

## PRODUCTIVE STRUGGLE

### Why Zombies Love ME: Shifting Mathematical Mindsets

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“I guess you are just not really a math person. That’s OK—your strengths lie more in the arts and humanities.” —My father, circa 1980 (sophomore year), in response to my C in Algebra 2.

I AM NO MATH EXPERT, and I have no math pedigree to recommend me. I am a liberal arts/humanities major. If someone had told me at the beginning of my teaching career that I would end up teaching mainly math (and loving it!), submitting an article to a math journal for publication, and having students with the top math scores in my district, I would have fallen down laughing.

Only rarely did I feel like much of a mathematician during my own schooling. Admittedly, I was what I would now call a “Betty Crocker mathematician.” I was a great little cook *if* I had the right recipes from the textbook and my instructors. Memorizing, replicating, and performing on tests was what math seemed to be about in most of my school experiences. I can almost hear you *real* math teachers and

mathematicians gasp. You are most likely wondering why you should even read on. Rest assured, I now proudly count myself among you—a confident and competent math educator. I have come to see the beauty, creativity, and connectedness of mathematics, and I strive to help my students do the same. Yet, my greatest strength as an educator, in mathematics and any subject I teach, stems more from my math journey from a fixed to a growth mindset.

Since 2013, I have overtly made it my number one mission to help my tween students understand and shift their own mindsets. It is this growth mindset journey—mine and theirs—I am excited to share with you. Never has there been such a wealth of supporting research in cognitive science to back up my long held belief, and that of so many educators, that **all students have the ability to learn in all subject areas.**

Early in my teaching career, I was keenly aware that I did not want to infect my students with my

own math fears and insecurities. I believe they can *all* succeed with effort, education, and practice. I had to come to believe the same of myself—even in math. For example, I would not say, “It’s OK that math is not your thing; it wasn’t mine either,” as so many well-meaning parents and teachers do. (Research now clearly shows what my instincts were telling me, that this kind of talk propels learners into a fixed mindset rather than soothing their anxiety, as intended.) I now had to model a positive attitude about and relationship to math if I wanted my students to believe they could succeed. I set about the task of deepening my own understanding of key math concepts and shifting my beliefs about my own math abilities—my math mindset—in order to become a better math teacher. This process involved a great deal of professional development and also collaboration with respected colleagues (and admitting when I needed help).

Every math teacher knows only too well that mathematics is a discipline with which learners often come to have an anxiety-based relationship. No matter how much we project a love for math (or fake it till we make it) and plan amazing math lessons and experiences, we still see the fear in far too many of our students’ eyes. Sadder yet is the dull look of students who have moved beyond fear to apathy, especially prevalent in upper elementary grades and middle school. During early adolescence, test scores and grades in mathematics usually show marked declines. This begs the question as to what may be done to help educators and students heed the call to greater math literacy in the 21<sup>st</sup> century.

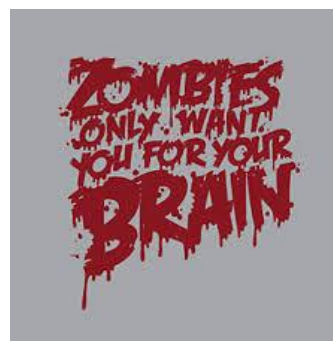
More depth, coherence, and rigor in the standards and testing, even when accompanied by major paradigm shifts in instructional approaches, are not enough. It will take more for students to become the nimble and confident “Top Chef mathematicians” these new standards and tests—and more importantly, 21<sup>st</sup> century careers—demand them to be. It is more crucial than ever for educators—especially math educators—to understand and explicitly address academic mindsets. There is no greater gift we can give a student than the knowledge and experience that she/he can learn math, and any other subject—with hard work, practice, and a growth mindset.

***“Students with no experience of examinations and tests can score at the highest levels because the most important preparation we can give students is a growth mindset, positive beliefs about their own ability, and problem-solving mathematical tools to equip them for any mathematical situation.”*** from “Aligning Assessment to Brain Science” by Jo Boaler.

