

Productive Struggle: How Collaboratively Inquiring about Growth Mindset and Mathematics Led to Deeper Learning for All Involved

Abstract

This is the story of how one school used growth mindset research to foster engagement and deep learning for all students. As a result of a number of math inquiries over a two year period, students, educators, and parents explored the big ideas in math and pedagogy including: growth mindset, rich math conversations and culturally responsive pedagogy and math. These experiences extended the learning by reaching out to local and global communities. By engaging in rich learning opportunities through the lens of inquiry, students at St Sebastian increased learning and achievement in math, writing and reading.

Keywords: Mathematics, Inquiry, Culturally Responsive Pedagogy, Growth Mindset, Equity, Professional Culture

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In her 2006 book, *Mindset: The New Psychology of Success*, Carol Dweck introduces the concept of “mindset,” or the set of beliefs or way of thinking that determine your behaviour, outlook and mental attitude. Dweck distinguishes between “fixed mindset” – believing that your qualities are permanent – and “growth mindset” – believing that your qualities can change. She argues that adopting a growth mindset leads to greater success: “the view you adopt for yourself profoundly affects the way you lead your life.” (Dweck, 2007, p.6). Through her research, Dweck discovered that “students’ mindsets – how they perceive their abilities – played a key role in their motivation and achievement, and ... found that if we changed students’ mindsets we could boost achievement.”ⁱ In one of her studies, she measured students’ mindset as they entered middle school and then followed the students for two years. Students with a fixed mindset declined, while students with a growth mindset improved. In a follow-up study, when students with a fixed mindset were taught explicitly about growth mindset, their math grades improved.

With this in mind, a group of teachers and principals decided to inquire about mindset, math and transitions. Their hypothesis was that if students, teachers, principals and parents understood and explicitly taught the role of mindset and metacognition in mathematics, then improvement in student achievement in math would be on-going and lasting through high school. This is the story of one school’s journey as it collectively worked to identify and change the mindsets of all members of the community about math, and how that led to significant improvement, high engagement, and unexpected forays into deep learning.

At the beginning of the 2014 school year, Gianna Helling, principal of St. Sebastian Catholic School in downtown Toronto, gathered together her junior and intermediate teachers, including those teaching special education, to look at the Grade 6 results on the provincial curriculum-based assessment, EQAO. There had been a decline in the students’ scores in mathematics, and upon further investigation with the support of a math program resource teacher, the staff began to realize that students were not persevering through challenging problems when working independently.

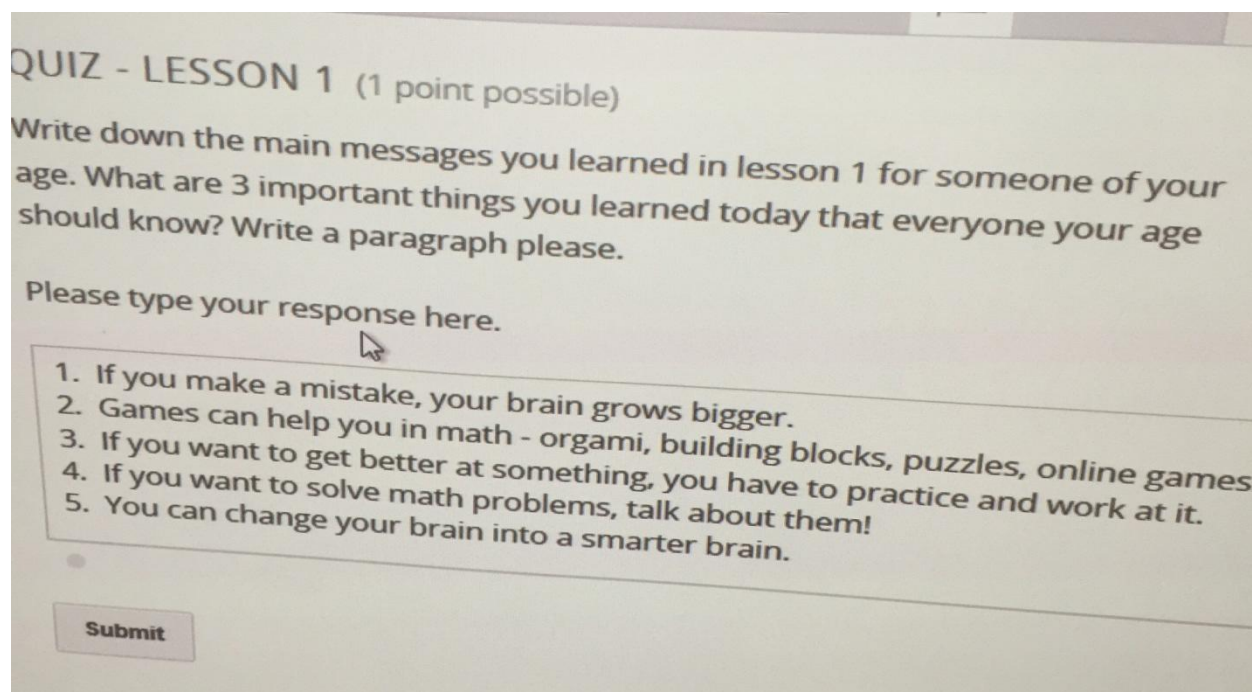
At the same time, Gianna was becoming increasingly interested in the research on growth mindset. A believer in the power of the principal as co-learner, Gianna worked with her Student Achievement Officer from the Ministry of Education, Nancy Steinhauer, to design a series of workshops for her grade 6-8 teachers on growth mindset, math and transitions. Gianna and Nancy invited other schools from both the TCDSB and TDSB, including the two local high schools, to send teams of principals and teachers as well. Over 40 people participated in three one day sessions with “work in between” that asked them to try out what they were learning at their own schools. Over the course of 6 months, the group explored the idea of teaching growth mindset explicitly in the context of a highly effective math program, and monitored the impact that was having on their students.

