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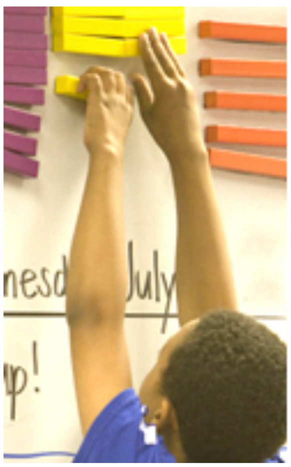


Leading a Group Discussion: Authority, Positioning, and Learning in Problem-Based Mathematics Classrooms

Jennifer M. Langer-Osuna

Stanford University

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Leading a Group Discussion: Authority, Positioning, and Learning in Problem-Based Mathematics Classrooms

Jennifer M. Langer-Osuna

Stanford University

Jennifer Langer-Osuna is an assistant professor of elementary mathematics education at Stanford University. Dr. Langer-Osuna researches math classrooms and the interactional mechanisms that drive cooperative problem-solving, as well as how social identities, such as race and gender, shape math learning. Drawing on discourse analysis and cognitive development, Dr. Langer-Osuna examines students' development of math solutions as mediated by their authority relations and discursive positions. The Spencer Foundation has funded her work and she has published in the Journal for Research in Mathematics Education, Journal of the Learning Sciences, Review of Research in Education, Mathematics Teaching and Learning, ZDM, Mathematics Education Research Journal, Canadian Journal of Science, Mathematics, and Technology Education, among other outlets.

Abstract:

In this essay, the author frames the high-leverage practice of leading a group discussion from the perspective of relationships of authority, allowing connections to both math learning and positional identities. Drawing on situated theories of learning and identity, the author argues that mathematics classroom interactions during both whole class and small group discussions take on both learning and positional functions, which become linked through relationships of authority. The author contextualizes these ideas based on two studies: (a) an analysis of a small group problem-solving discussion that illuminated dynamics around authority and (b) a professional development study meant to support teachers' noticing of students' authority dynamics. The essay ends with some examples of how teachers leveraged this high-leverage practice in ways that effectively supported equitable and productive student-led mathematical discussions.

When students engage in mathematics discussions by authoring, evaluating, or connecting across mathematical ideas, they are not only engaging in important cognitive work, but are also making bids for intellectual power. These bids are particularly impactful in mathematics as the discipline most linked to ideas of smartness or intelligence, even of genius. How students negotiate these bids for power – or, more specifically, bids for social and intellectual authority during mathematical discussions – matters for both learning and identity development.

In this essay, I offer a lens for understanding mathematics classroom discussions that centers both learning and identity through a focus on relationships of authority. To explore these ideas, I first start with a brief overview of what we know about the benefits and challenges of group discussions in problem-based mathematics classrooms. I then illustrate key challenges by drawing on an analysis of a cooperative problem-solving session that illuminated dynamics around authority. Finally, I close with examples of how educators might address these challenges, grounded in preliminary findings from a current research-practice partnership with an elementary school instructional team.

PROBLEM-BASED MATHEMATICS DISCUSSIONS: BENEFITS AND CHALLENGES

Decades of classroom-based research have illuminated important elements of productive mathematics discussions. For example, mathematical discussions are more productive when based on tasks with high cognitive demand (Stein, Grover & Henningsen, 1996).) and that include problems that can be solved through a range of possible strategies (Stein, et al, 2008). Furthermore, mathematical discussions are more productive when interactions serve to elicit, probe, and connect across student ideas (Chapin, O'Connor & Anderson, 2009). In such problem-based discussions, students gain the opportunity to reflect on and build their understanding of mathematical ideas and computational strategies (Cobb, Boufi, McClain & Whitenack,1997). These ideas are arguably promoted by the National Council of Teachers of Mathematics in the development of the NCTM Standards and more recently in the Common Core Standards for Mathematical Practice.Yet, problems remain especially in the context of student-led (i.e., small group) discussions.

