and ambiguity, as ideology and identity—is what it is and does what it does precisely because of how it is given spatial expression” (Delaney, 2002, p.7) makes clear the dangers of investigating a spatial justice issue without explicitly integrating questions of race and racism (Philip, Way, Garcia, Schuler-Brown, & Navarro, 2013). Insufficient support was given to students and the teacher in this iteration of *Cash City* to be able to anticipate or respond to these incidents in the moment and in place, or to contextualize or employ these exclusionary experiences as part of the spatial justice investigation.

Conclusions

This article has highlighted the potential of PM for teaching and learning in urban schools. Spatial themes can be investigated through multiple disciplinary lenses, such as social studies, literacy, science, or as shown in this paper, mathematics. Our analysis suggests that expanding the PM to investigate more than one neighborhood could deepen investigations and

enable comparisons across places, which might lead to consideration of systemic inequalities. Findings indicate that further consideration must be paid toward how to support PM in anticipation of the role of race, gender, and their intersections, so that students and teachers can contextualize racialized and gendered experiences in relation to systemic inequalities. These reflections highlight the importance of engaging critical race perspectives in future spatial justice projects (e.g., Vélez, Solórzano, & Pacheco, 2007). In subsequent iterations of *Cash City*, we have further emphasized the significance of mainstream banking resources for neighborhoods and their residents (e.g., Center for Urban Pedagogy, 2014) as a way to better contextualize the significance of accessibility. We have not yet connected students to existing social activism campaigns around the issue of equity in banking (e.g., Occupy Finance) but recognize that doing so would likely support students in further developing senses of agency (Gutstein, 2006).

Our findings support the hypothesis that rooting investigations of justice in students' places can motivate engagement in mathematical learning, as well as historical, socio-cultural and political learning. In particular, students viewed their contributions to PM as meaningful to a growing, shareable, and dynamic body of knowledge about their city. Such meaning lent a sense of purpose to students' participation in this school mathematics project, participation that transcended beyond learning mathematics to other disciplines including geography and social studies. Through PM, students were placed at the nexus of critical-mathematical perspectives, visualizations of maps and data, and the expansive complexities of urban space.

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