Math Anxiety in Middle School Math Teachers: Implications for Teacher Practice and Professional Development

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Abstract: We examine math anxiety in a sample of 33 middle school mathematics teachers in a large socioeconomically disadvantaged urban district. Most reported some math anxiety. Furthermore, findings suggest that math anxiety may adversely affect teachers' practices: the intensity negatively correlated with the emphasis they placed on instructional practices critical to students' development of both mathematical understanding and productive dispositions. We discuss the necessity to address math anxiety in research and practice in teacher professional development.

Introduction

Math anxiety is common in the classroom, in the workplace, and in many adults' everyday experience. It is classically defined as a "feeling of tension and anxiety that interferes with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations" (Richardson & Suinn, 1972). For students, it is strongly associated with disengagement from mathematical activities, failure to enroll in advanced math courses, poor mathematics performance, and failure to graduate from high school.

Our study focuses on math teachers, those most directly responsible for facilitating student learning and shaping students' lifelong mathematical dispositions. Although research has documented the occurrence of math anxiety among elementary school teachers (e.g., Hembree, 1990), little work has examined math anxiety in the middle school teaching population and the impacts it might have on practice. The middle school years are a particularly important and vulnerable transition point in the school trajectory, as mathematical concepts become increasingly difficult and abstract, and many students begin to lose interest in mathematics, fall behind in achievement, and consolidate their motivational attitudes toward mathematics. Ideally, teachers at this level should be able to support students' development of conceptual understanding and create a learning environment that facilitates students' development of productive dispositions toward mathematics. A teacher's own math anxiety could potentially undermine his or her capacity to engage with complex student thinking and model the mindset that will support successful future studies in higher level mathematics.

Within the context of a larger study examining the teaching practices, mathematical knowledge, and attitudes and beliefs of veteran middle school math teachers, we will examine four research questions:

1. To what extent do these middle school math teachers exhibit math anxiety?
2. What is the relationship between teachers' math anxiety and their mathematical knowledge?
3. What is the relationship between teachers' math anxiety and their teaching practices, particularly those supportive of the development of student thinking and productive dispositions?
4. What do middle school math teachers do when they encounter mathematical content that is unfamiliar?

Research Design

The data was collected as part of a study that is exploring the construct of adaptive expertise in middle school math teaching. We are investigating the tendency for teachers to approach the professional practice of teaching as a lifelong learning process. We are examining the relationships among habits of mind, pedagogical and content expertise, teaching practices, approach to professional development, and teaching effectiveness.

Veteran middle school math teachers were recruited via mass mailing from a large urban district in California serving large populations of primarily economically disadvantaged students (mean of 69% of campus-level students qualifying for free or reduced-price lunch). The sample was composed of 33 teachers. The mean years teaching was 14.1 (SD = 7.5) with a range of 5 to 33; 56% were female; the ethnic distribution was 61% White, 13% African American, 13% Hispanic, and 9% Asian.

Teachers did an in-depth phone interview, a written survey, and a written assessment of mathematical knowledge for teaching (MKT) middle school mathematics. In this analysis, we focus on their responses to (1) the Abbreviated Math Anxiety Rating Scale (AMAS; Hopko, Mahadevan, Bare, & Hunt, 2003), a 9-item scale (alpha = .90) that measures anxiety in math-related situations, with an emphasis on learning new mathematics; (2) an assessment MKT emphasizing the mathematics necessary to teach core NCTM Focal Points for seventh- and eighth-grade mathematics; (3) a questionnaire about how much teachers emphasize various practices in their mathematical instruction; and (4) teachers' interview responses to the questions about their formative assessment practices and how they deal with unfamiliar mathematical content.

Preliminary Findings

Teachers exhibited a range of math anxiety. Scored as an average of items rated on a 5-point Likert scale, the

mean AMAS score was 2.1 (SD = 0.58), with a minimum of 1.2 and maximum of 3.5. Female teachers were slightly higher in math anxiety (mean of 2.3 versus 1.9; $t(32) = 2.1$, $p < .05$). MKT did not differ significantly. In a preliminary analysis of the interview data, we encountered a range of approaches that teachers took to unfamiliar mathematical content, from highly motivated learning to complete avoidance. An example of the latter was Abby in our pilot. She admitted that she still did not understand several mathematical concepts in her sixth-grade curriculum. When asked what she does when she gets to these topics each year, she said she simply skips over them because they are not important.

As shown in Table 1, teachers' math anxiety was negatively correlated with their self-reported emphasis on several important teaching practices. Their MKT negatively but not significantly correlated with their math anxiety ($r = -.18$, n.s.) and was only significantly related to emphasis on one of the probed practices.

Table 1. Correlations between self-reported emphases on various teaching practices and the AMAS and MKT.

Teaching Practice	**AMAS**	**MKT**
Increasing students' interest in mathematics.	-.501**	.359*
Developing students' conceptual understanding.	.019	-.052
Having students learn mathematical procedures and algorithms.	.081	-.096
Having students learn to reason mathematically.	-.265	-.033
Helping students understand the logical structure of mathematics.	-.571**	.196
Proof and justification/verification (e.g., using logical argument to demonstrate correctness of mathematical relationship).	-.217	-.069
Problem solving (e.g., finding solutions that require more than merely applying rules in a familiar situation).	-.362*	-.090
Communicating (e.g., expressing mathematical ideas orally and in writing).	-.415*	.023
Connections (e.g., linking one mathematical concept with another; applying math ideas in contexts outside of math).	-.386*	-.007
Representations (e.g., using tables, graphs, and other ways of illustrating mathematical relationships).	-.324	-.201

* $p < .05$; ** $p < .01$

Discussion

The findings suggest that math anxiety is present in the middle-school teacher population, and that it may adversely impact practice in important ways. Most teachers reported at least some math anxiety. In examining relationships with practice, math anxiety was negatively related to emphases on practices critical to student's development of conceptual understanding (e.g., understanding the logical structure of mathematics, problem solving, communicating, making connections) and productive dispositions (e.g., increasing students' interest in mathematics). Math anxiety was not significantly related to MKT in this small sample; however, the negative trend aligns with previous research that consistently shows negative relationships between math anxiety and math knowledge (Hembree, 1990). MKT was related to an emphasis on increasing students' interest in math.

In the poster, we will expand on these results with our qualitative analysis of teachers' responses to questions about how they approach formatively assessing and responding to student thinking in the classroom. We will also expand on the results of the analysis of how teachers approach unfamiliar content.

These findings point to an important issue in research and practice in teacher professional development. Math anxiety may entail an experience of fear and risk for teachers, contributing to an avoidance of practices that require their engagement with more difficult mathematics. It may also entail the transmission of negative attitudes, consciously or unconsciously, to students. Although the impacts of math anxiety can be deleterious, substantial evidence shows that there are effective strategies for significantly reducing it. For example, for students, a number of psychological approaches such as anxiety management training and cognitive restructuring have been shown to both reduce math anxiety and increase math achievement (Hembree, 1990). Adapting such strategies to adult populations and incorporating them into pre-service and in-service teacher training could substantially reduce teachers' math anxiety and enhance their capacity to support their students' development of conceptual understanding and productive dispositions.

References

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