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One Instructor's Quest for a Collaborative Professional Culture

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With a B.S. in math but no prior math education training, my first job as a math teacher was at an alternative charter school with a holistic mission. I was charged with teaching math to five groups of 17 7th, 8th, and 9th graders, embracing problem solving, communication, and collaboration. Few of these students had been taught math in this way previously, and I had not taught math this way (or any other way, for that matter). While I still believe such an approach is possible and worthwhile, I was not prepared to pull it off. I struggled tremendously and no doubt left numerous opponents to math reform in my wake. Fortunately, I attributed my ineffectiveness to my lack of experience and skill as a facilitator and curriculum writer, not to a flaw in the vision. Though I have no way of knowing, I have since wondered what percentage of new educators in similar situations would draw a different conclusion, something like, "Math is different from other subjects. It can't be learned collaboratively. You just have to memorize." This experience motivated me to understand why and how math teachers can become effective in settings that stress understanding over memorization.

Why Did I Struggle?

I believe I struggled in the effort to engage students in the work of actually doing math, as opposed to practicing other peoples' math, not only because I was a new instructor, but also because I learned math quite differently from the way I was aspiring to teach it. My earliest school memories are of racing through addition and multiplication charts to win ice cream from my teacher. I remember doing pages of practice problems and receiving high percentage scores for getting most problems right. I do not remember ever applying math to real world problems with more than one correct answer, and I never remember working with other people on a problem. Interestingly enough, the only times I remember solving problems at the board in school were when I was racing to be the first finished with a correct answer in class competitions. Incidentally, I loved those days – no doubt because I usually won!

If memories like mine approximate the math experiences of others among the current group of math educators in the CES network, is it any wonder we struggle to create math environments where students solve meaningful problems collaboratively with others? If I, or any math instructor, haven't actually experienced learning important math concepts by solving and discussing problems in a collaborative environment, how do I even know it is possible? And if I don't believe it's possible for all students to learn math without an expert telling them what to do and encouraging (often coercing) them to practice and memorize, how much creative energy and perseverance can I bring to the challenges of engaging all students with a meaningful, creative mathematics education? With the benefit of a few years of experience, it now seems obvious that I struggled, and I believe many of us struggle, because I had almost no actual experience learning math concepts through problem solving in collaborative settings.

In my classes of 17 students ages 12 to 15, I was encouraged to select problems for students that were "open-ended" and offered a variety of solution strategies that allowed, at least in theory, students with differing math backgrounds to engage productively with the problem. As students with vast differences in prior experience and confidence asked questions about the problems, as well as the new teaching style, I clumsily directed them to "rely on each other." Within the first 20 minutes of my first lesson ever, the students figured out that I did not intend to answer all of their questions directly. Over the next few weeks, students, parents, and possibly colleagues questioned my understanding of the role of "teacher," sometimes with a real intent to understand where I was coming from, other times rhetorically, with disdain and judgment. "Teachers, especially math teachers, answer students' questions," they reasoned. "How am I supposed to know what to do, if you don't tell me?" "What should my student do when she is ready to move on and others aren't?" "How can someone struggling with fractions really work productively with my

'Algebra' student?"

These questions, I believe, represent something more than most first-year teachers endure. They reveal the responsibility reform-minded educators share in helping others come to understand why reform is warranted and worthwhile. This responsibility is not appropriately borne by any first-year teacher. Despite my best intentions and excitement, I failed my first year teaching math for two primary reasons. I failed because I was unskilled at facilitating a collaborative problem solving culture and had few prior teaching examples in my learning history to imitate. And I failed because I was unprepared to manage effectively the demands of first year teaching, curriculum development, and the necessary public relations work of a new charter school.

Before I discuss the nature of my failures, let me say that I resist the temptation to blame my employers. First, creating a new school is a tremendous amount of work and there was much they did to support me, including sending me to the National Science Foundation (NSF) funded Interactive Mathematics Program (IMP) training. Second, and this is my main point, I don't believe they understood the nature of the challenge. Because of that, to my knowledge, the right kind of professional development networks did not exist that could have adequately prepared me for the challenge I was facing. As good as the IMP training was (and still is), it was not designed with small, holistic-minded community based schools in mind, and I was therefore left to synthesize what was essential in the training with what was essential to teaching within the philosophy of my school. This is the task that I now believe is too large for any first-year teacher.

