Research-Informed Answers for Mathematics Education Leaders

LEADERSHIP IN MATHEMATICS EDUCATION
NCSM
NETWORK
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Improving Student Achievement in Mathematics by Promoting Positive Self-Beliefs

... many students have difficulty in school not because they are incapable of performing successfully but because they are incapable of believing they can perform successfully ... Consequently, parents and teachers do well to take seriously their share of the responsibility in nurturing the self-beliefs of their children and students, for it is clear that these beliefs can have beneficial or destructive influences.

Pajares & Schunk, 2002

Our Position

The National Council of Supervisors of Mathematics believes that in order to help students learn challenging, standards-based mathematics, educators must establish a classroom climate that promotes positive self-beliefs about intelligence and academic ability. We believe that teacher actions can significantly affect students' self-beliefs and that — as these student self-beliefs deepen and strengthen — teacher beliefs do so as well. Positive self-beliefs, as well as positive experiences in mathematics, increase student motivation and engagement.

Mathematics educators can best instill positive student beliefs about their intelligence and ability to do mathematics when we:

- Understand that educators play a crucial role in student motivation.
- Know that equity requires that educators reflect on their individual beliefs about intelligence and whether or not they believe that all children can learn mathematics.
- Establish a learning environment that promotes a view of intelligence as malleable and fosters a sense of belonging for each student.
- Recognize and act upon the fact that even students who currently appear not to care, do want to learn and be challenged.
- Ensure that all students have the right to authentic and meaningful mathematics curricula taught in engaging and accessible ways.
- Use mathematics as a forum for students to reach a better understanding of themselves as learners by providing opportunities for them to experience and recognize that hard work and perseverance results in deeper understanding and higher achievement.
- Teach and model the meaning of effective effort.
- Foster positive and encouraging relationships with students and among students by providing opportunities for students to engage in peer-to-peer learning communities.
- Implement assessment for learning strategies that involve students in goal setting, presentations of their learning, and self-reflections.
- Provide descriptive feedback to students about their work to help students identify the strengths and weaknesses of their mathematics strategies and suggest action steps for improvement.

The NCSM Improving Student Achievement Series is a set of position papers designed to provide research-based practices for school and district mathematics education leaders.

Research that Supports Our Position

In its *Principles and Standards for School Mathematics,* the National Council of Teachers of Mathematics (2000) put forth an ambitious vision of school mathematics that requires that all students engage in meaningful mathematics. For students even to try engaging in meaningful mathematics, however, it is critical that we not underestimate what it takes to motivate them to succeed in school. The National Mathematics Advisory Panel (2008), for example, found that 62% of Algebra I teachers reported "working with unmotivated students" is the "single most challenging aspect of teaching Algebra I successfully." In addition, former American Psychological Association president Robert Sternberg

asserts, "… motivation is perhaps the indispensable element needed for school success. Without it, a student never even tries to learn" (Sternberg, 2005, p. 19). NCSM's *PRIME Leadership Framework* (2008) promotes a vision for equity in which we, as leaders, embrace our responsibilities to address these issues directly.

Self-beliefs play a critical role in students' understanding about intelligence, success and failures, and the learning environment. Students who believe that intelligence is malleable tend to persist longer with challenging tasks and are more resilient in the face of setbacks (Dweck, 2000; Dweck & Leggett, 1998). Students who believe that their personal success or failures are within their own control demonstrate stronger skills in key metacognitive acts, such as self-monitoring and goal setting. Likewise, students with stronger metacognitive skills make more productive attributions for their successes and failures (Weiner, 2000). Students who have a sense of belonging to a particular learning environment are more likely to participate in and contribute to that community of learners. Students' feelings of authentic connections to others in the mathematics classroom are related to whether the environment promotes a malleable view of intelligence, dispels negative stereotypical views, and embraces risk-taking as an essential component for learning (Aronson, Fried, & Good, 2002; Eccles, Lord, & Midgley, 2002; Hamm & Faircloth, 2005; Ryan & Deci, 2000).

Students can develop growth mind-sets through instruction. Growth mind-set interventions, which explicitly teach students about the brain, its functions, and that intellectual development is the result of effort and learning, have increased students' achievement in a variety of settings, including middle school mathematics and English (Aronson, Fried, & Good, 2002: Blackwell et al., 2007; Good, Aronson, & Inzlicht, 2003). Students' mind-sets are also influenced by the type of praise that teachers provide. Praise that refers to students' intelligence fosters fixed mind-sets; whereas praise that explicitly refers to effort, engagement, perseverance, etc., promotes growth mind-sets (Mueller & Dweck, 1998).

Students must have opportunities to experience what learning feels like, to observe others "like them" who experience mastery, to learn alongside peers with high aspirations, and to understand the role that their own emotions play in their learning. For example, interpreting stress as anticipation of a challenging and positive learning experience instead of as a warning sign of impending failure influences the ability to learn (Bandura, 1977, 1997). Students who view intelligence as *fixed* often believe that feeling confused means they are not smart enough, rather than recognizing that confusion is a normal part of learning. Additionally, students need safe environments and adequate time to wrestle with complex problems, develop productive dispositions, and continually build confidence to persevere in the face of adversity and setbacks — all of which can bolster students' feelings of self-efficacy (National Research Council, 2001).

