Toward a Socio-spatial Framework for Urban Mathematics Education Scholarship

Gregory V. Larnell, Erika C. Bullock
University of Illinois at Chicago,
University of Memphis

The purpose of this paper is to re-engage the task of conceptualizing urban mathematics education by proposing a theoretical framework for scholarship, policy, and practice in urban mathematics education. The authors engage scholarship in mathematics education, urban education, critical geography, and urban sociology to consider a socio-spatial framework for urban mathematics education, which includes a visual schematic that locates mathematics teaching and learning—vis-à-vis a now-classic math-instructional triad—within a system of socio-spatial considerations relevant to urban contexts in the United States. The authors also consider the potential for such a framework for considering a more global perspective of urban within mathematics education scholarship.

> The challenge is to build theories and models that realistically reflect how geography and opportunity in mathematics education interact. If this challenge is addressed, the field will be one step closer to making scholarship in urban mathematics education visible (Tate, 2008, p. 7).

During the past two decades, urban mathematics education has emerged as a vibrant new area of scholarship in the United States—evinced most recently by the arrival and proceedings of the *Journal of Urban Mathematics Education (JUME)*. The roots of this subdomain of mathematics education extend back at least to efforts during the 1980s (see Tate, 1996), concurrent with the development and publication of standards by the National Council of Teachers of Mathematics (NCTM) for mathematics curriculum and evaluation (1989) and for the practice of mathematics teaching (1991). These developments also coincided with commensurable shifts in research; mathematics

education scholarship around the world was entering its much-discussed social turn (e.g., Meyer & Secada, 1989; also see Lerman, 2000; Martin & Larnell, 2013; Stinson & Bullock, 2012). For researchers, teachers, policymakers, and education-interested foundations in the United States (e.g., Ford, National Science Foundation), a crucial new question emerged: How would the then-new vision for school mathematics reform extend to and take shape in urban districts and classrooms (Tate, 2008)? This question remains central in the latest shift to the Common Core State Standards for School Mathematics.

Our aim in this presentation is to broaden the discourse in urban mathematics education in ways indicated by the above epigraph excerpted from Tate's (2008) commentary in the inaugural issue of *JUME*. Urban mathematics education scholarship has advanced to the point at which we may now begin to evaluate the production of knowledge in this subdomain—and, particularly, the building of "theories and models that realistically reflect how geography and opportunity in mathematics education interact" (p. 7). What has the study of urban mathematics education entailed? What can it become? The purpose of the present paper is to take "one step closer" toward addressing these questions and toward new directions for urban mathematics education scholarship and practice.

Overview of the Socio-spatial Framework for Urban Mathematics Education Scholarship

In the spirit of addressing Tate's challenge (also see Anderson, 2014), our objective is to posit a new theoretical framing for scholarship in urban mathematics education—the first of its kind (Figure 1). In this section, we detail the theoretical concepts undergirding the framework. We situate this framing squarely (but not entirely) in mathematics education scholarship—using as our central unit of analysis the well-regarded math-instructional triad of teacher(s), learner(s), and mathematics (Cohen, Raudenbush, & Ball, 2003; NCTM, 1991; Stein, Smith, Henningsen, & Silver, 2009).

Extending beyond mathematics education, we look toward the interdisciplinary areas of urban sociology, critical geography, and urban education scholarship to consider the various forces that influence

