MESSAGE

17 Constructive Struggling

THE VALUE OF CHALLENGING OUR STUDENTS

> Spoon-feeding in the long run teaches us nothing but the shape of the spoon.
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> —E. M. Forster, author

American teachers are soft. That's the message I heard when I started my service in the Peace Corps. I was assigned to teach mathematics (in French) in Burkina Faso, a small West African country unknown to most Americans. Throughout our eleven weeks of training, our Burkinabè teacher trainers explained to us that American teachers tend to want all students to succeed and that we grade students too high. "Your students won't respect you if you are too soft," Sou and Salam reminded us on more than one occasion. Over time, I learned to put that message in perspective. I observed that the Burkinabè system was based on a philosophy that seemed to be aimed largely at eliminating students from the school system—a totally opposite goal from that in the United States, and a goal that carried its own challenges. But this experience caused me to take a closer look at what we expect of students in U.S. mathematics classrooms. I began to wonder whether our compassion for students and our desire for all students to succeed might in fact be disadvantaging them. It is now clear to me that in too many cases we are not expecting enough of our students. In fact, most mathematics teachers report to me that their students are not willing to try hard problems that they can't immediately see how to solve.

Over and over again, we hear that U.S. math students deal with less challenging mathematics than students in other countries. The content of

international tests like TIMSS[1] and PISA[2], and the performance of U.S. students on those tests, reinforce the notion that our students may not be dealing with the same level of complexity in mathematics as students in other countries. I don't advocate that the United States should copy the programs of other countries; there are too many cultural and societal differences and too many challenges for any program to be successful on a large scale when it is transported in its entirety to a different setting. But I strongly support our close examination of practices used elsewhere that might inform our work to improve mathematics teaching and learning in this country.

Spoon-Feeding Our Students

In *The Teaching Gap*, Jim Stigler and Jim Hiebert (1999) report the results of classroom observations that were part of the 1995 TIMSS. This particular part of the study sent observers to eighth-grade classrooms in the United States, Germany, and Japan. Observers categorized the level of mathematics evident in classrooms in these three countries. They noted that in U.S. classrooms, students typically dealt with a much lower level of mathematics content than students in other countries. Observers also noted that our students had far fewer opportunities to develop new mathematical learning; instead, they were simply being told what to do. Worse, observers reported that on the few occasions when American teachers chose mathematically complex tasks, their teaching approach tended to remove the complexity and reduce the difficulty of the tasks.

Unfortunately, the kind of instruction Stigler and Hiebert described still seems to represent a common teaching model in many mathematics classrooms across the country. It appears that in the interest of having students succeed, we sometimes spoon-feed our students too much information and ask too little of them in return. We tell them what approach or tools they can use to solve a problem, wait to give them a problem until they have just completed learning a procedure they can use to solve it, or guide them in a directed fashion that makes one path obvious, thus removing the challenge. In essence, we tell them how to solve a problem before they have a chance to tackle it themselves. Somewhere along the way, we seem to have decided that students shouldn't struggle with mathematics.

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[1]Trends in International Mathematics and Science Study, formerly the Third International Mathematics and Science Study (http://timss.bc.edu).

[2]Programme for International Student Assessment, administered by the Organisation for Economic Co-operation and Development (OECD; www.pisa.oecd.org).

The Need for Complexity

One of the most important lessons we can learn from other countries is that sometimes mathematics is hard, and sometimes we have to struggle to figure things out, especially with problems that are complex. When we introduce complexity in the problems we ask students to solve and challenge them beyond what they think they can do, we give them the opportunity to struggle a bit—an opportunity that many students never experience in mathematics from elementary school through high school. A look at those American classrooms where teachers and students invite complexity shows that the kind of mathematics problems students can really sink their teeth into (and consequently might struggle with) are often more interesting and engaging than the problems we have traditionally provided in math classrooms. It turns out that offering students a chance to struggle may go hand in hand with motivating them, if we do it right. Most important of all, we now know that struggling with challenging materials can actually make someone smarter. As someone deals with a difficult problem, they grow new neural connections and increase their intelligence.[3]

Constructive Struggling

Some teachers and parents may be concerned that students will become frustrated or fall behind if they are given mathematics problems that seem too hard. I offer a new way to think about this by advocating *constructive struggling*, not pointless frustration. Constructive struggling can happen when a skillful teacher gives students engaging yet challenging problems. Constructive struggling can take place when a teacher decides that one demanding, possibly time-consuming problem will likely provide more learning value than several shorter but more obvious problems. Constructive struggling involves presenting students with problems that call for more than a superficial application of a rote procedure. Constructive struggling occurs when an effective teacher knows how to provide guiding questions in a way that stops short of telling students everything they need to know to solve a problem. Constructive struggling can build from the elementary grades through the rest of a student's education as teachers continually balance the types of problems they give students. An effective teacher provides problems that range from straightforward applications of recently learned mathematics to more complex problems that require critical thinking and the connection of more than one mathematical concept, skill, or idea. As students engage in the constructive struggling needed for some of these

[3]See Carol Dweck (2006) *Mindset*.

problems, they learn that perseverance, in-depth analysis, and critical thinking are valued in mathematics as much as quick recall, direct skill application, and instant intuition.

What Can We Do?

Of course we want students to succeed, and we don't want students to dislike math class. Perhaps the way to help them most, both in terms of success and attitude, lies in the counterintuitive notion of finding the right level of struggle or challenge—a level that is both constructive and instructive. The business community tells us that the ability and willingness to tackle a problem that is not easily solved is one of the most important traits of a well-educated adult today. If we do our job well and make students think just a little harder, we can not only help them grow smarter, we can also prepare them to take on some of the most difficult problems we face today as well as the unknown problems we are likely to face tomorrow.