At St. Sebastian, the idea of growth mindset took hold. Teachers began to change the way they were talking about math. One teacher showed her students a video by Jo Boaler, professor of mathematics education at Stanford University, explaining how making mistakes grows the brain. Students began to label their mistakes with post-it notes that said, “My brain grew!” Other teachers had students create

Productive Struggle: How Collaboratively Inquiring about Growth Mindset and Mathematics Led to Deeper Learning for All Involved

personal growth mindset statements that became visual reminders on their desks. On every floor of the school, there was a bulletin board that encouraged students to change their self-talk from fixed to growth statements. For example, instead of thinking, "I made a mistake," students were encouraged to think, "Mistakes help me improve." Instead of thinking, "I can't do math," students were encouraged to think, "I'm going to train my brain in math." Instead of thinking, "It's good enough," students were encouraged to think, "Is this really my best work?" Teachers learned how to praise differently, to emphasize effort over achievement and process over product. They shared these tips with parents at every opportunity, including Gianna's prolific use of Twitter to spread the news about her school. Examples can be found at storify.com/giannahelling/developing-a-growth-mindset-to-build-engagement-fo

In the workshops, teachers were introduced to the qualities of an effective math program, and challenged to evaluate the tasks that they were giving students. They explored the concept of "grit" and "productive struggle" and dug into math content that they found challenging. They were given the opportunity to explore resources, such as Mary Cay Ricci's *Mindsets in the Classroom* (2013) and Jo Boaler's MOOC "How to Learn Math" out of Stanford University. Some teachers even had their students go to Stanford, including St. Sebastian's Special Education teacher, Katharine Piotrowski, who enrolled her class and led them through the MOOC experience. Students learned important lessons, as seen in the image below:

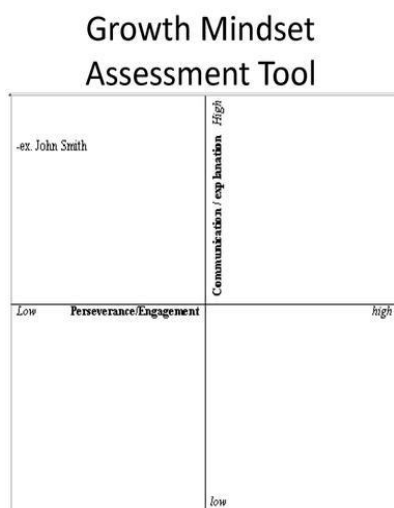


Teachers and principals responded very positively to the opportunity to learn about math and mindsets in this way. Some of their key learning included:

Productive Struggle: How Collaboratively Inquiring about Growth Mindset and Mathematics Led to Deeper Learning for All Involved

- *The importance of consolidation: Relates to growth mindset because it places the focus on the difficulties encountered in the process and how to work around them.*
- *The teacher determines the tone by providing a safe, risk-taking environment where students feel that errors are a natural part of their learning process. Process first, product second.*
- *Give them time. Listen. Mistakes are not failures.*
- *Learning comes from the struggle and challenge. (For the teacher too – never stop learning math!)*

Gianna and her teachers began to document the students' responses to their learning in a variety of ways. One tool they developed was a Growth Mindset matrix, which plotted students on two axes: perseverance/engagement vs. communication/explanation. Staff looked at ways to move students into the top right quadrant:



Teachers used this data to identify individual students who needed more prompting and direction to encourage them to persevere through struggle.

Gianna and her teachers also captured students' conversations about math problem-solving through various digital means (video, audio, blogs, and the use of apps like "Explain Everything," "Aurasma"). Students were visibly engaged in their learning, and proudly explained their thinking in confronting challenging math problems. The school began to explore how to integrate challenging math problems into their charity work. As the year progressed, teachers became more skilled at creating meaningful questions that would stretch their students' thinking. They began to wonder how they could deepen the learning by using math in meaningful ways.

