Spring 5-9-2018

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Moving Beyond Numbers: Examining Language in Mathematics Classrooms
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Introduction
There is growing attention on the mathematics learning experiences of emergent bilingual students, a term used rather than English language learners to emphasize the rich linguistic knowledge of students who know and speak two or more languages instead of how they are often positioned as not knowing in the field of mathematics education. The majority of past and current studies have examined the impact of students’ language proficiency on academic performance. While this work has deepened understanding of mathematics learning for emergent bilinguals, language is only one of many semiotic resources (e.g., physical control of space, gestures, and gaze) at play in bilingual/multilingual classrooms. Research is needed that unpacks the development of principled instruction that supports students’ engagement in meaningful disciplinary discourse practices.

Using Cultural Historical Activity Theory (CHAT) as a framework, classrooms are examined as complex activity systems. Specifically, we highlight a framework to analyze a mathematics classroom and bring to attention ways to honor and leverage students’ funds of knowledge to develop language and mathematical understanding. Study findings demonstrate the importance of using a classroom approach to examining individual and intersectional impact of teacher’s decision-making (e.g., tasks, mediating artifacts, division of labor, community, and norms) on student learning. Findings offer guidance to mathematics educators on the design of classroom learning spaces that better leverage emergent bilingual students’ individual and collective knowledge.

Methods
This study uses an ethnographic case study to examine the teaching and learning experiences of a first-grade bilingual classroom. The teacher attended a post-baccalaureate teacher education program at a West Coast public university. She was selected purposefully because of her expressed commitment to bilingual education and equity-oriented teaching. She now teaches at a dual language program (English and Spanish) in an urban elementary school named Valadez Elementary. By examining her teaching context, we are able to use this unique opportunity to examine her teaching practices within a mathematics classroom.

Data
Data was collected for three years with three visits per year. During the classroom visits, 50 to 70 minute mathematics lessons were video recorded along with a 30 to 60 minute post-lesson interview. Classroom artifacts (lesson plans, student assignment, and class generated work) were gathered to serve as data sources.

Theoretical Framework
Cultural Historical Activity Theory (CHAT) guides our examination of learning (Engestrom, 2001). We view learning as a social, historical, and cultural practice, and classrooms are complex activity systems (Engestrom, 2001). Learning is a social endeavor that occurs as students engage individually and collectively with each other and with mediational tools that shape their participation in the classroom activity system (Lave & Wenger, 1991). Language is a central tool that impacts student participation, and therefore, their learning.

Findings
The teacher uses three central principles to support disciplinary literacy. Figure 1 provides a visual of how the teacher organizes a classroom activity system to honor and leverage students’ funds of knowledge (Gonzalez, Moll, & Amanti, 2005) when developing their language and mathematics skills.

Three central principles to support disciplinary literacy:
1) honor students’ linguistic, cultural, and experiential knowledge;
2) focus on a multi-modal approach;
3) distribute knowledge authority in the classroom to ensure that ALL students have opportunities to demonstrate their “mathematical brilliance”.

Implications
From Research to Practice
Every decision teachers makes impact student learning. Therefore, teachers need to view classrooms from a systems perspective in which each component (rules, community, artifacts, and division of labor) are interconnected. It is not just one component that supports students’ learning and development of mathematics and language, but how its interconnection that matters.

From Practice to Research
Research often examine achievement using a single measure. A single measure does not capture its complexity. Future studies would benefit from the use of multiple measures to capture student achievement and teacher effectiveness.

References