My failures manifested themselves in two ways. First, few students made significant gains in mathematics that year. Second, most people attributed the lack of learning to the change in instructional philosophy. That is, my first year of teaching helped reinforce what many students, parents, and educators believed in the first place. "Math is different from other subjects. Math is memorization and practice. Math is not creative." And, worst of all, "Some people are good at math, and some people aren't."

But I refuse, and continue to refuse to believe the conclusions so obvious to many students, parents, and colleagues, because I have had two experiences learning important mathematics through problem solving in a collaborative culture. The first experience was in college in an Abstract Algebra course. Our instructor gave us problem sets designed for us to discover, explain and prove the major theorems of Abstract Algebra. He answered our questions with questions of his own and forced us to rely on each other for validation. We even took two group exams! The second experience was the IMP training mentioned above, a two-week course provided as professional development. Sixty secondary math instructors, some converted art teachers with outright math anxiety, others, like me, with degrees in mathematics, discovered that much of what we thought we knew about probability and expected value was in fact quite superficial and unable to be applied accurately to non-routine problems. Collectively, we expanded our notions of what it meant to understand a mathematical concept.

These experiences, and others since, form the foundation of my beliefs that 1) math can be learned through solving problems collaboratively with others, and 2) the math I thought I learned previously lacked the depth and flexibility of true knowledge.

Forming a Network

After my first teaching experience, I decided to opt out of the "sink or swim" model of professional development offered by so many of the new small schools sprouting up across the nation. I pursued an internship at Eagle Rock School with the hope of learning to teach math alternatively from an experienced educator. While Eagle Rock teacher Jason Cushner fit (and continues to fit) that description, as I was applying, he was making plans to leave. Jason worked at Eagle Rock School for seven years as the Instructional Specialist in mathematics prior to my application to Eagle Rock and had even received the Presidential Award in Mathematics Education in 2002. I was offered the position and worked with the previous year's intern while the school looked to fill Jason's position.

Fortunately for me, the position was still vacant seven months into my internship and the job was offered to me. While this was a tremendous opportunity, the hope of learning to teach math alternatively from an experienced educator never played out for me. Even with Eagle Rock's belief in the "Teacher as Generalist" principle, there were few, if any, people offering experience and knowledge about how to facilitate a collaborative problem solving class in a heterogeneous environment, how to develop and utilize inter-

disciplinary courses, and how to re-engage students with mathematics. On the contrary, in my perhaps overly cynical moments, I sometimes got the sense that people were just glad someone at Eagle Rock was willing to do math.

So I began to look outward. I invited instructors I admired from professional development experiences outside of school to observe my courses, collaborate with me to address challenges unique to Eagle Rock, and help identify and recreate our successes. At the debriefing of one such experience, the idea of creating the community of math instructors I was craving was born. While musing about how most math conferences talk about things meant for dramatically different schools settings and how most internal school professional development focused on anything but implementing math curriculum consistent with our school vision, my guest suggested I invite people to Eagle Rock for a conference. Eagle Rock is in beautiful Estes Park, Colorado, he reasoned, and people would love to come here to "work on math."

Math Innovators' Forum

As a result, Jason Cushner and I created the Math Innovators' Forum. The Forum's purpose is threefold: 1) improve the collective practice of math education in alternative schools, 2) support new instructors in the Herculean task of being a new math instructor in an alternative school, and 3) to advocate for our agenda of improving math instruction in our schools. For two years, Jason and I have worked to connect math educators with one another in small alternative schools in the belief that such work improves our practice and is desperately needed. We have hosted four retreats connecting with about 30 instructors. Of particular interest to us are the several brand new instructors who attended and seemed extremely thankful to have someone, anyone, with whom to work on math.

At these gatherings, we identify challenges common to our situations and work to share effective ideas and resources. In the first few Forums, we worked to develop curriculum and projects together. More recently, we have examined existing lessons and projects with examples of student work. Participants who bring work to be reviewed agree to make any improvements to the assignment based on the discussion, and we disseminate the work to the larger group. The goal is to build a significant collection of lessons, projects, assessments, rubrics, and other material that can be used as a resource, particularly for new instructors striving to make math more meaningful for their students.