I credit Professor Jo Boaler’s Stanford online course, EDU115 “How to Learn Math for Teachers and Students” which I took in 2013, with first opening my eyes to Carol Dweck’s mindset research, especially as it relates to math. In reflecting on my teaching career during this Stanford course, I experienced so many “ahas”. Looking back through the lens of mindset research, I clearly see that behind every student turnaround, every light coming back into dull eyes that often seemed so magical and mysterious, was a shift to a growth mindset.

I want each and every one of my students to experience this mindset magic at some point in our time together, whether in math, or in some other area of study or aspect of their lives. I openly and often declare to my students and their parents, from the beginning of the year to the end, that I am on a mission to shift fixed mindsets toward growth mindsets. Before I elaborate on how I go about achieving this mindset mission, let me share with you student reactions to a year of mindset lessons and messages. I am sure you noticed by this article’s title that I chose to put a pop-culture zombie spin on my mindset mission.

Let’s dig into some tween braaaaaaiins! At the end of the 2015 school year, I asked my fifth and sixth grade students to respond to this prompt (note that it does *not* mention mindset):



### **Why Zombies Love Me!**

In what academic area (this school year) have you grown and stretched your brain the most and created the most NEW synapses (neural connections – oh, ZAP!)? Write a TEEEEECC paragraph (at least 7 excellent sentences).

PROOFREAD for clarity, flow, and mechan-



ics, please.

- **Topic Sentence:** Address the prompt using key words from it.
- **Example Sentences:** How have you accomplished this? Be specific. What measure(s) could teachers, parents, and/or classmates see to show this growth?
- **Conclusion Sentence:** How do you feel about your achievement(s) in this subject area and why?

All but a few of our 67 students said math was the academic area in which they had grown and stretched their brains the most. Overwhelmingly, they credited learning about mindsets and neuroscience with their successes. The errors, grammatical, mechanical, and typos, are all theirs—as is the spirit and content. (All revision and editing is their

own and was done without the aid of word-

processing tools because

Juno assignments are designed for assessment purposes.) Enjoy these glimpses into the amazing, colorful, juicy zombili-cious brains of fifth and sixth graders following a year with growth mindset lessons and messages. I have introduced their responses with some observations and included

brief

some of their mindset brain collages.

This learner took to heart messages from number talks along with the growth mindset messages:

I have grown in math the most this year. I have grown so much because before 6th grade, I thought there was only one way to do a problem. I also thought that some people were not that much of a math person. But, now I know that there are multiple ways to solve problems. I also know now that sometimes there are multiple answers. I now know there isn't a math person or non-math person because everyone can be good at what they try hard at (practice makes permanent). I now feel that I have a growth mindset in math and I have improved a lot.

There will be no more Betty Crocker recipe math for this student—she will be a Top Chef!

The subject I feel that I have grown the most in is math. I have learned that math isn't just remembering a lot of formulas but it is actually taking time to read a problem and work your way to finding an answer. I have accomplished growing my brain in math by using a growth mindset on math. I love the idea of a growth mindset because you can put a growth mindset on anything not just that but anyone can have a growth mindset on anything. Mrs. Hammes really helped me with this and really encouraged me not to

give up and to not be afraid to make a mistake doing anything. When I put a Growth mindset on math I grew a lot and I mean a lot. With all the support Mrs. Hammes gave me throughout the year I really appreciate her. I feel that with the foundation Mrs. Hammes gave me I really do get what math is and how it math works.



This next response is from a student on an IEP who *was* apathetic about math. He shifted his mindset about two-thirds of the way into the year, and his achievement followed. It is never too late to shift a mindset. Just when you think a student has not listened to all the mindset messages, he/she may surprise you. This young man received one of nine “Growth Mindset Awards” we gave at sixth grade promotion for a 26% improvement in his overall math grade from trimester 1 to trimester 3!

I feel awesome when I get something done I feel excited. I improved on getting something done because at the beginning of the year I was not getting stuff done and I was getting frustrated and stressed and starting to go into a fixed mindset but somehow after spring break I was getting so much work done and not being frustrated and stressed and I went into a growth mindset. My prediction for next year in middle school I am

going to have a great year.

