WHITE PAPER

by Cathy Seeley

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Many PK–12 teachers of mathematics have come to recognize the power of organizing their teaching less around presenting content and more around active student discussion of mathematical ideas. Making this kind of shift can seem like a daunting task, especially if you have not experienced student-centered teaching yourself. But the benefits can be significant for students on a day-to-day basis and also for the long term, making the effort a rewarding investment.

There are many reasons why mathematics classrooms are moving toward more focus on student thinking and student-centered classroom discussion as a foundation for learning. Numerous reports show that the United States has made gains in some areas of mathematics achievement but that we still have room for improvement in terms of student learning (Organisation for Economic Co-Operation and Development, 2013; U.S. Department of Education, 2014). Regardless of the reasons why not all students may be achieving at the level we might wish, looking at how we structure our mathematics classrooms is a reasonable place to begin to look for solutions.

In particular, we know that not all students receive the same opportunity to develop a strong and broad foundation in mathematics nor the same opportunity to engage in thinking or to solve nonroutine problems (Aguirre et al., 2013). Major inequities persist at a systemic level in schools, with advanced or deep mathematics too often seen as appropriate only for certain students. Too many students, like many adults, believe that they cannot do math and that they will be fine without it.

Students who have missed out on success in mathematics, as well as students who have done well in a traditional teacher-directed classroom, can benefit from more focus on student involvement. In shifting toward a more student-centered approach in teaching mathematics:

- Teachers can apply what research has shown about e□ective instructional practice for mathematics learning.
- More students can build conceptual understanding and computational proficiency.
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In addition to articulating the importance of the teacher identifying a mathematical goal for each lesson, NCTM's eight teaching practices focus on helping students develop fluency and build understanding and gathering evidence of students' thinking and understanding

teacher-centered. Student-centered classrooms may not look the same every day. As always, teachers are ultimately responsible for determining on a day-to-day and moment-to-moment basis how to best help students take in new learning, making decisions constantly about when to ask and when to tell. In a student-centered classroom focused on thinking, it is quite likely that the balance between asking and telling is continually shifting, even as it moves toward the teacher doing more asking than telling.

Shifting teaching to a more student-centered approach also does not mean that the emphasis is only on concepts or strictly on problem-solving. Rather, the teacher is constantly balancing the development of concepts, procedures, and problem-solving to ensure that students' learning is both broad and deep. The teacher knows that the best way to build procedural fluency is on conceptual understanding (NCTM, 2014b) and that solving the many kinds of problems students are likely to face calls for them to have a strong foundation of both concepts and skills.

In a well-designed student-centered classroom, every student's ideas are valued, helping each come to see herself or himself as a person who does mathematics. (Aguirre et al.) (2013) offer five equity-based teaching practices that connect with and enhance NCTM's eight teaching practices. These equity-based practices offer insights into research about how we can transform the traditional culture of the mathematics classroom in support of increasing student agency and strengthening students' mathematical identities. Further, these practices provide the kind of deep and lasting learning that NCTM (1991, 2000) and others have long identified as necessary and appropriate for all students.

The five equity-based practices include:

- Going deep with mathematics: Implementing lessons with high cognitive demand, which help students develop proficiency, fluency, conceptual understanding, reasoning, and problem-solving.
- Leveraging multiple mathematical competencies: Tapping students' various mathematical strengths, backgrounds, and competencies.
- Affirming mathematics learners' identities: Valuing all students' contributions and creating multiple entry points to the mathematical ideas of a task or lesson.
- Challenging spaces of marginality: Moving past lecture and seatwork to embrace student competencies, decrease the emphasis on status, and value all contributions.

- Allow students to work collaboratively. Give students time to wrestle with a problem on their own before telling them how to solve it or having them work with others. Also allow time for them to work with a partner or in a small group. Some teachers find it easier to start with partner work.
- Ask questions as students work, while planning for class discussion. Look for students who may get stuck in unproductive struggle and ask questions that can push their thinking and reasoning (How did you decide to use multiplication? What does the 7 tell you? How are the two functions similar/different?). As you circulate among students, make note of whose work would be most beneficial to share in a group discussion (whether correct or incorrect), and in what order.
- Create a safe environment for discussion. Discuss classroom norms that set ground rules for how everyone in the class will respect the thinking and sharing of others as they contribute their own thinking and ask clarifying questions. Discuss how mistakes and discussions about mistakes can lead to learning. Over time, help students come to expect that in math class we talk about our ideas and our thinking.

It may seem overwhelming to fully implement a student-centered approach in the classroom. Taking one step at a time can be a productive approach, with a commitment to stay the course and with the right kind of support. Working with colleagues can smooth the bumps in the road and can provide moral support as teachers work together with each other and with coaches or instructional leaders. Planning for ongoing, collaborative professional development during this kind of transition is an important consideration.

In spite of the challenges, more and more teachers are finding that moving through the inevitable obstacles and stumbles on this journey is more than worth the effort as they come to see the dramatic results that are possible, both with students who have traditionally done well and with students who may never before have been successful in math class. Perhaps shifting classroom practice in these proven ways can help us finally move past achievement blocks and gaps to unlock the potential in every student and allow each of them to flourish as a mathematical thinker and reach the level of achievement we all want to see.