

## EXPLORING TEACHERS' CONSTRUCTIONS OF EQUITY IN MATHEMATICS EDUCATION: AN ECOLOGICAL APPROACH

Megan Brunner  
Oregon State University  
brunnerm@oregonstate.edu

*Research in mathematics education over the recent decades has resulted in a large number of definitions, conceptual framings, and operationalizations of what it means to do equitable teaching. An exploration of the activity system of equitable mathematics teaching is necessary to synthesize current literature and to work from teachers' current understandings of equity in education. A systems-approach to exploring equitable mathematics teaching is necessary to capture how individuals navigate structures of culture, power, and privilege to engage in equity work. We must re-center the voices of teachers to understand how they construct notions of equity in mathematics education. The object-constructions held by teachers inform their goals for instruction, which then influence the types of instruction enacted in classrooms.*

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Equity research in mathematics education has only grown in the last few decades, resulting in a variety of perspectives on and definitions of equitable mathematics teaching and learning. The PME-NA Equity Statement captures a broad swath of framings: “include ideas ranging from access to educational resources, to positioning students as capable and humans as valid sources of knowledge, to questioning the curriculum and high stakes assessment practices, to promoting critical social justice perspectives of mathematics as sociopolitical.” These variations in definitions and resultant frameworks guiding practice exist for researchers as well as practitioners. It is critical to clarify how teachers define equity, for this “directly relates to how we seek to both measure and achieve it in our schools” (Gutiérrez, 2002, p. 152). Teachers work within classrooms, school departments and districts, and broadly as part of the professional community, to achieve equitable mathematics teaching. Explicating how teachers construct their understandings of equity and social justice provides context for unpacking the goals they hold for instruction.

Researchers have explored teacher identities in the classroom and how that impacts attention towards equity and social justice in schools, broadly, or pedagogy, locally (Wager, & Foote, 2012). Others attend to what teachers are disposed to notice in classroom interactions (Edwards, 2011; Hand, 2012) or the orientations that drive decision-making in instructional moments (Schoenfeld, 2010). One's personal experiences, values, and beliefs influence the ways teachers engage in the profession, especially around equity work (Gutiérrez, 2002; Wager & Foote, 2012). Commentaries on the roles power structures, in the form of culture (Louie, 2017, 2018), race (Martin, 2009), class, and whiteness, among other social identifiers the perpetuate hierarchies of inequity, explore how the teaching and learning of mathematics is inherently situated within systems that privilege certain perspectives of the discipline (Rubel, 2017). Although there is a rich body of research on equity in mathematics education that focuses on teacher conceptions and identity, and a separate but equally fertile body of literature on equity in mathematics education that addresses issues of power and oppression, literature that attends to both is still emerging. Reed & Oppong (2005) worked with teachers on their definitions of equity, noting how race and class influence how equity is carried out in practice. Bartell (2013) explored how teachers' goals for instruction may align with goals for social justice. While these arguments are critical, we must consider how systems interrelate with activity on an empirical scale to understand how these relationships play out within instructional

settings, departments and districts, as well as interactions among members of the profession. A common implication for future scholarship across these studies explicates this need: a call for systems-focused research on *equitable mathematics teaching* that investigates how structures of power and culture interact with teachers' goals for instruction and their resultant practice (Louie, 2018).

Systems-focused research would target the integration of micro-, meso-, and macro-environments that influence how teachers make sense of and work towards more equitable forms mathematics teaching and learning. Bronfenbrenner states, "studies of learning should take into account the social ecology that forms the context for human activity. An ecological approach considers the development of an individual in relation to the "immediate environment, and the way in which this relation is mediated by forces emanating from more remote regions in the larger physical and social milieu" (1979, p. 13). Teachers' commitments to equity may draw upon their personal experiences in and outside of the classroom environment, as well policies or practices held as normative within their school organization, understandings of the field of mathematics educators interested in social justice work, and broader understandings of the ways societal hierarchies of power and privilege shape teaching and learning for individuals. An ecological approach frames ones' experiences within the cultural and historical milieu that make meaning through personal and professional commitments to equity and how one acts in service of those commitments.