This response is from a “gifted” student—the other end of the spectrum in terms of prior achievement in math. She came in with excellent math skills, and she learned to stretch, to take risks, and to dig deeper. Like Dweck, I find that students labeled “gifted” are even more likely to have fixed mindsets than students who struggle with math anxieties and/or skills.

An academic area where I have grown and stretched my brain the most is math. I have accomplished



this by turning my fixed mindset closer to a growth mindset. Another way I have accomplished this is by becoming a little more positive. You can see me do this by looking at my survey results.

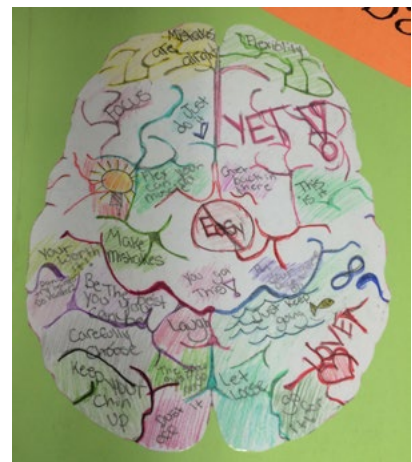
A final way to do this is by adding yet when I say I can't do something. You can hear me adding yet if I say I can't. I feel proud of my achievements in this subject area because I had a very fixed mindset about math.

Note that she is highly aware that she is not quite fully in growth mindset—yet.

This next learner has also internalized some good math strategies and our math class norms (adapted from Professor Boaler's suggested norms, available at Youcubed.org).

The academic area I have stretched my brain the most was science and math because it's where Mrs. Hammes taught us that you can grow your brain no matter what. We watched a video where people interviewed other people that said their hardest subject was math because they didn't get it but that's probably because they were older and hadn't practiced it much lately. Like Mrs. Hammes says “Practice makes permanent.” Also if you don't get things you should probably raise your hand. Also like Mrs. Hammes says “The

smart people are the ones that raise their hands.” I used to think that you were born with your smarts and you couldn't increase your smarts in any area no matter what, so when Mrs. Hammes said that my peers and I could I was totally shocked. Now that I know that I think about things differently than how I used to. Also I use one of Mrs. Hammes's methods: When you get stuck on a problem take a break and come back with fresh eyes don't go panicking and banging your head against the wall. All in all I think that my efforts have been better than earlier in the year.



I am so proud of my students, their growth mindsets, and their academic progress in math. They constantly teach me new ways of seeing the world of mathematics (and the world, in general). It is an honor to get to peek into their dynamic growing and changing brains and glean insights. I have seen firsthand how powerful a shift from a fixed to a growth mindset can be—with my own and with my students' math mindset shifts. In addition to this compelling anecdotal evidence in the students' own words, **this group of students had the top Smarter Balanced Assessment Consortium (SBAC) scores in our district last spring!**

The math scores for my two sixth grade math classes were significantly higher (over 10%) than the school site that usually has the top scores in our district—a site with higher API rankings and higher socioeconomic status. (Our fifteen fifth graders also helped raise the bar for that grade level in math.) The next highest scores were those of my friend, colleague, and math mentor, who teaches math at the aforementioned site. Her scores were also quite impressive—the second highest at our grade level and *well above* district averages (again, over 10%)—not only at our grade level, but at *every* grade level tested.





We both took the online Stanford course in 2013, and we discussed it throughout the summer. Both of us started the year with the article “You Can Grow Your Intelligence.” (available at [mindsetworks.com](http://mindsetworks.com)). Both of us piloted new Common Core aligned textbooks last year and sat on the district’s math text adoption committee. Our multiple site Professional Learning Community meets monthly, so we share a great deal, including SBAC style assessments created by members of our PLC—most often her. What was the big difference between our courses then?

My friend and colleague is an example of an educator with a growth mindset and a generous spirit. She called to tell me about the scores—excited for my students’ success, and even more excited about the potential for integrating more mindset lessons and messages into her own math classes. Remember that people with growth mindsets find inspiration in the success of others. She knew that we used common assessments and materials, and we have similar philosophies and teaching styles. **The most significant difference in our math courses last year was that I’d gone further with mindset lessons and reinforcement,** at the expense of some of the textbook lessons her students made it through.

