



## The Pillars of Math Teaching

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Effective teaching requires the ability to communicate effectively. George Bernard Shaw stated that “[t]he single biggest problem in communication is the illusion it happened”. Ultimately, communication is at the heart of learning, and teaching mathematics requires the ability to communicate effectively. In his TEDx talk entitled *5 Principles of Extraordinary Math Teaching*, Dan Finkel describes mathematical best-practices as the following: 1. Ask questions; 2. Let students struggle; 3. Say ‘yes’; 4. Don’t be the answer key; 5. Explore. These five ideas contribute to the ability of being able to communicate effectively.

Firstly, motivational teachers ask questions and encourage students to follow suit. Launch your lessons with questions and allow students to formulate their own. Later, you can incorporate their questions to guide classroom discussions. Remember, not all questions need answers. More importantly, students must learn to ‘think’ creatively and out-of-the-box; this begins by considering questions as empowering, rather than a sign of ignorance. Moreover, good questions are exciting and keep the classroom active, engaged, and full of surprises.

Secondly, empowering educators allow students to struggle. Students learn by grappling with mental obstacles and overcoming them. When you interfere to solve problems, students don’t learn. This is not to say you should not be involved in their speculative/learning processes. However, you must differentiate between being ‘productively stuck’ (i.e., unable to answer the question but still making progress),

and being ‘unproductively stuck’ (i.e., giving in to despair). Productively stuck students need encouragement, while unproductively stuck students need help scaffolding the problem by rephrasing the question. For both, time is critical: prioritize giving students the time to let their curiosity flourish.

Third, an emboldening instructor says, “yes” to students’ ideas. Doing math requires making connections between distinct concepts, translating knowledge into new contexts, and making intellectual leaps into unexplored territory. These are the hallmarks of creative thinking. However, when that effort is received with negativity, it demoralizes. You should not disallow the exciting process of student conceptualization. Rather, allow your students to come up with ideas and follow them, even down rabbit holes, to see what they can discover.

Fourth, impactful tutors understand that they are not the answer key. Most students will avoid hard work if they suspect that there is an easier way. Often this is an efficient strategy for handling a complex world with an abundance of information. However, by always providing answers, students can be discouraged from developing higher levels of cognitive curiosity. Rather, the teacher should be an orchestrator, setting up learning opportunities, where students take ownership of their knowledge through grit. Instead of showcasing your own knowledge, encourage students to reference their own understanding of the mathematical problem. If they don’t have the conceptual models at hand, help them build what they need.

Lastly, great teaching involves exploration. The educator is in many ways a master storyteller who guides students through a shared journey of discovery. One must encourage student participation, say, “yes” to their ideas, but, also, be careful not to disallow their struggle or readily provide answers. Instead, encourage students to test out their ideas for themselves. Say “yes” to their creative act and respond, “I don’t know; let’s find out together”.

