What Does It Mean to Be Good at Math?

Mathematics seems to be unique in the attitudes it brings out in people. Many adults dislike mathematics, and many believe they are just not born to be "math people." Unfortunately, that harmful belief seems to have been passed on to many students. In truth, there is absolutely no evidence to support the idea that mathematical ability is based on a "math gene." Mathematics has many dimensions, and there are many ways to be good at math. We now know that anyone of average intelligence can learn mathematics if we teach it in appropriately engaging ways. Emerging work on the nature of intelligence and how people learn mathematics is helping educators reexamine old assumptions and beliefs about what it takes to be good at math and even what it means to be smart in general.

A Growth Mindset of Intelligence

Historically, two bodies of thought have dominated both research and public perception about intelligence. In the groundbreaking book *Mindset*, Carol Dweck (2006) describes two mindsets about intelligence—a *fixed mindset*

and a *growth mindset*. A fixed mindset represents the point of view that intelligence is a fixed quantity determined solely by a person's genes. People with a fixed mindset about intelligence believe that every person is born as smart as they will ever be. A growth mindset, on the other hand, represents the idea that genetic makeup is only the starting point. People with a growth mindset about intelligence believe that, while a person may be born with certain genes, their life experiences and a variety of influences from family, society, and the media can impact how smart that person may become. A growing body of hard scientific research supports the idea that intelligence is, in fact, malleable, not fixed. From brain scans of people working on difficult problems, we have learned that the brain can grow new neural connections—new synapses—that form the basis of a person's intelligence. Dweck believes that a person's mindset affects not only how well that person will do in school, but also how she will function in relationships, the workplace, and everyday life.

The Impact of Mindset on Learning and Teaching

Students who have come to adopt a fixed mindset about intelligence, even if they don't use those words, believe they are as smart now as they're ever going to be. When they encounter difficult math problems they don't immediately know how to solve, they're likely to think, "Well, I guess I've hit my limit. I must not be smart enough to solve this kind of problem." And they give up. An unwillingness to try a hard problem is pervasive among American teenagers,

reaching epidemic proportions by the time students leave high school. This unwillingness to try and lack of persistence cross all levels of academic success, affecting students who are successful (perhaps even in an accelerated track) as well as students who struggle to learn. Too many students have come to believe that they either have reached or will soon reach the limit of how smart they are. Their fixed mindset has become entrenched as a fundamental belief.

On the other hand, students who understand that intelligence is not fixed but can grow may approach a tough problem by thinking, "Wow. This seems like a really hard problem. I may have to work on it a while. It may take some time." A growth mindset equips students to be willing to tackle hard problems and persevere until they arrive at a solution.

Probably at least as important as a student's mindset is a teacher's mindset. If a teacher believes that students are limited in terms of how far they can go, the teacher is likely to set low expectations and potentially fail to adequately challenge students. A teacher's mindset about intelligence affects plans for daily teaching as well as interactions with students during class. Both teachers and students can benefit from learning about a growth mindset and the potential to become smarter as they tackle challenging mathematics.

Teaching About a Growth Mindset

Learning about the nature of intelligence, including the power of a growth mindset, and learning how to share this knowledge with students should be part of every teacher's professional education. Some programs, like the Academic

Youth Development program (The Charles A. Dana Center at the University of Texas at Austin, 2016) have shown that we can be successful teaching students about intelligence, learning, and even brain research as part of their instructional program.

Understanding a growth mindset can change how we plan and implement our mathematics teaching. In the book *Mathematical Mindsets*, Jo Boaler (2015) makes a beautiful case for helping students learn about a growth mindset and making some shifts in how we teach. She also reminds us about the value of embracing mistakes. From what we've learned about how intelligence can be affected by experience, we now know that not only is making mistakes normal, it may actually represent an important component to learning and growing intelligence.

Being Smart in Math

It's a common misconception that someone who's good at math is someone who can compute quickly and accurately. But mathematics is a broad discipline, and there are many ways to be smart in math. Some students are good at seeing relationships among numbers, quantities, or objects. Others may be creative problem solvers, able to come up with nonroutine ways to approach an unfamiliar problem. Still others may be good at visually representing relationships or problems or translating from one representation to another—from a graph to a table, from an equation to a graph, or from a word problem to a pictorial model, for

example. All of these students—and others—should have the opportunity to access mathematics from different entry points and become successful math students. A compre-hensive mathematics program not only makes room for and nurtures all kinds of smart students, it also creates opportu-nities for students to expand the strengths they have to help them access other dimensions of mathematics. And it offers such opportunities to all students—even those who may be disenfranchised or disengaged with mathematics, often hid-den in remedial programs or special classes.

www.ascd.org
books@ascd.org

www.mathedleadership.org
office@mathedleadership.org

www.nctm.org
publications@nctm.org

Published simultaneously by ASCD, 1703 N. Beauregard Street, Alexandria, VA 22311, the National Council of Supervisors of Mathematics, 2851 S. Parker Road #1210, Aurora, CO 80014, and the National Council of Teachers of Mathematics, 1906 Association Drive, Reston, VA 20191.

PAPERBACK ISBN: 978-1-4166-2246-8 ASCD product #SF116068

Also available as an e-book (see Books in Print for the ISBNs).

Library of Congress Cataloging-in-Publication Data

Names: Seeley, Cathy L.
Title: Building a math-positive culture : how to support great math teaching in your school / Cathy L. Seeley.
Description: Alexandria, Virginia, USA : ASCD, 2016. | Includes bibliographical references and index.
Identifiers: LCCN 2016004940 | ISBN 9781416622468 (pbk. : alk. paper)
Subjects: LCSH: Mathematics--Study and teaching (Elementary) -Handbooks, manuals, etc. | Mathematics teachers--Training of--Handbooks, manuals, etc.
Classification: LCC QA135.6 .S445 2016 | DDC 510.71/2--dc23 LC record available at http://lccn.loc.gov/2016004940

24 23 22 21 20 19 18 17 16 1 2 3 4 5 6 7 8 9 10