I worried that I had not covered enough, and was thankful that it was just a baseline year for SBAC testing. During the online testing, I noticed my students were confident and they said felt well prepared. They did not stress out when confronted

with problems types they’d never seen, and even glitchy iPads did not ruffle them. Jo Boaler is so right that “the most important preparation we can give students is a growth mindset . . .”

Like my friend and mentor, I, too, am inspired by the success of others and always looking to grow and improve. I am so grateful to all the generous teachers, researchers, and companies who make mindset materials and lessons

for both educators and students so readily available. There is so much great material from which to choose!

For those of you interested in implementing your own “Mission Mindset,” I encourage you to make whatever mindset materials you use your own. You saw from the “Why Zombies Love Me” prompt, that you can put your own spin on mindset lessons in order to best connect with *your* students. I went with zombie pop culture and the “ick” factor, and my tween students ate it up. (Pun completely and unapologetically intended—6<sup>th</sup> grade humor.)

One of my students was so inspired by the mindset lessons and messages that she baked me a very special red velvet brain cake right after conferences this fall. My teammates and I ate it “zombie style.”

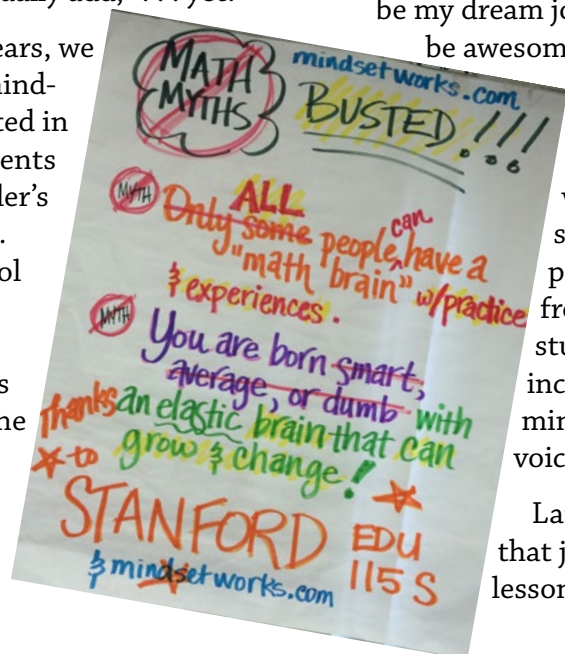
Consider teaming up with a science teacher if you teach math exclusively and having him/her present more information on brain



structure and function and neuroscience. Don't give away *all* the yummy mindset lessons though—research and experience inform us that math is definitely the subject area in which the most students have fixed mindsets, so take the time to present at least a couple lessons. My team even carries the “zombies only want you for your brains” theme out to PE and our weekly mile run. Good cardio can prevent you from becoming zombie chow *and* help you succeed in school.

I begin on day two of school with the Mindset Works article: “You Can Grow Your Intelligence.” My students first listen to the article as I read it aloud, and then complete the review activity that goes along with it as a listen and sketch. Their homework is to read the article aloud to a parent/guardian (or older sibling, in a pinch) and to do the listen and sketch activity with him/her. Thus, parents are primed and ready when Back to School Night rolls around and I share the information on mindsets and my mission. I also give parents an article about resilience that quotes Carol Dweck and discusses how to praise your child for a growth mindset along with other math support materials. This article, “The Fourth R: Resilience” is available online. (See references.) I continually reinforce growth mindset messages, especially when writing descriptive feedback on formative assessments and in daily discourse throughout the year. When I hear a student say, “I can't . . . I don't know how . . .” I pause for a couple of breaths, and they eventually add, “. . . yet.”

The last two academic years, we delved more deeply into mindsets than when I first started in 2013. I now show my students the first module of Jo Boaler's online course for students. The first lessons share Carol Dweck's mindset research and engage in math myth busting. Our “Math Myth's Busted” poster hangs on the wall all year. Students also complete the “Effective Effort Rubric” (also from Mindset Works) at the start of the year and again



at the end of the year. Eduardo Briceño's TEDxtalk “The Power of Belief—Mindset and Success” gives us a mindset booster (linked on Mindset Works, and also available on YouTube, 2012).

