



INTRODUCTION

BRINGING JOY TO UNINSPIRED TEACHERS OF MATH

Something surprising happened for me in the fall of 1973 during the very first days of my work as Assistant Director of Project Open Classroom, a progressive change project, in Wayne and Pompton Lakes, New Jersey. I was hired to work with teachers in four school districts to assist with the districts' goals of changing teachers' instructional practice to progressive, interdisciplinary teaching. Math was my focus. Midway through my very first set of workshops, I was shocked to find teams of teachers weeping. We were having fun, I thought, by using manipulative materials to engage deeply in conceptual math. Their words between the tears included, "How am I expected to teach this way if I never learned this way?" and "I've been teaching this all wrong for 10 years! What have I done to those kids?"

I learned pretty quickly that the emotions they felt were valid. Almost immediately I sensed the need to study this so that I could help them (and myself) deal with those emotions in order to have any chance of helping these teachers grow and change. I am forever grateful to those teachers and to one woman in particular named Ms. James. Ms. James repeatedly resisted "change" in her teaching. She both cried and argued with me. After two years, Ms. James was the teacher identified by the project as having the most changed classroom. It was her photo we put on the cover of our published book titled *Changeover* (NSF, 1972). It shows Ms. James sitting on the floor with two of her fourth-graders playing a concept teaching game about multiplication and factors using Cuisenaire rods. I reshaped my career research based on that work with Ms. James and all of her colleagues, and it helped me develop my mantra as a change agent: Embrace resistance.

In the past 43 years of teaching teachers about math instruction at Bank Street College of Education in New York City, I have maintained a clear commitment to two goals. First, I relentlessly insist that teachers understand conceptual underpinnings of big math ideas and, second, I hope to inspire teachers as mathematical inquirers. Throughout the years, I have encountered resistance in achieving both of these goals. Therefore, as a progressive educator, I have come to expect resistance to unfamiliar ideas. What I have learned through observation, research, and study is that, for the most part, the resistance is emotion-laden.

Disciplines like mathematics, science, anthropology, or even art in and of themselves, do not carry emotions, but learners surely conjure up feelings about learning them. For many well-researched reasons, feelings about math appear to be overwhelmingly negative, especially for North Americans (Battista, 1986; Bryant, 2009; Hembree, 1990).

Explanations for why elementary teachers could be uninspired teachers of math are varied. Myths exist that some people are hard-wired as math people and some are literary/writing/reading people (Boalar, 2017). Sadly, even though those myths have been debunked, I can still walk into any school today and surprisingly find some teachers who hold onto them. After years of careful personal study, I have developed my own theory as to why. I echo the words I first heard in the 1980s by Marilyn Burns, recipient of a Bank Street Honorary Doctorate and national math educator, that one learns math only by doing mathematics. She boldly suggests that you don't learn math when you simply learn about math. You learn math when you do math by actively solving real problems with friends: grappling with confusing

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ideas, making models to get yourselves out of confusion, asking each other questions, and arguing or debating relative solutions. After hearing Burns say this, I began to ask myself, 'Might this be the source of the problem? Maybe people never actually did any mathematics themselves, ever – and maybe they never felt inspired?'

Emotion and Math

Anyone who carries the moniker “Bank Street Faculty” should be expected to address the social, intellectual, and as emotional development of the learner, child, and adult alike. As faculty we refer to emotional development as the “affective realm.” Research on affect and math education tends to define affect as having three sub-concepts: beliefs, attitudes, and emotions. Hannula, et al., in the Psychology of Mathematics Education’s research summary (2004), cites noted researcher Douglas B. McLeod, Professor Emeritus of Math Education at San Diego State, who offers distinctions between the four sub-concepts worth considering for my work with teachers. McLeod (1992) made distinctions among these and described emotions as the most intense and least stable, beliefs as the most stable and least intense, and attitudes as somewhere in between on both dimensions. Beliefs were seen as the most ‘cognitive’, and emotions as the least so. Later, DeBellis and Goldin (1997) added a fourth element, values. Most research on affect in mathematics education has addressed one or more of these four concepts (Hannula, 2004, p. 106). However, according to Hannula (2004), “the theoretical foundation beneath these concepts is not quite clear.”



Multiple lines of research conclude that emotion is probably the most fundamental concept when we discuss affect. Researchers who have studied the psychology of emotions have used different approaches, and while there is no final agreement upon what emotions are, there is agreement on certain elements. Researchers seem to agree that: first, emotions are tied to personal goals. Second, emotions also involve physiological reactions that are distinct from non-emotional cognition. Third, emotions are also seen to be functional, i.e., they have an important role in human coping and adaptation (Goldin, 2000; Lazarus, 1991; Mandler, 1989; Power & Dalgleish, 1997).

Reflective Teaching

To become a successful Bank Street-educated teacher, one needs to be skilled as a reflective professional. We ask our graduate students first to reflect on what they have read and learned in academic courses and in conference group, a course in which instructors facilitate reflective conversations about the learning that happens during students' fieldwork. During fieldwork observations, advisors aim to help aspiring teachers "reflect-on-action" by discussing observed teaching moments. This "reflect-on-action" process continues throughout the year in advisement, with the hope that the new teacher will progress to "reflect-on-action" in future teaching when no advisor or coach is there to observe. The goal is for each learning teacher to become skillfully able to "reflect-for-action" in their planning and in their curriculum design (Schon, 2016).

