CHARACTERISTICS
OF A GREAT STEM PROGRAM

Think Through Math

5 Characteristics of a Great STEM Program

Think Through Math

ONE: PRODUCTIVE STRUGGLE

Allow for multiple correct solutions and reframe failure as a necessary part of learning.

Due to the poor math experiences that so many students have had to endure, we find that most have a negative or even a "fixed" mindset toward mathematics. They fear failure and are less likely to take risks. Everything in TTM is engineered to help students develop their math "muscle" and a positive "mathitude." By adopting a growth mindset, students who previously struggled learn they overcome setbacks and excel. As a learning system that provides productive feedback at every step, TTM and its live teachers use mistakes or incorrect answers as teachable moments.

The result is that students learn that, with patience and effort, one of the cool things about math is actually the struggle and grit it requires!

See Boaler, J. (2013). Ability and mathematics: The Mindset revolution that is reshaping mathematics. Forum, 55(1), 143-151. Also see Dockterman, D. (2013). Three ways to foster productive failure. ASCD Express, 9(4). Also see Dweck, C. (2006). Mindset: The new psychology of success. New York: Ballentine Books.

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TWO: RELEVANCE

Focus on real-world issues and problems.

Think Through Math helps educators lay the groundwork for creating minds that will eventually tackle the world's problems. It does this by connecting persistence to results.

For starters, TTM helps students become aware of important real-world issues – social, economic, environmental – and provides an outlet to think more deeply about issues and make strategic donations. As students accrue points for doing math, they can decide how to use their points. Though they can use points to customize their avatar and compete in special contests, they may also donate points to select charities. TTM will turn their points into real financial donations. So far this school year, TTM students have donated $80,000 to charity.

Secondly – and with a much narrower focus – TTM's contextually-based problems are always meaningful, pragmatic, and purposeful. Students interact with problems worth solving. Not only is every item in TTM thoughtfully constructed (no auto generation), they always ensure that contexts, when used, are relevant to students. We strive to create contexts in which using the mathematics makes the problem easier to solve. TTM helps students learn that math is a useful tool, not mere exercise that must be completed.

At TTM, relevance means more engaging, more motivation to persevere, more opportunities for sense-making because there is something to connect it to in the web of knowledge.

TTM also designs problems that are appropriately challenging for students to go further into a contextualized understanding of mathematics which builds a solid foundation for kids to genuinely explore STEM concepts and career connections.

See Robinson, L.P. (2010). Who cares? Using real-world perspectives to engage learners. Reaching every learner: Differentiating instruction in theory and practice. LEARN NC. Also see O'Leary, Z. (2005). Researching real-world Problems: a guide to methods of inquiry. London: Sage Publications.

Think Through Math

THREE: PROBLEM SOLVING

Takes students from identifying a problem—or a design challenge—to creating and developing a solution.

Research shows students with robust problem solving skills are more prepared for college and career. Not only does problem solving flexibility form a strong foundation for mathematical development, it produces positive attitudes towards mathematics, fosters creativity and encourages cooperative skills.

Think Through Math provides authentic problems in meaningful contexts and provides a special focus on teaching students to navigate through complex problems with research based strategies – analyze, plan, solve, justify, evaluate. As students utilize the program, they develop "habits of mind" and think more deeply about mathematics rather than just doing math for a short period of time or to accomplish a short term outcome such as passing a test. TTM helps students make sense of complex problems and persevere in solving them. This often means taking different approaches, making mistakes, learning from mistakes, and trying again.

See Jonassen, D. H., (1997). Instructional design models for well-structured and ill structured problem-solving learning outcomes. Educational Technology Research and Development, 45, 65-90. Also see Lyle, K. S. & Robinson, W. R., (2001). Teaching science problem solving: An overview of experimental work. Journal of Chemical Education, 78, 1162-1163

FOUR: TEAMWORK

Involve students in productive teamwork.

A critical STEM skill that is required by the 21st Century workplace is for workers to possess a high level of understanding around collaboration. Helping students work together as a productive team is never an easy job. It becomes exponentially easier if all STEM teachers at a school work together to implement teamwork, using the same language, procedures, and expectations for students.

One of the powerful elements of a Think Through Math school or district is how the program can support the transformation of its math culture. Here's how it works: TTM has a unique system that allows students to translate their hard-earned points into charitable contributions. But students also are encouraged to participate in a series of fun, short-term contests (one to four weeks) that target a wide range of relevant and engaging themes– State Math Showdowns, I Heart Math, March Math Madness, and many others. Educators are able to leverage district, school, class goals or allow students to compete as individuals. The powerful peer-to-peer collaboration process combined with teacher leadership has proven to be a significant driver for students to make a strong effort both in class and outside of school.

See Ciston, S. (2014). Building teamwork process skills in students. Center for Teaching and Learning. University of California Berkeley. Also see McQuerrey, L. (2013). Why is teamwork important in the classroom? The Journal of Effective Teaching: Guiding Collaborative Teamwork In The Classroom.

Think Through Math

FIVE: RIGOR

Apply rigorous math.

According to the most recent research, focus and coherence are meant to fuel greater achievement in a deep and rigorous curriculum – one in which students acquire conceptual understanding, procedural skill and fluency, and the ability to apply mathematics in order to solve problems. To help students meet the expectations of the rigorous standards, TTM pursues, with equal intensity, each of these aspects of rigor in the major work of each grade. The word "rigor" isn't a code word for just one of these three; rather, it means equal intensity in all three.

As a rigorous curriculum, TTM delivers this, and particularly important, does an outstanding job of developing conceptual bases for mathematical work. TTM provides rigorous instruction and meaningful practice and also embeds opportunities for students to demonstrate their understanding and extend their learning. Best of all, as students work on adaptive pathways, they learn that math is a system that makes sense.

See Nussbaum, P. D. (2009). Brain health and wellness. Tarentum, PA: Word Association Publishers. Also see Kemple, J. and Scott-Clayton, J. (2008). Career academies: impacts on labor market outcomes and educational attainment. New York: MDRC.

THE CHALLENGE

United States Ranks 27th in math internationally.

Our Students

- **60%** grade 3-8 students "Below Proficient"
- **56%** high school students "not ready" for college math
- **50%** post-secondary students take "remedial" math coursework

Our Teachers

- **59%** of public elementary school teachers only took one math course to receive teaching credentials
- **36%** of public middle school math teachers either did not major in the subject in college and/or are not certified to teach it

Workforce projections

- By 2018, **63%** of all US jobs will require a post-secondary education
- By 2018, US projects to have 3M "skilled worker" jobs unfilled

Source: NMSI – STEM Education Statistics