Students utilize a viewing guide, which I adapted from the PERTS & Khan Academy growth mindset lesson plan, and take notes. As homework, they are asked to share their notes with a parent/guardian and/or watch the talk and discuss it with him/her. Last year, I showed the video at the end of the year as a refresher. This year I showed it right before student-led conferences. Most of our students chose to watch the talk with their parents, and I received a lot of positive notes from parents on the viewing guides. My dozen returning students from our 5<sup>th</sup>/6<sup>th</sup> grade combination class remembered the video fondly and enjoyed seeing it again. They are our best growth mindset advocates. Both years, a number of parents expressed that they felt somewhat guilty over praising their kids for being smart (fixed mindset praise) and would make a shift to praising effort and hard work (growth mindset praise).

As I checked in the viewing guide work, one of my boys excitedly told me: “My mom really loved this video! Our whole family watched it, and she said she wishes *every* teacher in the district would teach about mindsets.” I must admit that I wish the same thing. I shared with him that being a traveling mindset coach for grades 5-8 in our district would be my dream job. “Yeah! That's a great idea—You'd

be awesome at that!” he responded. (I am considering asking him to write me a letter of recommendation!) Having students, and most of their parents, view this inspirational mindset message just before conferences led to powerful discussions about shifting from fixed to growth mindsets. Many students wrote trimester 2 goals that included “talking back to their fixed mindset voice with a growth mindset voice,” as Briceño suggests.

Large scale research definitively shows that just two forty-five minute mindset lessons—including teaching about neural



plasticity and the central idea that **you can grow and change your brain throughout your life**—can have a significant positive impact on math achievement for up to two years, especially among students most at risk to stereotype threat (which includes girls in math). Academic mindset interventions, praise, messages and feedback may not be a magic potion that will cure *every* student’s math woes immediately, but they are a math teacher’s best bet for maximum impact with a minimal investment of time. I hope you will join me, and educators across the country and world, on this mindset mission. Spend at least a couple of precious instructional days teaching your math students about the power and promise of mindsets. Then let your students—and their improved scores—speak for themselves!

In grades 5 and up, mindset interventions and growth mindset feedback is particularly important. This is where much of the research has shown students to be the most vulnerable to negative academic impacts from fixed mindsets. Prior to this, differences in mindset in early elementary school do not seem to have much impact on academic success. Still, it is never too early to begin with growth mindset praise and feedback, even if you do not present formal lessons.

There are now many high quality, solidly research-based resources and references available. Some great resources for mindset materials, most of which are free, include:

- Khan Academy’s Growth Mindset Lesson Plan – created in collaboration with PERTS [www.khanacademy.org](http://www.khanacademy.org)
- Mindset Works Educator Kit [www.mindset-works.com](http://www.mindset-works.com)
- PERTS – Project for Education Research that Scales [www.perts.net](http://www.perts.net)
- YouCubed at Stanford University – Professor Jo Boaler’s site that also has a wealth of math resources, articles, videos, and a link to the free “How to Learn Math for Students” online Stanford course [www.youcubed.org/think-it-up/](http://www.youcubed.org/think-it-up/)

If you are interested in further reading, the best of the myriad of resources I have explored is Jo

Boaler’s latest book: *Mathematical Mindsets: Unleashing Students’ Potential through Creative Math, Inspiring Messages and Innovative Teaching*. This book wraps up the main ideas presented in Professor Boaler’s online course beautifully in a neat little package. Admittedly, I am a huge fan of *all* her work. My edition is already well worn and dog-eared, and I’ve only had it since November. (Be sure to check out Professor Boaler’s mention of our very own CMT editor and stellar math teacher on page 19 of the book.) Here’s to being lifelong learners with growth mindsets, generous spirits, and juicy braaaaaaiins! Get infected!

(Editors note: Stephanie Hammes is a former Colorado teacher from Cañon School in Cheyenne Mountain District 12, and recently graduated with a Masters of Arts in Teaching from Colorado College.

For another example of how teachers are using pop culture to engage students in the sciences, see the Living Dead in Fact and Fiction course offering at the University of Nebraska at Kearney <http://unknews.unk.edu/2015/10/28/zombies-vampires-find-their-way-to-unk-classroom/>.)

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