This metacognitive process becomes better internalized for new teachers when personal emotions (the affective dimension) have been articulated, listened to, honored, and further reflected upon. One of my process goals is for new teachers to continually reflect, so that they can affirm their feelings as purposeful in the act of learning. According to Hannula and colleagues, "Consideration of meta-effect suggests that the most important affective goals in mathematics are not to eliminate frustration or to make all mathematical activity easy and fun. Rather they are to develop meta-affect where the feelings about emotions associated with impasse or difficulty are productive" (2004, p. 113). Many teachers I have taught indicate intensive reflections on their emotional engagement with learning during my course.

Teachers' Emotions and the Children They Teach

Recent research indicates that math-anxious teachers can have a negative impact on their first- and second-grade students' views about math and on resulting achievement (Bellock, Gunderson, Ramirez, Levine, 2009). Researchers at the University of Chicago found that math-anxious women teachers have a direct impact on the girls in their classes. They measured the degree of math anxiety of a team of female first- and second-grade teachers and the math achievement of these teachers' students (boys and girls). After one full year of being in any one of the math-

anxious teacher's classrooms, it was more likely that girls (not boys, however) grew to: 1) endorse the belief that boys are good at math and 2) girls are good at reading. They also found that "Indeed, by the end of the school year, girls who endorsed this stereotype had significantly worse math achievement than girls who did not and than boys overall" (Sian L. Beilock, Elizabeth A. Gunderson, Gerardo Ramirez, and Susan C. Levine *Female teachers' math anxiety affects girls' math achievement*)¹. Those findings suggest that in early elementary school, where teachers are almost all female, a teacher's math anxiety can have serious consequences for girls' math achievement. This could be a contributing factor to the high numbers of women that have avoided STEM (Science, Technology, Engineering, and Mathematics) study at US colleges. Although women fill close to half of all jobs in the US economy, they hold less than 25 percent of STEM jobs (Beede et al., 2011).

These conclusions bear out both in my observations as well as my naturalistic, qualitative data collecting. It is common to see only one or two men in my Math for Teachers courses at Bank Street during most semesters. Therefore, the large percentage of students attending Math for Teachers who, year after year, describe their feelings toward math as basically negative are mostly, but not all, female. I have always felt that their lack of inspiration about math will likely influence how they will teach math. My commitment stands to do what I can to help them reorganize their emotional relationship with math, so that they can be inspired and can inspire their students, be they boys or girls!

Suggested Instructional Practice for Teaching Math to Teachers

The suggested instructional practices I refer to here in my paper also grow from my life of teaching at Bank Street College of Education, as first articulated in my dissertation research, "The Voices of Teachers Learning in a Constructivist Based Graduate Math for Teachers Course (Melnick, 1992)." I aimed to study the nature of "change" that my students repeatedly told me they experienced while in my classes. I unearthed the themes of change they were experiencing before, during, and up to five years after completing Math for Teachers with me. Four themes were

¹ PNAS -Proc Natl Acad Sci U S A. 2010 Feb 2; 107(5): 1860-1863. Published online 2010 Jan 25. doi: 10.1073/pnas.0910967107
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found: 1) Grief in a graduate-level course, 2) Healing, 3) Reconstructing of one's math self-identity, and 4) unpacking their personal locus of change. Key strategies that emerged from that study and that I use in my instruction will be addressed in this work, which is intended as a resource for math teacher educators.

Throughout my career, in student course evaluations and conversations with fellow faculty, I have been described as an effective math teacher educator. I believe there are factors in my teaching that cause that. Most specifically, I believe it is the conscious effort I make to address the emotional component in my teaching that gives rise to these comments. I boldly address the affective realm in my instruction. In this work, I offer teacher educators a set of suggestions to consider when planning to teach groups of teachers who may present as having been taught by being

“told” about math rather than by “doing” math. I will lay out eight “touchstone” strategies, behaviors, perspectives, or moves that I have enacted time and again as I taught teachers. Each is designed to help reveal the feelings students have about math and their perceptions of themselves as math thinkers.

Anyone teaching Math for Teachers at Bank Street or a similar course elsewhere may consider some or all of my indicated touchstone strategies. I use the term “touchstone” since I believe the term best characterizes strategies that include the affective dimension of teaching mathematics. I offer this truncated set of ideas in the spirit with which our annual Bank Street professional appraisals are conveyed: through consistent and self-revealing generative inquiry.

This Document Outlines 8 Touchstone Strategies:

1. **Math Autobiography:** Use a math autobiography as an in-class assignment.
2. **“Do” Math:** “Wow” students on the first night of class by doing lab-type experiential tasks across Nursery School through Grade 6.
3. **Collaborative Math:** Model how collaborative group work is a special kind of group work.
4. **Honoring Mistakes:** Model how to honor mistakes and see them as opportunities rather than failings.
5. **Journaling:** Monitor everyone’s learning through a math journal that is linked to class readings.
6. **Work a Problem to Death:** Work one intentionally perplexing problem “to death,” unearthing confusions that arise.
7. **Non-Dominant Language:** Teach one night’s class in a language other than the dominant one.
8. **Concept Teaching Games:** Have each student plan and share their own concept teaching game.