The demonstrated positive effects of helping students gain an understanding of their own learning and the role of effective efforts in that learning can be found in some small studies based on larger scale interventions designed for wide use in public schools. For example, over the past four years, the Charles A. Dana Center at the University of Texas at Austin has been working to create a positive culture for learning high school mathematics by leveraging ideas from the fields of cognitive science, neuroscience, and educational psychology. The Dana Center's program, known as Academic Youth Development[1], engages students in discussions and activities that teach them how people learn, how to overcome obstacles to learning, and how to create a community of learners through mutual accountability. All these "youth development" or psychological strategies are taught in parallel to content focusing on mathematical knowledge, particularly around ratio and proportional reasoning, multiple representations of relationships, and problem solving. Initial results for the program are encouraging and indicate an increase in students' confidence, motivation, persistence, and a strengthening of their belief that intelligence is something over which they have control (Charles A. Dana Center, 2008).

Teacher beliefs also play a critical role in which instructional and assessment strategies they choose to employ as well as in which self-beliefs they foster with their students (Stipek, Givvin, Salmon, & MacGyvers, 2001). Teacher beliefs can truly shift when they implement a teaching practice that does not fit within their normal teaching worldview, and then observe subsequent significant changes in how well, or how much, their students learn (Guskey, 2002). Therefore, professional learning initiatives that lead to long-term changes in teacher beliefs around student motivation require safe structures that enable teachers to wrestle with ideas of motivation when working with their own students.

Research also provides strong evidence that involving students in the assessment process impacts their achievement and increases their motivation to learn. Students gain ownership of their learning, engage in the process of learning, become more motivated to learn and exhibit fewer disruptive behaviors (Harlen

[1] The Academic Youth Development program (www.utdanacenter.org/academicyouth/) was created by the Charles A. Dana Center at the University of Texas at Austin in collaboration with Agile Mind, Inc., networks of school districts, and a working group of educators and psychologists. As of summer 2009, the program was being implemented with 4,000 students in 129 schools across eight states.

& Deakin-Crick, 2003). Using assessment for learning strategies, teachers provide clear learning targets and descriptive feedback (versus judgmental) that suggests next steps for students. Students engage in setting realistic goals and track their progress towards these goals. Teachers who employ the power of formative assessments to adjust their instruction and target the learning needs of students improve student achievement (Wiliam, Lee, Harrison, & Black, 2004).

How NCSM Members Can Implement Our Position

As leaders, NCSM members can:

1. Encourage teachers to provide rich and engaging mathematics experiences while setting the expectation that all students can learn the content.
2. Provide ways for teachers to incorporate oppor–tunities for students to experience mastery and learn the value of persistent and effective effort.
3. Offer opportunities for teachers to reflect on their own beliefs about intelligence and about who can and cannot "do" mathematics. Remind teachers that their self-beliefs can affect their students in subtle, yet powerful ways. Encourage teachers to incorporate appropriate action based on their new understandings.
4. Challenge deficit-based views regarding students. Statements are still too commonly heard regarding the "smart" kids or claiming that some or most students "can't" or "won't" learn a given concept or skill.
5. Eliminate policies that perpetuate fixed views of intelligence, such as grading policies that don't allow any opportunities for student self-reflection and revision.
6. Encourage research and development of professional learning opportunities that focus explicitly on examining classroom-based best practices for increasing student self-efficacy beliefs in mathematics, and collaborating to incorporate emerging best practices into their ongoing work.
7. Promote and support the development and implementation of assessment *for* learning strategies.
8. Work with leaders and teachers to establish an understanding that persistent effort improves achievement and instills the belief in students that anyone can become smarter.

One of a series of position papers of the
National Council of Supervisors of Mathematics
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National Council of Supervisors of Mathematics

Mission Statement

The National Council of Supervisors of Mathematics (NCSM) is a mathematics leadership organization for educational leaders that provides professional learning opportunities necessary to support and sustain improved student achievement.

Vision Statement

NCSM envisions a professional and diverse learning community of educational leaders that ensures every student in every classroom has access to effective mathematics teachers, relevant curricula, culturally responsive pedagogy, and current technology.

To achieve our NCSM vision, we will:

- N: Network and collaborate with stakeholders in education, business, and government communities to ensure the growth and development of mathematics education leaders
- C: Communicate to mathematics leaders current and relevant research; and provide up-to-date information on issues, trends, programs, policies, best practices and technology in mathematics education
- S: Support and sustain improved student achievement through the development of leadership skills and relationships among current and future mathematics leaders
- M: Motivate mathematics leaders to maintain a life-long commitment to provide equity and access for all learners

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