

# Enhancing Mathematical Discourse in Elementary Classrooms

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**Abstract:** Using conversational formative routines among students, this study focuses on the discursive practices found in two fifth-grade mathematics classrooms. The analysis considers student identity work situated in meaningful engagement in knowledge practices. Particular attention is paid to how students become proficient in speaking the language of mathematical communities and the relationship this has on their identity within the group.

## Introduction

Accountability-oriented reforms present new challenges for elementary mathematics instruction. The passage of the *No Child Left Behind* (NCLB) act requires increasing percentages of students to score at or above proficient benchmarks each year on criterion-referenced achievement tests. Additionally, elementary mathematics lessons are composed of instructional methodology based on I-R-E, Initiate, Respond and Evaluate (Mehan, 1979); with limited time devoted to mathematical discourse involving students in meaningful peer discourse, supportive reasoning, engagement, and revision of thinking intended to enhance metacognitive awareness. Herrenkohl and Guerra (1998) propose that “engagement can be viewed in terms of discourse practices that extend beyond the behavior of individual students and involve both social and cognitive activity” (439).

Additionally, Barnwell, Leung, Morgan and Street (2005) argue the need to view mathematical language abilities as socially embedded in linguistic practices within the classroom. Gee (2003) points out that much of the knowledge in academic domains (i.e. mathematics) involves going beyond everyday vernacular and is manifested in the non-vernacular specialist language of the discipline. As such, students need to be mentored into the discourse of practice in order to become fluent in mathematical reasoning and usage of mathematical concepts. In this investigation, we use student talk as a window into their experiences, competing perspectives, and abilities to linguistically engage in sophisticated mathematical concepts. We document the social practices and discursive models that illuminate the divide between vernacular and scientific linguistic practices in mathematics. In short, “discursive acquisition is the lynchpin of schooling. . . It is learning to walk, talk, write, and think. . . like a mathematician” (Gallas, 2000).

This presentation describes the first year of a three year study funded by the National Science Foundation (NSF) (Hickey, Mewborn & Lewison, 2005) building upon an underlying multi-level/multi-type model for alignment of instruction, assessment and testing (Hickey & Zuiker, 2005) also funded by NSF. Using informal math assessments, to enhance and inform teachers’ instructional practices, this study continues the investigation into linguistic practices of elementary students as they engage in small group mathematics discussions.

## Method

This paper focuses on two fifth grade classrooms, each at different schools in the Midwest. The first school serves a working-class neighborhood with 54% of its students eligible for free and reduced lunch. The second school is situated within a middle-class community with 16% of its students eligible for free and reduced lunch. Both classrooms use the *Everyday Mathematics* program (University of Chicago, 2003) for math instruction. Five times during the semester, students individually complete three open-ended Math Investigations. These items were carefully selected from the *Balanced Assessment in Mathematics* (McGraw-Hill, 2005) and relate closely to what has been taught in the classroom. In small groups, students discuss how they solved the problems and explain their rationale. Once each semester the students watch two animated video clips, which show a group of students discussing one of the problems the students in the classroom have just discussed. The students observe and discuss the differences between vernacular talk and academic mathematical discourse by the video coaches. The whole class then discusses how they would rate each video coach discussion and then identify the characteristics of mathematical discourse that were embedded in the more academic video clip. Using a rubric, the students go back to their small groups and informally assess their own math conversations and score themselves as compared to the ratings they assigned the video coaches. At this point, field notes and videotapes of the small group discussions are

analyzed using grounded theory and discourse analysis to assess classroom implementation, students' participation and growth in mathematical discourse.

## Outcomes and Implications

This study explicates the distance between students' understandings of mathematical concepts using everyday language and their ability to engage in authentic, fluent, mathematical discourse. By enacting and embedding student-led mathematical discourse as a regular part of teachers' instruction, we are able to show how to fine-tune individual understandings, build collective participation in mathematical communities, and increase student achievement. Students and teachers often require explicit coaching on the methods in which to engage in a particular discourse community, in this case that of mathematics. Our findings extend those of Southerland, Kittleson, Settlage and Lanier (2005) who state, "the exercise of power within group-exchanges guided not only group discussions but also the learning of the individual in those groups and the power of a persuasive speaker, a power that comes not from empirical grounding but from a learner's need to have ideas explicitly evaluated and explained."

Through discourse analysis of small group student interaction, we were allowed to examine how students take on multiple and varied identities through the uses of informal *Math Investigations* and video coaches. Osborne, Erduran and Simon (2005) make a strong argument for "engaging students in argumentation and its evaluation" and additionally submit that argumentation "offers a means of transcending the dogmatic, uncritical, and unquestioning nature of so much of the traditional fare offered in classrooms" (p. 1017). This study demonstrates the power of teaching students to question, argue, and evaluate their own mathematical solutions.

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