Productive small group discussions in mathematics classrooms are notoriously challenging. For example, during small group discussions, some students end up having more influence than is explainable by the quality of their arguments alone (e.g., Anderson, Holland & Palincsar, 1997; Barron, 2003; Bianchini, 1997; Carletta, Anderson & Garrod, 2002). Such undue influence raises issues of quality and equity. With respect to quality, unmerited influence can propagate misleading ideas. The spread of mathematical ideas can become affected by social conflicts and resolved through social dominance rather than argumentation (e.g., Anderson et al., 1997; Barron, 2003; Hogan, Nastasi, & Pressley, 2000). With respect to equity, students whose ideas may be useful to the group's progress may not become influential. This can negatively affect how they are viewed by others and themselves, and—if repeated regularly—can even shape their trajectories and enduring identities as learners (e.g., Wortham, 2006).

There is therefore a dilemma: we know a fair amount about how to lead productive mathematics discussions with students, yet the challenges of sustaining productivity in small group settings remain. In order to start unpacking this dilemma, the next section explores the main conceptual preoccupations behind what we know about effective mathematics classrooms and then revisits this conceptual framing in order to take issues of equity fundamentally into account.

CONCEPTUALIZING ENGAGEMENT, LEARNING, AND IDENTITY IN MATHEMATICAL DISCUSSIONS

Much of the research on mathematics classroom discourse has come from intellectual traditions in psychology, in particular situative perspectives on cognition that emphasize the social origins of knowledge and frame learning as the process of enculturation into broader social and historical practices (Greeno, 1998). This body of work has mainly focused on the role of classroom discourse in facilitating learning. For example, several studies have illuminated the importance of students having the opportunity to engage in particular kinds of interactions, such as offering and explaining ideas, making sense of peer's ideas through revoicing, or expressing agreement or disagreement, and using everyday language to describe mathematical ideas (Chapin, O'Connor & Anderson, 2009; Forman, Larreamendy-Joerns, Stein & Brown,1998). Other studies have investigated how teachers and students interact in ways that establish a mathematics sense-making classroom community, focusing on the development and maintenance of particular kinds of norms and activity structures (Yackel & Cobb,1996). Overall, the bulk of this work is focused on the relationship between participation or engagement in mathematics classroom discourses and the learning of mathematics (see Figure 1).

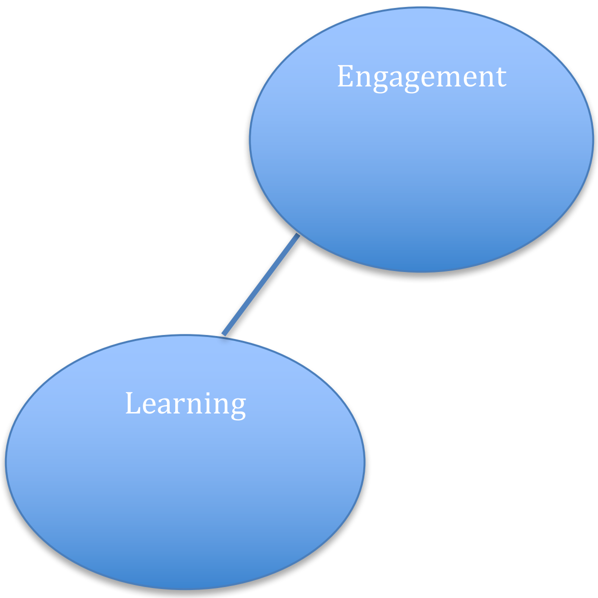

Figure 1. Engagement or participation in mathematics discourse is linked to learning

Though much of the work has focused on the links between engagement and learning, the most prominently used framework, the Communities of Practice framework by Etienne Wenger (1998), argues that identity, engagement, and learning are all tightly linked and constructed through social activity. Yet far less work has focused on the relationship between engagement and identity in mathematics classrooms or identity and learning. Understanding the connections to identity are crucial to issues of equity because identity addresses positionality and thus can better complete the picture of how mathematics classroom discourse functions. That is, classroom interactions serve both to communicate about mathematics and to make claims about individuals in relation to classroom activity.