### **Theoretical Framework**

I leverage Engeström's (1987) Cultural-Historical Activity Theory (CHAT) as a way to capture how teachers navigate interlocking systems to engage in the activity of equitable math teaching. Activity "involves people operating jointly in a persistent system of relations with other people and institutions," asking us to conceptualize equitable mathematics teaching as something which is constantly developing through the joint work of teachers with others in the community (Foot, 2014, p.9). Communities are not defined by proximity, but span place and space in pursuit of some shared values or goal (Wenger, 1998). Members of an activity system identify a specific need, or an object, that drives collective action. In this instance, we consider the collective of teachers across the profession actively oriented towards the object of equity in mathematics education.

### **Objects and Object Construction**

The motivating need, or object, of an activity system is a complex idea that cannot be explicitly identified or captured, but rather, shifts and expands as actors within the system work to achieve it. An object is worked-towards on an individual level, by subjects setting and achieving goals through actions. Individuals within the activity systems may hold varying constructions of the object under focus that shape the goals they set (Engeström, 1987). For example, some teachers may consider equity in mathematics education as the equitable distribution of opportunities to learn, while others may prioritize curriculum that are relevant to students' lives (Bartell, et al., 2008). Engeström (1990) notes that the historical development of object-constructions - in this case, what equity in mathematics education has looked like and meant throughout time - affords and constrains how teachers perceive of and engage in it, including the resources and conceptual tools they take up to guide their work. It is also important to note the teacher's personal experience can include their learning journey, professional experience, their positions within power structures, and environmental characteristics of their classroom, school, and surrounding contexts (Foot, 2014).

A teacher's object-construction of equity in mathematics education informs their goals for instruction. Goals may directly or indirectly relate to the object-conception held by the subject; for example, a teacher whose object-conception of equitable mathematics teaching is that of Teaching Mathematics for Social Justice (TMfSJ) (Gutstein, 2006), which includes the use of socio-political mathematical tasks in the classroom as a key component, their goal might be the implementation of a

particular curriculum across the year. Another goal for that teacher may be incorporating reflective questions and discourse into their mathematics tasks so that students can engage actively in reading the world using mathematics. Both of these goals are tangible, actionable steps the teacher can work to achieve that serve the object-conception of engaging in TMSJ. The object as each individual has constructed it will lead to different actions within the activity system. Unpacking the ways teachers construct equity and social justice in relation to mathematics teaching and learning provides opportunities to clarify how they move towards instructional goals that align or contradict those intentions (Bartell, 2013).

The research question explored in this presentation is part of a larger study that attempts to explicate the activity system of equitable mathematics teaching. Foot (2014) comments that “understanding an activity system requires understanding its object” (p. 10); thus, to understand the object of equity in mathematics teaching, we must first explore how teachers involved in the activity system construct their object-conception and related goals for teaching. Thus, this session explores how teachers committed to equity and social justice construct the object of equity in mathematics education. Further, how do teachers draw upon micro-, meso-, and macro-levels of educational systems in their constructions and resultant goals for instruction?

### **Methodology**

This study collaborates with secondary math teachers committed to equitable mathematics teaching to understand how they construct the object of equity in math education. Participants are mathematics educators at a non-profit educational organization for rising middle school students in the Bay Area. This program's mission is explicitly oriented towards creating equitable educational spaces for students, and this mission is a key factor in hiring. Educators in this organization have made an explicit commitment to equitable teaching through their employment status and program-offered professional development opportunities to reflect on their teaching and inequities in education. All participants are licensed educators, yet their experiences teaching in a non-traditional learning environment offer considerations for disrupting existing educational systems and transforming spaces for learning towards more equitable ends (Freire, 2000; hooks, 1994; Martin, 2009).