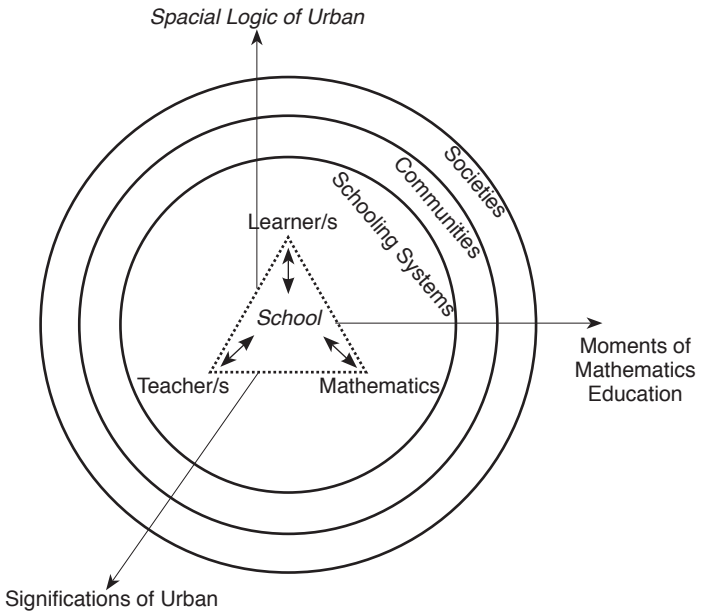

Figure 1: Socio-spatial framework for urban mathematics education scholarship

mathematics teaching and learning in urban spaces as well as the social significations that shape interactions in urban settings—and to emphasize the ways in which urban spaces and their meanings are reciprocally constituted. We recognize, however, that the task of defining urban has been an overwhelming challenge across disciplines, and our attempt here is to incorporate what is known inasmuch as we can given what is available to us contemporarily (Milner & Lomotey, 2013).

To inform the framework with respect to the social meanings that shape urban mathematics education, we draw on Leonardo and Hunter's (2007) typology of significations that circumscribe urban education (also see Martin & Larnell, 2013). We represent that typology as an axis of the framework that intersects with spatial considerations of urban, drawn from scholarship in human and critical geography (e.g., Soja, 1980; Thrift, 2003) and urban sociology (e.g., Johnson, 2012). These two axes, when taken together, are intended to signal a "socio-spatial dialectic" regarding urban education (also see Soja, 2012). By socio-spatial dialectic, we mean that the social significations and spatial considerations necessarily interact to determine

meaning for urban such that, as Tate (2008) suggested: "to realistically reflect how [spatial] geography and [social] opportunity in mathematics education interact." We then add a third axis to situate the socio-spatial elements in relation to the evolution of mathematics education. The third axis incorporates the various theoretical orientations—e.g., cognitivism/behaviorism, constructivism, sociocultural perspectives—that have emerged amid "moments" of mathematics education during the past century (Stinson & Bullock, 2012).

Math-instructional Triad as the Central Element of the Framework

At the center of our framework are the interactions and participation by and among learners, teachers, learners and teachers together, and other interactions permuted according to learners, teachers, and mathematics curriculum (see Figure 2). As Cohen and colleagues (2003) suggest, "Teaching is what teachers do, say, and think *with* learners, concerning content, in particular organizations and other environments, in time" (p. 124, emphasis added). This depiction of a triadic relationship is traceable beyond mathematics education scholarship to the works of John Dewey, Jerome Bruner, Theodore Sizer, and others (Cohen & Ball, 2000). In terms of the diagrammatic representation of the framework, the triad represents a kind of coordinate point with respect to the social, spatial, and math-education "theory-moment" axes that we describe in the following sections. Furthermore, we embed this triad within these multiple levels and axes to acknowledge that the math-instructional triad along is a limited representation of the ways in which mathematics education unfolds amid sociohistorical and contemporary contexts (see Weissglass, 2002).

Spatial Axis of the Framework

To substantiate the spatial aspect of this framing, we draw primarily on and discuss Thrift's (2003) four conceptions of space in relation to the other aspects of the framework: (a) empirical-constructing space, or the ways in which space is rendered measurable or objective

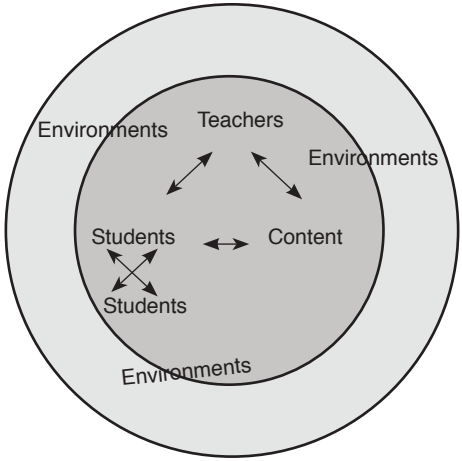

Figure 2: Math-instructional triad,
with Cohen & Ball's (2000) focus on interaction

(b) interactive-connective space, or the pathways and networks that constitute space (c) image space, the visual artifacts that we readily associate with certain kinds of spaces, and (d) place space, or our everyday notion of spaces in which human beings reside--even if notions of "human" and "being" are actively being reconsidered (p. 102). Each of these types refers to ways in which space is conceptualized in relation to human geography, and not necessarily with respect to either a strictly geographical sense of urban spaces or the meanings that are derived from them. This allows us to avoid constraints of a spatial logic that is determined solely by, for instance, characterizations based on population density or physical geography (see Milner, 2012). The strength of articulating four distinctive conceptions of urban allows one to look across their various permutations in ways that provide a nuanced perspective on space.