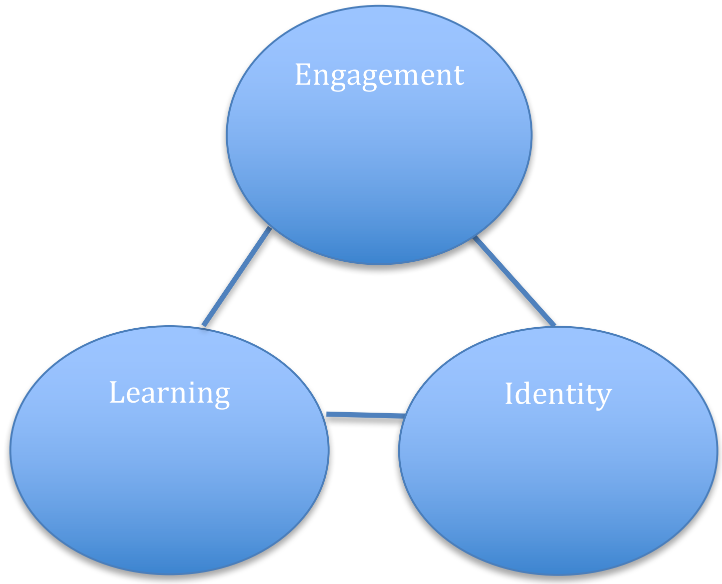

Figure 2. Engagement, learning, and identity are strongly inter-related.

The construct of identity within mathematics education research refers to what it means to be a learner and doer of mathematics both in general and in particular local contexts and how individuals are located, both how they locate themselves and are located by others, in relation to what it means to be a mathematics kind of person. However, research on identity in mathematics education has not consistently examined the discourse processes related to identity development in situ, allowing us to consider these processes alongside classroom discourse processes related to teaching and learning. In my own work and that of colleagues, this particular concern – understanding the discursive production of mathematical selves in the classroom – has been approached through positioning theory, which defines identity as constructed through social interactions that make claims about who a person is in relation to others in a social context (Davies & Harré, 1999).

As people interact with one another, they act to position themselves as displaying certain qualities (e.g., friendly, smart, or authoritative) or as having a particular role (e.g., teacher, student, or group leader). People also act to position others, and accept or reject acts of positioning about themselves or others. While always agentive, no one has the capacity to solely determine one's own identity. Rather, people interactionally negotiate their positions within a particular community through an ongoing process of positional acts that draw from local norms and activity structures that partially determine what is possible. Studies of positional identity have focused on what have been called *micro-identities* ("the position of a person in a moment of time," Wood, 2013, p. 780) Studies of micro-identities consider how particular acts of positioning constrain opportunities for learning during classroom activities. Other studies have focused on what have been called *thickened* identities, in which micro-identities accumulate discursively over time to construct a seemingly stable identity, that is, when a student becomes more and more likely to be positioned in a particular way (e.g., as a trouble-maker, Wortham, 2006).

Positional perspectives study the discursive mechanisms that explain the development of particular mathematics-linked identities. In particular, this work illuminates how students take up, alter, and resist the opportunities for engagement, learning, and identification that are offered in particular mathematical spaces. It also illuminates the kinds of mathematical learning spaces that enable a greater range of students to construct positive mathematics identities.
In doing so, this work enables possibilities for design-based research into equitable and productive mathematics learning spaces.

Relationships of authority meditate both of these functions, making it a critical and potentially unifying mechanism in supporting both productive and inclusive mathematics classroom discourse (Langer-Osuna, 2011, 2016).

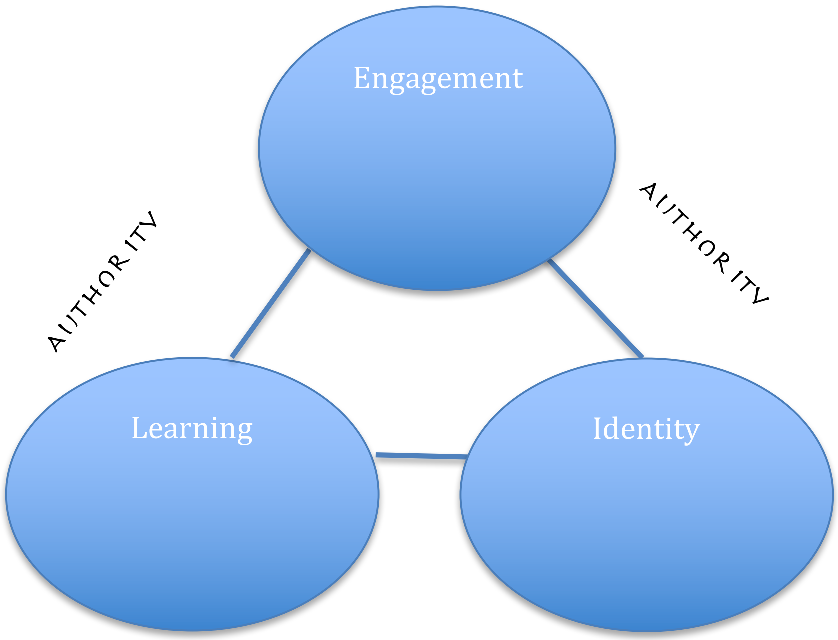

Figure 3. Authority relations link participation to both learning and identity development.

