

## PRESIDENT'S MESSAGE

### The Value of Struggle

—FRANCIS EDWARD SU

**My stomach sank** as I read these two students' take-home exams. Their proofs looked unusually similar in notation and phrasing; yet I was quite sure neither student knew the other. So, on a hunch, I Googled the problem I had posed and found a solution online that was the likely source of both answers.

What should I do? Rather than confronting the students and putting them on the defensive, I decided to give them an opportunity to step forward. If they did take responsibility for their actions, I could advocate for a less severe penalty. So I emailed the entire class, explaining that I'd discovered instances of cheating using online resources but that I was hoping responsible parties would come clean.

The next morning, I was startled to find 10 confessions in my inbox, including the two I had identified! Though I'd heard of significant cheating incidents at other schools, I was startled that this could happen in my class.

What pressure was so strong that so many students felt compelled to cheat? Said one, in tears: "I really did try the problem! But I was tired, and had so much work to do . . . so I looked for a solution online. I just wasn't sure if I kept at it that I would have solved it." Others confessed feeling enormous pressure to achieve because they wanted the approval of peers or parents, to get a good job or to get into graduate school.

Is the internet to blame? Yes and no. The underlying temptations have

always been there. But the internet has greatly amplified our ability to compare ourselves to others and lowered barriers to indulge our immediate desires—even ones that aren't good for us. A dozen years ago Facebook didn't exist, but now it's far easier to feel inadequate when we see only highly curated versions of everyone else's lives and accomplishments. The pressure from comparison has never been greater. And now it's also easy to find solutions to every text online. In one advanced course, I've noted a decline in the number of students who come see me about the most difficult problems compared with just a few years ago. It's too easy now to avoid the path to learning that comes through struggle.

And the hardest question: did I have some culpability? I began to feel disappointed, not so much in my students as in myself. Was I inadvertently causing my students to feel that grades were paramount? What could I do differently?

According to research on academic dishonesty by Eric Anderman, an educational psychologist at Ohio State University, rates of cheating have risen over the last several years, and technology has contributed. Moreover, one of the strongest predictors of student cheating is when parents or teachers place an undue emphasis on grades. His research shows that students are less likely to cheat in situations where teachers emphasize mastery—learning for its own inherent value—over external outcomes such as grades.

Whether we realize it or not, there are subtle ways we signal the importance of grades, even if we want our students to care about mastery. For instance, whom do we praise in the classroom? Whom do we show attention to? If we show more fondness for A students than C students, we are implicitly valuing performance over mastery. And even if we are not sending such messages, students receive signals from society that grades matter, and they are prone to blowing

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those signals out of proportion. So we must take steps to actively counter the idea that grades reign supreme.

Because of this incident, which happened a few years ago, I have changed the way I teach. As part of the first assignment of the semester, I now ask students to read "The Secret to Raising Smart Kids," a short article by Carol Dweck (*Scientific American*, January 1, 2015, <http://bit.ly/dweck-mindset>). Her research shows that people who believe intelligence is fixed ("a fixed mindset") are more fearful of challenges and easily discouraged by failure than people who believe intelligence is malleable and can grow ("a growth mindset"). Students with a fixed mind-set equate talent with doing things easily. Consequently, they see struggling with problems as evidence that they do not have ability.

On the other hand, those with a growth mind-set see that setbacks are an opportunity to learn and can be

remedied by perseverance through struggle.

On the first day of class, I also present a selection of quotes that emphasize the value of struggling in mathematics. Simone Weil, best known as a French religious philosopher, also loved mathematics, and you will find her in photographs of Bourbaki along with her mathematically famous brother André Weil. She said:

Every time that a human being succeeds in making an effort of attention with the sole idea of increasing his grasp of truth, he acquires a greater aptitude for grasping it, even if its effort produces no visible fruit.

Throughout the semester, I remind my students continually that struggling is a good thing, that it's where learning happens, it's what we professors are always doing in our research, and that the struggle is the most interesting place to be. I also like to remind my students that although grades are a (just one) measure of progress, they are not a measure of promise.

And I am adapting my assessments to reflect how I value the struggle. I give partial credit to students who can show me they've thought through a strategy, even if they couldn't solve the problem. I also ask questions on exams, like this one, that show I value the process of doing mathematics:

Reflect on your overall experience in this class by describing an interesting idea that you learned, why it was interesting, and what it tells you about doing or creating mathematics.

The responses are often a joy to read. Like this:

I've learned a lot of interesting things in this class, but I think my experience is best reflected by the

article we were instructed to read for Homework 0. This article talked about how [some] think of intelligence [as fixed] so that when things get difficult, one feels helpless. . . . Until recently, I was often frustrated by math and unhappy with myself because I held a view similar to this. In the article, the alternative is to understand that learning takes effort and persistence. While this is not a great revelation to me, I feel that I have learned to better accept it this past semester. This has been an important lesson to me because I now have more confidence to continue with math. I have learned that doing and creating mathematics can depend on insight and inspiration, but is also largely dependent on putting in the effort to become good at things.

Here's another question I asked recently:

One of the luxuries of the internet era is that you can look up the answer to almost any problem you want—as long as it's been solved. Yet when you are learning a subject it can be counterproductive. In this class, I have emphasized the importance of struggling in mathematics: that it's normal and part of the process of learning, and that when you are stuck, you should just "try something." Describe an instance, so far in the course, where struggling and trying something was valuable to you.

The following response came from a former U.S. Marine who returned to finish college:


I know that learning to do something with your hands is probably the equivalent to struggling to do something academically. For example, when I was ten, I taught myself

to juggle and got really good at it. I stopped juggling once I realized it wasn't cool but 15 years later was able to shock my wife with this hidden skill and realized I could still do it. Similarly, a lot of the skills I learned in the Marines required me to perform some complicated action with my hands or body. I'm pretty sure I will always remember how to disassemble and assemble any crew-served machine gun. Similarly, shooting is something I spent years doing and I'll probably always be good at it until my body stops working.

I look at math professors effortlessly solve problems on the board even if they didn't initially remember how to do the problem. I've seen you do this at least a couple times when a student asked a good question. I think that for you math is a lot like fixing a car or putting something together without instructions. You have struggled so much that all previous experiences are burned into your brain. You simply cannot forget things that easily anymore, so because of this you are just better at math because you put in the time and hard work.

I'm hoping that I can get to that level with some subject someday.

Yes! With that perspective, I am confident he will.

Hope to see you all at MAA MathFest! 



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