Social-signification Axis of the Framework

It is clear that urban is not simply geospatial; it also carries social and political meanings. Therefore, considerations of the urban in mathematics education must engage these social and political dimensions directly because "'place matters' in the study of urban mathematics

education" (Anderson, 2014, p. 10). The social-signification axis of our framework includes Leonardo and Hunter's (2007) three significations of urban: urban-as-sophistication (or cosmopolitan space), urban-as-pathological (or urban as "dirty, criminal, and dangerous;" p. 789), and urban-as-authenticity (or the politics of authenticity). It has become apparent that "urban" does not always refer to the geographical urban space; rather, studies have used the label urban as a proxy descriptor for poor, Black, and Brown populations who inhabit these spaces and disproportionately fall victim to the segregation and concentrated poverty that often characterize these spaces (Darling-Hammond, 2013). Such employment of "urban" ignores the heterogeneity of urban space, its politics, its people, and their experiences (Fischer, 2013).

Theory-moment Axis of the Framework

With a third axis in the framing, we attempt to construct (at least initially) what could be called a mathematical-socio-spatial dialectic. That is, we situate the math-instructional triad within the dimensional space of not only the socio-spatial dialectic but also with respect to the ongoing "moments" of mathematics education theory and practice (Stinson & Bullock, 2012; also see Martin & Larnell, 2013). Put differently, the axes represent the intersectionality of geography (or spatiality), social opportunity, and the development of mathematics education, which is what Tate (2008) originally outlined. The moments of mathematics education—the "process-product," "constructivist-interpretivist," "social turn," and most recently perhaps, "sociopolitical turn"—are overlapping categorical periods of research, practice, and policy (also see Gutierrez, 2013). These periods have often been indexed by a crisis metaphor within mathematics education scholarship (Washington, Torres, Gholson & Martin, 2012); this notion of crisis also connects to particular significations of urban life and contexts.

Ecological Rings of the Framework

In addition to the axes that situate the math-instructional triad amid social, spatial, and sociohistorical considerations, we also locate the

triad—and its associated network of practices—amid nested and reciprocally formative organizational fields in which mathematics teaching and learning occur (Arum, 2000; Martin, 2000; Weissglass, 2002). For the purposes of our initial framing, we consider the activity of mathematics teaching and learning within schooling systems (e.g., classrooms, schools, districts), communities, and at broader societal levels. Our attention to these levels also incorporates issues related to state regulation (e.g., Common Core State Standards), professional associations (e.g., National Council of Teachers of Mathematics), market competition (e.g., choice and charter movements), and other institutional forces that shape and circumscribe school-level practices (Arum, 2000). We recognize, however, that this aspect of the framework should be further developed to address the nuances of particular contexts to which the framework is applied—particularly, the various global contexts beyond the United States (from which this current articulation emerges).

Objectives and Global Considerations

The primary objective of the paper is to engage the task of conceptualizing urban mathematics education scholarship by offering a theoretical framing that pushes beyond traditional notions of "urban" in relation to education and mathematics education particularly. Our hope is to continue building and refining this framing toward application in research involving the "network of mathematics education practices" (Valero, 2012, p. 374) in urban spaces. We recognize that access to quality mathematics opportunities is a global issue given increased disparities in wealth and resource allocation (English et al., 2008; Thomas, 2001), and we posit that it is necessary to locate the network of mathematics education practices in a socio-spatial context in order to address these disparities.

However, we do not intend to present this framework as universal to mathematics education as a global enterprise. Toward that end, we acknowledge two key issues as we offer this conceptual framework for consideration among the MES community. First, we acknowledge that our present notion of urban relies heavily on U.S. scholarship. As such, we recognize that elements of the framework—particularly the three significations of urban—may not map onto other socio-political

contexts, thus limiting the framework's global applicability. Secondly, we acknowledge the related importance of avoiding an "uncritical globalization of issues" (Atweh & Clarkson, 2001, p. 86), and we hope to expand the framing to encompass a more global sense of urban. Based on these acknowledgements, the purpose of this paper is not only to present a conceptual framework for urban mathematics education, but also to engage an international audience about its global potential.

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