There's No Limit: Mathematics Teaching for a Growth Mindset
A summary of dissertation work by Kathy Liu Sun[1]

Research examining the degree to which teachers influence their students' mindsets has only recently begun. Preliminary findings, however, suggest teachers' mindsets are *not* predictive of students' mindsets. Using quantitative survey data and qualitative data, Sun (2015) built on prior seminal work by Jo Boaler (Boaler, 2013, 1998) to examine the relationship between teachers' classroom practices and students' beliefs about math ability. Here we offer an in-depth review because of the important contribution it makes to our understanding of how teaching practices influence students' mindsets.

A total of 40 middle school math teachers from six schools and 3400 of their students were surveyed. Survey data revealed that teachers' self-reported mindsets were not related to students' mindsets. However, teachers who endorsed a multidimensional rather than one-dimensional view of math had a greater influence on shaping their students' mindsets by the end of the semester. In other words, students were more likely to have a growth mindset about math ability if their teachers disagreed with statements such as, "Mathematics involves mostly facts and procedures that have to be learned," or "There is usually only one way to solve a math problem" (p. 51). Indeed, the qualitative data revealed that while a number of teachers with one dimensional views of math paid homage to the rhetoric of growth mindset - for example, using the term "growth mindset" or encouraging persistence - their teaching practices often conveyed more fixed mindset messages.

To understand how mindset messages were being conveyed in the classroom and how teaching practices varied across teachers, Sun (2015) collected extensive qualitative data over one year. Classroom observations, two semi-structured interviews, and artifacts were gathered from seven teachers at four schools who held a mix of fixed and growth mindset beliefs. Each teacher was observed between 11-13 times over the course of one year and a selection 3-4 of both fixed and growth mindset students from each class were interviewed. The analysis revealed variations in teaching practices in four general categories between teachers with one dimensional and multidimensional views of math: 1) how students were sorted, 2) what classroom norms were set, 3) which types of math tasks were given, and 4) which types of assessment and feedback were provided. Within each category, practices were rated as more or less growth mindset promoting.

Fixed Mindset Classroom Practices

Teachers who held more one-dimensional views of math utilized practices that were categorized as more fixed mindset promoting. These teachers were more likely to group students together based on past achievement, and to convey high expectations for past high achievers and low expectations for past low achieving students. Low achieving students were typically seen as needing help but being incapable of offering help to others. Sorting students and displaying differential expectations signals to students that math ability is a fixed trait. High performing students were also more likely to be publicly praised or acknowledged for their

[1] Excerpted from Growth mindset and achievement: Insights from mindset research for educators, by Jacquie Beaubien.

success in accuracy and speed, which seemed to signal that these were the primary goals rather than emphasizing the goal of learning or productive struggle. When a student in a fixed mindset classroom was asked what happened when someone made a mistake, the student responded, “the teachers will tell us why it's wrong, how we can fix it, and how it should be done” (p. 123). In other words, students were not encouraged to explain their thinking or to try to work through confusion or mistakes on their own. Students in these classes were also typically only given one opportunity to submit assignments or to take tests.

Growth Mindset Classroom Practices

By contrast, in the classrooms of teachers who held more multidimensional views of math, the teaching practices tended to align with growth mindset messaging. In these classrooms, teachers made explicit attempts to group students based on how each student might contribute to the group’s collective mastery of mathematics concepts; the classroom norm was that the contribution of all students was valuable.

The math tasks given in these classrooms often encouraged students to think conceptually rather than to use rote memorization of formulas to solve problems. Multiple methods of solving the same problem were also encouraged (e.g., “find 12 percent of the same number using different methods”). This legitimized different approaches to solving problems; thus it wasn’t always the same students being publicly acknowledged for their work. Feedback (praise) also tended to focus on the processes used, effort, and students’ ability to explain their thinking process rather than on producing the correct answer or solving problems quickly.

In many growth mindset oriented classrooms, a norm was explicitly set that intelligence is malleable and that the brain is like a muscle that grows by being challenged. Students were encouraged to embrace struggle, make mistakes, take risks, and persevere through confusion or frustration. They were expected to be able to explain their rationale for answers. These teachers were also more likely to utilize formative assessments to help students understand what they still needed to work on and to allow students to resubmit work or retake exams to improve scores. In these ways, students were trained to think of learning as a process and to understand that all students can be successful. Students in these classes were more likely to use conceptual language to describe the subject of math, whereas students in fixed mindset classrooms used more formulaic descriptions related to following set procedures.

Towards a Framework for Growth Mindset Professional Development

An important finding from Sun’s (2015) research is that teachers’ mindsets and even their explicit use of growth mindset language were often not aligned with their actual classroom practices and did not lead to their students developing a growth mindset. In fact, teachers who explicitly endorsed a growth mindset often engaged in practices that implicitly contradicted this message and produced more fixed mindsets in their students. This underscores the importance of teachers receiving effective training on the specific practices that reinforce adaptive learning mindsets.

References

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