The participants engaged with questionnaires and follow up interviews to explore their commitments to equity in teaching mathematics. The questionnaires provided a baseline operationalization for how each teacher constructs equity in mathematics education and how they see it play out in an ideal classroom setting. A series of three interviews following the questionnaire allowed opportunities to probe for more detail and to have participants explain their experiences and perspectives that inform their object-construction. Each interview, and subsequent analysis, attended to a different layer of micro-, meso-, and macro-level ecological systems. Analysis of the data included iterations of structural coding and inductive thematic coding (Auerbach & Silverstein, 2003). First, data from both sources was linked for participants and segmented by topic, which provided context for codable instances and captured detail on the ways teachers saw equity issues in their practice. Next, I applied structural codes, noting when teachers drew upon micro- (such as classroom tools or norms), meso- (like site or program policies for mathematics teaching), and macro-systems (for example, the resources available in the broader professional community for TMfSJ or ideological systems like racism or whiteness) as they construct and work towards goals for equitable mathematics teaching and learning. I coded all teacher responses, allowing their language to drive the creation of themes for how teachers in the activity system of equitable mathematics teaching construct the object of equity. Across these codes, trends emerged that outline the landscape for how teachers make sense of equity in their practice. Throughout this process, I continuously engaged in member-checking with participants to accurately amplify their voices and regularly

constructed memos to process my positionality and understandings of participant experiences (Auerbach & Silverstein, 2003).

### Findings and Discussion

The study is ongoing, and thus, there are no clear themes to report as of yet. However, the expectation is that teachers generally conceptualize equity in ways that have been previously discussed in the field, though not consistently explicitly linking to the frameworks with which their constructions of equity are aligned. Teachers describe aspects of equity in mathematics to contextualize how these constructions are worked upon in practice, connecting to their goals for mathematics teaching and learning. These goals will provide nuance to aid in explicating how equitable mathematics teaching is understood and taken up by committed practitioners, including understanding the tangible goals for instruction each is oriented towards. Finally, these responses illuminate how teachers recognize, draw upon, and negotiate concentric systems of education. For example, how might one teacher's construction of equity in mathematics education as a status concern between students, drawing on the work of Complex Instruction (Cohen & Lotan, 1995) (macro-) align or contradict with departmental expectations for tracking students into courses (meso-) or their instructional strategies for inviting classroom discourse (micro-level).

This session contributes to the field of research on equity in mathematics education by centering teachers' constructions of equity and attending to how these constructions shape and are shaped by their goals for instruction. The lens of Engeström's (1987) CHAT provides opportunity to highlight ecological systems teachers work within as they negotiate their practice. I draw explicitly on notions of objects and object-constructions to understand how teachers committed to equity in mathematics education makes sense of this driving object and how their constructions are both similar and different. Further, I consider the link between one's construction of equity in math education and the goals they hold for instruction to understand how teachers are acting towards their object-conceptions. These results provide a more nuanced understanding of how teachers take up the work of equitable mathematics teaching within their educational contexts.

This research is part of a larger study that aims to articulate the activity system of equitable mathematics teaching. As objects are one of the centering tenets of an activity system, it is paramount we begin describing the activity system with the collective themes for how teachers construct equity in mathematics education. Future goals of this research include understanding how teachers committed to equity work towards their goals for instruction, employing equitable mathematics teaching practices and navigating systems in their disruptive action. This study will support grounding research on equitable mathematics teaching in the lives and work of teachers committed to equity. I also claim that the systems-level approach will bring light to the contradictions and tensions across everyday professional practice, which in turn opens space for professional development, restructuring of school policies, and future research on equitable mathematics teaching to explicate and reduce these challenges so that the field can more successfully move towards our object of equity in mathematics education.

