

Math Talk: An Investigation of Language Practices in Middle School Mathematics Instruction Using Data from the Measures of Effective Teaching (MET) Longitudinal Study

The proposed dissertation study is designed to increase the power of my initial investigation (detailed on the previous page) of math teachers' verbal scaffolding by observing more subjects, across a wider range of geographic and socio-cultural demographics and teaching contexts, and by evaluating the relationship between teacher instructional language characteristics and student achievement outcomes. Samplings of teacher observational data collected from the AERA-MET (Measures of Teaching Effectiveness) longitudinal study of teachers will be used as the data set for this study. In particular, I will utilize several types of available data: 1.) video recordings of teachers teaching mathematics; 2.) observational assessments of teachers including the Classroom Assessment Scoring System (CLASS); the Framework for Teaching (FFT); and the Mathematical Quality of Instruction (MQI); 3.) student math test score data from state assessments and the Balanced Assessment in Mathematics (BAM); and 4.) student feedback from the perception of teachers TRIPOD survey.

Using a grounded theoretical approach, I will examine the video recordings of 100 teachers during math instruction to middle school students in grades 6, 7, and 8. Observations will focus on observing participants' verbal scaffolding using a specified set of linguistic characteristics which have been parsed into categories in accord with best practices in the teaching of mathematics as outlined by the National Center for the Teaching of Mathematics (NCTM) and developers of the national Common Core standards. The following categories are used as starting points to examine and characterize how participants use language to scaffold math concepts and build problem-solving and conceptual fluency: 1) type and frequency of questioning, 2) use of exemplars, 3) use of segues and prompts, 4) use of cognitive modeling, 5) use of elaboration/explanation/follow-ups, and 6) use of vocabulary. Using discourse analysis, each teacher's scaffolding will be observed according to the six named linguistic characteristics using the Teacher Language Log (TLL), an instrument developed specifically for this study to quantitatively capture and qualitatively describe the nature and frequency of instructional language characteristics with respect to the designated language use categories.

Of specific interest is the anatomy of instructional language within the scaffolding process - *what* teachers are saying, *how* and *when* they are saying it within the frame of an instructional lesson to promote student thinking about mathematical concepts and processes. The TLL coding framework has been established to analyze the MET video data by the stated language use categories (1 through 6 above). High quality recordings of instructional language will be coded qualitatively using sub-descriptors of each primary category to aid in more specifically characterizing the language used to scaffold during the lesson. Each of the six linguistic categories will also be quantitatively coded for frequency of use. Scores for each category descriptor will be tallied and a composite score for each category will be derived by summing the total frequency of use of each particular language element within each category, 1 through 6. Rating scales (0-5) will be established to describe relative performance levels in each category after all data is analyzed. Once teacher linguistic elements are parsed and categorized, each teacher's verbal scaffolding style will be assigned a composite score and codified into one of three groups: *verbal-high*, *verbal-moderate*, or *verbal-low*. Student assessment data from each teacher's classroom will then be analyzed using hierarchical linear analysis of the quantitative data to examine differences in student achievement across the three scaffolding style groupings. In this way, I aim to investigate any patterns in the data which may suggest a relationship between verbal scaffolding style and student math achievement outcomes.

As additional points of comparison, I will compare the outcomes of the TLL evaluation to scores given on the CLASS, FFT and MQI. If relative scoring designations remain stable across those evaluation measures conducted in the MET process, this could suggest the TLL may have potential to be developed into another evaluative instrument for observing math teaching ability. Finally, student feedback on the TRIPOD survey will be compared to outcomes on the TLL observational instrument to determine any correlations between student perceptions of teacher ability and findings resulting from examinations of the data throughout the course of this study.