Interactions around authority among students may be a key mechanism that connects identity, engagement, and learning. Specifically, students who are positioned with authority are more likely to gain access to the conversational floor, are more likely to be attended to by others, and are more likely to have their ideas taken up as true, regardless of the objective merit of the idea (Engle, Langer-Osuna & McKinney de Royston, 2014). In this sense, being positioned with intellectual or social authority during mathematical discussions is linked not only to particular valued learning opportunities but also to the actual mathematics that becomes constructed in interaction due to whose ideas become influential (Langer-Osuna, 2016). In addition, when a student is regularly positioned with intellectual authority over time, a trajectory or thickening of such experiences may lead to the student developing an identity as a mathematics learner infused with a great deal of intellectual power.

At the whole class level, the teacher has a great deal of control over how students become positioned with authority. In traditional classrooms, the teacher holds the mathematical and social authority. The teacher controls much of the turn-taking by choosing who speaks, evaluate the merit of students' mathematical ideas, decides what is correct, generates questions, and authors much of the mathematics that is constructed in the classroom. But even in classrooms where the teacher deliberately shares authority with students, the teacher is able to control how many voices are invited to contribute, can often frame contributions, including errors, in ways that position students with mathematical competence, among other moves. But within the small group itself, the processes that govern the construction of mathematical authority among the students is not at all clear. Indeed, research shows that group dynamics can often fall prey to issues of social dominance and this social dominance can become linked to intellectual authority in ways that bypass mathematical sense-making.

In the remainder of this essay, I contextualize these ideas based on two studies: (a) an analysis of a collaborative problem-solving session that illuminated dynamics around authority and (b) a professional development study meant to support teachers' noticing of students' authority dynamics.

AUTHORITY DYNAMICS AT THE SMALL-GROUP LEVEL: FINDINGS FROM A CASE STUDY

In a previous article, I analyzed two students working together, Ana and Jerome, on an open-ended mathematics problem (Langer-Osuna, 2016). I was interested in examining how students in racially and linguistically diverse classrooms engage in collaborative mathematics problem solving. The case is one where the interactional dynamics around authority very clearly affected the uptake of, in this case, largely Ana's ideas. The normative quality of Ana's ideas does not explain how she garnered intellectual authority, nor why her ideas were taken up. Indeed, an incorrect answer was constructed throughout the session though it's hard to explain this case even using a misconceptions framework as the students did not engage in much sense-making at all. Indeed, this case shows how social forms of authority, specifically the right to issue directives or what I refer to in the article as directive authority.

By following each moment when a particular mathematical idea was taken up by the pair of students (written onto the shared poster) and analyzing the interactions preceding and subsequent to each of those moments, I found that interactions preceding the uptake of each idea onto the shared poster were mediated by authority relations rather than sense-making. The problem-solving session was dominated by Ana, who garnered much directive and intellectual authority. Specifically, I found that (a) Jerome was positioned at first by the teacher and then by Ana as disengaged and in relation to Ana; (b) Jerome's social demotion was linked to Ana's ability to issue directives to Jerome; and (c) Ana's directive authority then became linked to intellectual authority. That is, Ana's directive authority becomes intertwined with her intellectual authority, as the nature of her directives increasingly includes mathematical ideas, and Jerome increasingly asks Ana for help on implementing those ideas and treats Ana as a credible source of information.

This analysis starts to consider how positionality affects the collaborative problem solving process in ways that are not necessarily grounded in mathematical sense-making, but rather mediated by both social and intellectual relations of authority. This insight thereby points to the importance of teachers' noticing students' dynamics around authority during small group discussions.