CES Math Super Team

I discussed these ongoing efforts with Skyview Academy math teacher David Singer, a colleague from the CES network. David suggested we pursue the same idea nationally within CES. From that conversation came "Developing a CES Math Super Team: Collaboratively Solving the Math Dilemma," a pre-conference session on mathematics in CES schools at the 2006 Fall Forum in Chicago, an email listserv on which math educators can post questions and discuss math-related challenges and share successes with each other, and a space on the CES ChangeLab site where instructors can post lessons, activities, and video clips of successful curriculum and activities.

Spending the Fall Forum pre-conference day with more than 25 other instructors from similar school environments interested in improving math education within the CES network was a tremendous gift. I left the experience with a renewed commitment to keep math relevant and meaningful for all my students. We began the day together defining a collective vision of a CES graduate, and we then articulated a vision for CES math classrooms in support of our vision for CES graduates.

Insights

The experiences of isolation relieved by collaboration have led me to a few insights about my practice as a math educator and math education in small, personalized, and student-focused schools:

Effective instruction requires collaboration with other instructors.

There are people working effectively to implement alternative math programs, but they are exceptions to the rule and they are not currently in positions to share their wisdom with people who could benefit.

New instructors need experiences that will ground their belief in the idea that math can be learned through collaborative problem solving, or else they will teach the way they were taught. If that support isn't present in your school, then it is our responsibility to make it available.

Curriculum writing is hard! We need to collaborate and share with one another so instructors can spend more of their time focusing on questioning and assessment strategies in support of collaborative classroom cultures.

In our brief time in Chicago, it was clear there are many areas of common interest and concern: developing more inter-disciplinary classes and projects, developing additional classes and projects connecting math to issues of social justice, wrestling with the challenges of heterogeneous groupings, understanding and implementing a "less is more" philosophy in the current "high-stakes" climate of accountability, and developing collaborative, inquiry-based classrooms, to name a few.

I'll close with some questions that suggest some thoughts about how we can continue and expand this work. What if we could gather, develop, and share five ways linear relationships have been successfully taught in interdisciplinary courses? What if we knew who within CES really understands how to teach spatial reasoning and made her knowledge readily available? What if we collectively advocated for a more complete, humane, and useful vision of mathematics education? What if CES offered training in math education meant for smaller community-based schools? What if CES collaborated to bring math educators together in the summer to develop curricula and offer intervention courses to students who need them at little or no cost in support of high expectations for all students and with the goal of sharing that curriculum?

With every challenge we face, there is an opportunity. The fact that so many have such similar opportunities suggests we are dealing with something larger than our own schools and classrooms. Individual successes in the network can create future allies, and more successes can add to the momentum.

The CES Graduate Vision

- CES graduates will continuously seek to understand the world around them in an effort to meet the needs of self and community and have the moral courage and integrity to live the life that fulfills their passions.
- CES graduates will be knowledgeable, curious and passionate problem solvers who continually learn about, participate in, and enjoy life in the community and world around them.

The CES Math Classroom Vision

CES Math Classrooms:

- Establish and maintain a positive culture of learning where students are working together and are developing confidence in their math abilities and understanding.
- Set clear learning objectives/goals for each class or lesson so that students and teachers know what they are learning and why.
- Differentiate instruction and assessment to meet the needs of individual students and provide multiple opportunities to demonstrate understanding.
- Keep it real, relevant, and authentic
- Personalize instruction
- Practice the 3 Ds: demonstrate, debate, and defend
- Emphasize mathematical culture and discourse
- Are relevant – interesting, applicable and integrated
- Challenge all students
- Actively engage students by developing a community of learners
- Require students to demonstrate/justify understanding

To learn more about and participate in the Colorado-based Math Innovators' Forum, contact Jimmy Frickey

at jfrickey@eaglerockschool.org or Jason Cushner at jcushner@hotmail.com. The Forum meets twice a year, in the fall and the spring, and is exploring ways to incorporate more school visits between members and other smaller gatherings to increase dialogue and communication.

To create connections with other math teachers within CES, join the CES Math Superteam email listserv. Here's how:

Visit www.essentialschool.org

Log in. If you have not ever created a CES Interactive account, you will be prompted to do so.

Click on the My Homebase tab

Join the Math Superteam discussion by entering Math Superteam into the Find a Discussion search box

Start connecting!

The Math Superteam can also be accessed at www.essentialschools.org/cs/homebase/forum/cs_disc/1565

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