Ultimately, this study aims to aid in effectively unpacking the scaffolding process with respect to instructional language, an area that in many respects remains elusive in the mathematics domain. One possible outcome of a study such as this is the establishment of an alternate measure of teacher quality based on language usage to support assessment of math teacher effectiveness. Should results of the study find a significant relationship between the classifications of teacher verbal scaffolding style within the context of instructional language use and student achievement outcomes, the framework employed to analyze teacher discursive practices in this investigation may evolve into an additional mechanism by which schools can better assess the quality of math instruction. Further, teacher preparation programs may find the need to implement courses to better develop math teachers' ability to utilize language components to scaffold learning during instruction.

MATH TALK: An Exploration of Language Practices in Urban Mathematics Instruction

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Premise

Previous studies suggest the importance of language modeling to engage student reasoning and problem solving abilities. This preliminary study investigates how teachers use language to scaffold student learning during middle school math instruction.

I seek to better understand:

1.) *characteristics of discourse employed by teachers to teach novel math principles to urban students*, and 2.) *outcomes of current linguistic math instructional techniques on student learning*.

Research Question

What are the characteristics of instructional language used to verbally scaffold learning in urban middle school math classrooms?

Participants

Ten (10) professional math teachers of 6th, 7th, and 8th grade students at a middle school in a large urban district in Georgia were recruited for this study. The participants were all designated as “highly qualified” educators as deemed by the school district’s standards for teacher quality.

Study Impetus and Implications

Interest in math cognition is on the rise. While many studies highlight the use of instructional language related to subjects more readily associated with the Language Arts (Eeds, et al, 1989; Darling-Hammond, 2000; McGhee, 2009), fewer studies examine how language impacts teaching and learning in math content areas. Further, though research on best practices in math pedagogy is ubiquitous, ensuring that these are actually *active* practices in math classrooms can be a challenge for school systems (Moschkovich, 2007; Schleppegrell, 2010). Educational policy expects teachers to be able to execute best practices in the teaching of mathematics by successfully scaffolding student learning and imparting effective strategies for problem solving. However, assessments of teacher effectiveness often neglect to answer the key question of whether teachers know *what to say*, *how to say it*, and *when to say it* during the scaffolding process to optimize student mathematical understandings and achievement. A study examining teacher language characteristics during scaffolding may be of interest to educational researchers in the area of teacher quality and assessment as it may: 1) be a step towards determining the extent to which teachers are utilizing language components that support math cognition and conceptual understanding for their students, 2) help to characterize the relationship between instructional language use and student achievement in mathematics, and 3) have implications for the ways in which teachers are trained at the pre-service and professional development stages in the effective teaching of mathematics.

Data Collection

Several types of data were collected during the course of the preliminary study: 1.) teachers’ audio-recorded their own teaching in their regular classroom settings for up to 1.5 hours, twice over the course of four weeks; 2.) participants responded to a survey of their experience, teaching philosophy, and ideas on best practices in math pedagogy; 3.) school math coach and principal completed an evaluation of each participant’s instructional abilities. Researchers collected and analyzed recorded data for linguistic and discursive instructional parsed into categories of verbal scaffolding techniques utilized during instruction.

Preliminary Findings

Preliminary findings from analysis of audio-recorded data suggest that although expected to do so, teachers may not adequately employ verbal scaffolding strategies to most effectively engage students in the knowledge-construction required to best understand novel math concepts and successfully solve complex problems. Additionally, teacher survey feedback suggests that teachers do not readily associate aspects of their own language usage with best practices in the teaching of mathematics, indicating that they may not fully understand the value of their instructional language and verbal scaffolding habits/abilities on student math achievement and learning. Finally, one key concern in mathematics pedagogy in U.S. schools is that novice teachers are disproportionately assigned to urban schools in core subject areas, particularly mathematics and science. It is interesting that in this investigation, 4 out of the 5 teachers who completed all aspects of data collection were newer teachers with 80% having less than 3 years of experience instructing mathematics, and 60% having less than 1.5 years of experience teaching mathematics as their primary subject.

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As a follow up to this preliminary investigation of teacher instructional language, please see next page for information on my related dissertation study, “MATH TALK: An Investigation of Language Practices in Middle School Mathematics Instruction Using Data from the Measures of Effective Teaching (MET) Longitudinal Study.