### References

- Auerbach, C. F., & Silverstein, L. B. (2003). *Qualitative data: An introduction to coding and analysis*. New York University Press.
- Bartell, T.G. (2013). Learning to teach mathematics for social justice: Negotiating social justice and mathematical goals. *Journal for Research in Mathematics Education*, 44(1), 129-163. doi:10.5951/jresmetheduc.44.1.0129
- Bartell, T. G., Meyer, M. R., Knott, L., & Evitts, T. A. (2008). Addressing the equity principle in the mathematics classroom. *The Mathematics Teacher*, 101(8), 604–608.
- Bronfenbrenner, U. (1979). *The ecology of human development: Experiments by nature and design*. Cambridge, MA: Harvard University Press.

- Cohen, E., & Lotan, R. (1995). Producing equal status interaction in the heterogeneous classroom. *American Educational Research Journal*, 32(1), 99–120.
- Edwards, S. (2011). Developing Diversity Dispositions for White Culturally Responsive Teachers. *Action in Teacher Education*, 33(5–6), 493–508. <https://doi.org/10.1080/01626620.2011.627038>
- Engeström, Y. (1987). *Learning by expanding: An activity-theoretical approach to developmental research*. Helsinki: Orienta-Konsultit Oy.
- Engeström, Y. (1990). *Learning, working and imagining: Twelve studies in activity theory*. Helsinki: Orienta-Konsultit.
- Foot, K. A. (2014). Cultural-historical activity theory: Exploring a theory to inform practice and research. *Journal of Human Behavior in the Social Environment*, 24(3), 329–347.
- Freire, P. (2000). *Pedagogy of the oppressed* (30th Anniversary ed., M. B. Ramos, Trans.). New York, NY: Continuum International.
- Gregson, S. A. (2013). Negotiating social justice teaching: One full-time teacher's practice viewed from the trenches. *Journal for Research in Mathematics Education*, 44(1), 164–198. <https://doi.org/10.5951/jresmetheduc.44.1.0164>
- Gutiérrez, R. (2002). Enabling the practice of mathematics teachers in context: Toward a new equity research agenda. *Mathematical Thinking and Learning*, 4(2–3), 145–187. [https://doi.org/10.1207/S15327833MTL04023\\_4](https://doi.org/10.1207/S15327833MTL04023_4)
- Gutiérrez, R. (2009). Embracing the inherent tensions in teaching mathematics from an equity stance. *Democracy & Education*, 18(3), 9–16.
- Gutstein, E. (2006). *Reading and writing the world with mathematics: Toward a pedagogy for social justice*. New York, NY: Routledge.
- Hand, V. (2012). Seeing culture and power in mathematical learning: Toward a model of equitable instruction. *Educational Studies in Mathematics*, 80(1–2), 233–247. <https://doi.org/10.1007/s10649-012-9387-9>
- hooks, bell. (1994). *Teaching to transgress*. New York, NY: Routledge.
- Louie, N. L. (2017). The culture of exclusion in mathematics education and its persistence in equity-oriented teaching. *Journal for Research in Mathematics Education*, 48(5), 488. <https://doi.org/10.5951/jresmetheduc.48.5.0488>
- Louie, N. L. (2018). Culture and ideology in mathematics teacher noticing. *Educational Studies in Mathematics*, 97(1), 55–69. <https://doi.org/10.1007/s10649-017-9775-2>
- Martin, D. B. (2009). Researching race in mathematics education. *Teachers College Record*, 111(2), 295–338.
- Reed, R. J., & Oppong, N. (2005). Looking critically at teachers' attention to equity in their Classrooms. *The Mathematics Educator*, 2–15.
- Rubel, L. H. (2017). Equity-directed instructional practices: Beyond the dominant perspective. *Journal of Urban Mathematics Education*, 10(2), 66–105.
- Schoenfeld, A.H. (2010). *How we think: A theory of goal-oriented decision making and its educational applications*. New York: Routledge.
- Wager, A. A., & Foote, M. Q. (2012). Locating praxis for equity in mathematics lessons from and for professional development. *Journal of Teacher Education*, 64(1), 22–34.
- Wenger, E. (1998). *Communities of practice: Learning, meaning and identity*. Cambridge, UK: Cambridge University Press.