At this point in our learning, an unexpected collision of ideas occurred. Nancy had been exploring the use of Culturally Responsive Pedagogy in mathematics as an approach to making math teaching more equitable. She was interested in how teaching math through a social justice lens could lead students to engage in critical thinking about issues of importance to them. Nancy was telling Gianna about a classroom she had visited in inner-city Toronto where the teacher was deliberately using culturally

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responsive practices to teach math. The school was in a high poverty neighbourhood with a large Black population. In an effort to promote achievement in a community that was largely marginalized, the teachers had deliberately chosen to approach the curriculum through a social justice lens. The intermediate special education teacher provided statistics around police carding to engage her students in the data management strand of the math curriculum. The class, which consisted mostly of Black boys, was examining the carding statistics in several major urban centres, and exploring the significance of the prominence of black men in the sample groups, then considering possible responses to this apparent injustice. St. Sebastian's work using math in their examination of charity and social action fit nicely into this approach. Both of us had recently acquired a copy of Zaretta Hammond's *Culturally Responsive Teaching & the Brain: Promoting Authentic Engagement and Rigor Among Culturally and Linguistically Diverse Students* (2015) and were excited by the direct link Hammond made between Culturally Responsive Pedagogy and Mindset. We began to wonder if we could pull these two ideas together and explore them with other interested educators.

In April, 2015 we designed a mini-inquiry for teachers at St. Sebastian who were interested in exploring the links between Culturally Responsive Teaching and mathematics. As the first workshop approached, we became increasingly excited about the work we were planning to do, and opened it up to more schools. We ended up exploring the idea of Culturally Responsive Pedagogy and Teaching Math for Social Justice with about 15 teachers and principals from schools in both the TCDSB and TDSB. After an introduction to Culturally Responsive Pedagogy, we looked at samples of lessons that taught math through a social justice lens and began to design our own. After a month, we gathered back together to share our learning. We were amazed at what the students had been able to do.

For example, in Kathleen Keenan's class at St. Sebastian's, the Grade 1 and 2 students had examined a map of the world, and compared population distribution to wealth distribution. Their reflections on poverty and inequity in the world led them to invest in a micro-loan through the charitable organization, Kiva. As part of this process, they discussed what criteria they should use in choosing a micro-loan to support, and read through descriptions of people who had applied online.

In Mary Ginocchi and Irena Albinowski's Grade 7 & 8 classes, students had focused on local economic realities and had explored the growing gap of income between Toronto's richest and poorest citizens. In response to their investigation, they created a budget based on the funds that a low-income person would have access to, which raised their awareness about food scarcity in the local community. They also looked at the Ontario policy about minimum wage for temporary and permanent employees, as well as daycare policies and fees and brainstormed possible recommendations for our provincial government.

When we gathered together again at the end of April, teachers were invigorated by the experience and wanted to continue this exploration. We agreed on a hash tag to continue our learning (#tm4sj) and began to ponder continuing this inquiry in the 2015-2016 school year. We are currently planning our first get-together with 5 schools from the TCDSB and 5 from the TDSB to explore Culturally Responsive

Productive Struggle: How Collaboratively Inquiring about Growth Mindset and Mathematics Led to Deeper Learning for All Involved

Pedagogy in Mathematics in a deeper, more extended way. Examples of the original inquiry can be found at storify.com/TorontoTeamCRRP/teaching-math-for-social-justice-tm4sj

At the beginning of the 2015-2016 school year, Gianna and her team decided they were ready for a full school effort to incorporate growth mindset into their math program. Using resources from Jo Boaler's website, www.youcubed.org, the school decided to embark on a "Week of Inspirational Math." Every student from Kindergarten to Grade 8 learned about growth mindset, the brain, and engaged in rich math tasks – problems that Boaler calls "low floor, high ceiling" tasks. At the end of September, the Student Council led an assembly on growth mindset, which included a video of students explaining the importance of mistakes. Growth mindset has become the framework for the 2015-2016 school year. To see the Week of Inspirational Math at St. Sebastian please follow the link storify.com/giannahelling/week-of-inspirational-math.

What started as a simple inquiry into EQAO data evolved into a multi-faceted exploration of the big ideas of math and pedagogy. By posing interesting questions, celebrating the search for answers, and giving permission to explore mathematics in meaningful and innovative ways, St. Sebastian was able to provide transformative learning experiences – not only for its students, but for its staff and parents as well. Certainly the use of technology facilitated some of this exploration, but it was not technology itself that created the innovation; through technology we were able to document and reflect on our learning in new ways – ways that extended the learning by reaching out to the local and global communities. And did it work? Yes it worked. Student achievement in mathematics at St. Sebastian CS is on the rise. An unconventional approach led St. Sebastian's students to conventional success. More importantly, the students, staff, and parents at St. Sebastian love math; they can't get enough of it. And that is the biggest sign of success of all.

ⁱⁱ Dweck, C. September 22, 2015. Carol Dweck Revisits the "Growth Mindset" retrieved from <http://www.edweek.org/ew/articles/2015/09/23/carol-dweck-revisits-the-growthmindset.html?cmp=eml-enl-eu-news2-RM>, October 19, 2015.

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