SUPPORTING TEACHERS' NOTICING OF AUTHORITY DYNAMICS: EXAMPLES FROM A RECENT PROFESSIONAL DEVELOPMENT STUDY

My research team and I engaged with an instructional team at an elementary school in California that serves linguistically, racially, and culturally diverse students for exactly such noticing work. The teachers initiated this partnership and were interested in facilitating group discussions in mathematics at both the whole class and small group level. My research team and I engaged teachers in professional development that, among other elements, included a video club where we collectively watched, reflected on, and discussed videos of student group discussions from their own classrooms. The purpose of the video club was to notice and reflect on cooperative student dynamics, especially authority relations. In particular, we asked teachers to notice: how do students engage with one another around mathematical tasks? What mathematical ideas are at play, whose ideas are they, and what happens to those ideas?

In addition to noticing these dynamics, we asked teachers to reflect on what they noticed and to connect it back to their practice. Specifically, we asked, what might you try in your classroom to further support and deepen students' joint work? That is, we didn't tell teachers to try out any particular instructional strategy. Rather, we asked them to reflect on what they noticed and to make instructional choices based on those reflections. Because teachers responded in their own unique ways, we had the opportunity to document and analyze multiple paths for supporting joint work. Here, I offer two examples – one from a first grade classroom and the other from a fourth grade classroom to illustrate two different approaches teachers took to support productive, inclusive small group mathematical discussions. These two examples are chosen because preliminary analyses of participating classrooms (Langer-Osuna, in progress) showed that these are the two classrooms that most robustly supported productive, shared small group discussions among students.

The first grade teacher decided to support her young learners in revoicing one another's ideas. The teacher drew on the video club discussions and noticed the need for students to orient toward one another's ideas, rather than focusing on more social control. She decided to teach her students how to revoice one another's ideas. For example, upon gathering at the carpet after partner work, the teacher first introduced the idea of revoicing and supports her young learners in practicing the move with one another:

> Teacher: Something that I wanted to share was that I noticed that partners were able to do this work more easily when they checked in with each other. SO I want us to practice that right now. SO when you are sharing, your partner can show that he or she is listening by revoicing what it is that you said and you guys can make sure that you are understanding each other and if you aren't then you can give more information so you can be on the same page because if you are not understanding each other can you guys work together?
> Students (chorus): No
> Teacher: Its a lot harder to understand each other. So I want us to practice this together now…Partner A is going to tell partner B how many passengers are on the bus and how they know. And partner B is going to revoice what your partner is saying.
> Student: Retell?
> Teacher: It's just like re-tell. It is just like re-tell! And that's how you show your partner that you are listening and understand what their saying.

The teacher then modeled the process of sharing and revoicing ideas, offering a particular sentence frame, "I heard you say mmmm, is that right?" Students then took turns practicing with one another. This process was revisited several times, as students learned to better orient toward and clarity one another's ideas through revoicing.

At the upper elementary grade, the fourth grade teacher decided to engage her students in ongoing reflective discussion about "productive partnerships" alongside discussion of the mathematics itself. The fourth grade teacher went a different route, supporting her students' own reflections of what it means to engage in productive partnerships. She chose to utilize whole class discussions to discuss not only the mathematics, but also what it means to engage in this work together. For example, after re-gathering from significant group work that day, the teacher engaged students in a whole group discussion about both the target mathematics and the group dynamics themselves.

> Teacher: Monica? So Monica what did you notice? Was there some difficulty in the partnerships? Show me a thumbs up if you had difficulty in your partnerships. You can be honest. Show me a private thumbs up. So maybe let's talk about it. What was happening to create some difficutlies in the partnerships? Sandra?

This topic was revisited regularly, allowing students to deepen their own ability to notice and reflect on what it means to engage with a partner in mathematical discussions.

Across these two brief examples, a key takeaway is that the teachers engaged students in reflective discussions about both mathematical ideas and the process of partnering with others to do mathematics together. In doing so, students were able to gain a sense of ownership over mathematics discourse – that is, they are authors of ideas and owners of the collaborative process. They also get the opportunity to learn new strategies for engaging with others productively in shared thinking. Shared thinking increases the likelihood of learning and of each student experiencing themselves and, importantly, one another as legitimate contributors to mathematical activity.

CONCLUDING THOUGHTS

Connecting back to the high-leverage practice of leading a group discussion, effective teacher moves, such as supporting student reflection about partnerships or teaching how to revoice peers' ideas, support both learning mathematics together and learning about how to learn mathematics together. There are several implications for teacher education: (1) videos of student collaborative work has the potential to support teachers' noticing of students' collaborative dynamics during group discussions; (2) such teacher noticings can lead to robust ways of leading group discussions to support learning, identity, and collaboration.

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