Reflection and Discussion

FOR TEACHERS

- What issues or challenges does this message raise for you? In what ways do you agree with or disagree with the main points of the message?
- What teaching actions or strategies do you think support or inhibit students' willingness to accept the struggle that goes with solving a challenging problem?
- How long do you allow your students to wrestle with a complex problem before you offer increasingly guided assistance? How frequently do you provide such an opportunity?
- How can you determine the right amount of frustration and struggle for any given student on any given task?
- How can you help your students develop the confidence and persistence necessary to persevere through a challenge?

FOR FAMILIES

- What questions or issues does this message raise for you to discuss with your son or daughter, the teacher, or school leaders?

- How can you help your daughter or son understand that it's OK to struggle with a math problem sometimes?
- In what ways can you help your son or daughter with math homework without spoon-feeding all of the steps needed in order to solve a challenging problem?
- How can you help your daughter or son develop confidence and persistence in tackling hard mathematics problems? How can you support the teacher's efforts in developing student confidence and persistence?

FOR LEADERS AND POLICY MAKERS

- How does this message reinforce or challenge policies and decisions you have made or are considering?
- How can your mathematics program support students in learning the value of working through hard or complex problems?
- What kinds of professional learning opportunities can you offer teachers to help them learn how to determine and incorporate appropriate levels of struggling in their mathematics teaching?

RELATED MESSAGES

Faster Isn't Smarter

- Message 16, "Hard Arithmetic Isn't Deep Mathematics," makes the argument that mathematics must include more than computation.
- Message 32, "Yes, but . . . ," examines some of the reasons we think students don't learn challenging mathematics.
- Message 2, "Untapped Potential," reminds us that many students can do much more challenging work than we currently expect of them.
- Message 31, "Do They Really Need It?," discusses the value of letting students tackle challenging mathematics, even if we aren't sure whether or when students will use it.

Smarter Than We Think

- Message 12, "Upside-Down Teaching," describes the teaching model advocated in this message.
- Message 1, "Smarter Than We Think," looks at the importance of effort and perseverance when dealing with hard problems and describes the role of challenge and struggle in growing smarter.

- Message 32, "Problems Worth Solving—And Students Who Can Solve Them," looks at the nature of problems or tasks that can lead to deep student learning.
- Message 35, "Math in the *Real* Real World—Mathematical Modeling in School Mathematics," considers the importance of helping students learn to use mathematics to model and solve contextual situations and problems.
- Message 5, "Getting It," discusses what it means for students to come to deeply understand a mathematical idea or concept.

MORE TO CONSIDER

- *Mindset: The New Psychology of Success* (Dweck 2006) is a breakthrough book for both educators and the public about the implications that a person's mindset has on intelligence.
- "Ability and Mathematics: The Mindset Revolution That Is Reshaping Education" (Boaler 2013a) presents an overview of the impact of a growth mindset on mathematics teaching.
- *Mathematics for Equity* (Nasir et al. 2014) describes a school that successfully implemented equity-based teaching practices focused on student engagement and discourse around rich problems.
- *How Children Succeed: Grit, Curiosity, and the Hidden Power of Character* (Tough 2013) looks at how one's effort, persistence, and other factors affect a student's intelligence and school success.
- "The Mathematics of Hope: Moving from Performance to Learning in Mathematics Classrooms" (Boaler 2014) discusses how changing the nature of our classrooms can improve mathematics learning for all students.
- "Evidence of Deeper Learning Outcomes: Report #3 Findings from the Study of Deeper Learning: Opportunities and Outcomes" (Zeiser et al. 2014) considers how to help students achieve deep, lasting learning of mathematics.
- "Educ115N: How to Learn Math" is a Massive Open Online Course (MOOC) offered by Stanford University and taught by Dr. Jo Boaler for educators, students, or noneducator adults addressing key issues related to learning mathematics, including discussions on intelligence, mistakes, perseverance, problem solving, teaching for student engagement, and other topics (see also the related website www.youcubed.org).
- *Strength in Numbers: Collaborative Learning in Secondary Mathematics* (Horn 2012) discusses the rationale for students engaging collaboratively in solving tasks and looks at the nature of tasks worthy of students' time that support the development of their thinking.

- The Dana Center (www.learningandtheadolescentmind.org) provides a nice summary of issues affecting students' success in school, especially in mathematics, noting the importance of productive struggle. It includes background information, teaching suggestions, and resources for further study.
- *The Teaching Gap: Best Ideas from the World's Teachers for Improving Education in the Classroom* (Stigler and Hiebert 1999) considers differences between American mathematics teaching compared to mathematics teaching in other countries, including differences in how students may or may not be encouraged to struggle with hard problems.
- *Professional Standards for Teaching Mathematics* (National Council of Teachers of Mathematics 1991) remains one of the richest descriptions of the nature of worthwhile tasks and classroom discourse that can push students' thinking and develop mathematical understanding.
- My website on Burkina Faso (http://csinburkinafaso.com) includes photos and stories about life and teaching during my Peace Corps assignment from 1999 through 2001, providing a backdrop for the opening of this message.
- See also Appendices A and B on finding, selecting, and evaluating in-depth tasks and Appendix C for several resources on focusing mathematics teaching around problem solving, listed as part of the Essential Library.