"Math Class" vs. "Mathematics"

by David Nash

Many students today unknowingly believe that *Math class* is about turning human beings into computers. They believe that the goal of each class is to make them memorize isolated algorithms that can be used to "solve" specific types of problems. They've "learned" if they can correctly recall and apply those algorithms when told what type of problem they have been tasked with. Hence, their mathematical skill is directly proportional to their memory rather than their understanding.

This sort of consistent (and blind) application of steps is exactly what we expect computers to be good at (and they are!) We can give a working computer an algorithm and *know* that the computer will faithfully carry out our instructions as long as we did a good job carefully describing them. Unfortunately, human beings are not nearly so consistent. For one, we make errors – as an exercise, try adding one thousand pairs of double digit integers and see how you do. We also have less than perfect memories, as many students discover when they sit down for an exam (not just math exams either!). In fact, **computers** were created with the expressed purpose of taking the job of "computation" away from us.

Thankfully we live in a technological age where no one has to have "computer" as a job title. So why should we want to turn human beings into computers? More importantly, why do students believe that mathematicians are, in the broadest sense of the word, computers and that mathematics is equivalent to computation? Can we change this perception? If so, how? If you stop and reflect for a moment, its no wonder that so many students dislike mathematics. When they believe that it is an exercise in memorization and following orders it sounds pretty dull and boring. Furthermore, as we discussed above, many of them are just downright bad at doing those things. So why should they want to waste time failing at something boring?

Of course, there are many ways that we can try to directly improve student performance and, honestly, for some students, just doing better will increase their enjoyment of *Math class*. (Does it increase their enjoyment of mathematics?) This approach does not, however, address student misconceptions about what mathematics really is. Not only that, but I for one (and I hope you agree with me), do not want students to "like" math simply because they've trained themselves to be better computers. I would rather do a better job selling *Mathematics* in its true form. My hope is that when students understand what math is really about they will find it an interesting, frequently useful, often beautiful subject.

So what is the right sales pitch to make? The best I've come up with (but I would love to hear others) is to sell *Mathematics* as a mindset. It is a discipline that is all about solving problems, understanding complicated ideas, and being able to find patterns and connections between seemingly unrelated topics. Mathematics is all about patterns and generalization. Understanding that, from the right point of view, a whole bunch of specific questions really boil down to answering the same more general one. That is the power of mathematics: to be able to study numerous examples and

extract the important features for each example as well as those shared by them all. It allows us to realize that a question we would like to answer is just like a different one we already know how to.

Not only that, but with the right definition of *Mathematics*, suddenly human beings become interesting participants. We may make terrible computers, but we are amazingly good at recognizing patterns and drawing connections. It started as a survival trait that allowed us to decipher complicated arrangements of grasses, plants, trees, and lighting to determine whether there were also predators lurking somewhere within. In fact, human beings are so hard-wired for recognizing patterns, that we occasionally even "see" them when they aren't really there (e.g. clouds that look like things). Moreover, finding patterns is still something that computers are not very good at, although admittedly they are getting better.

What we really want our students to be good at is pattern recognition, abstraction, and problem solving. These traits are immensely useful outside of mathematical fields as well. Even if students do not enjoy the abstraction and generalization that occurs in mathematics (because some certainly won't), they will hopefully at least appreciate the applicability of those skills. They allow us to come up with new, often more efficient, solutions to real-world problems. What students will then need to understand is that, although human beings are generally good at pattern recognition, finding **useful** patterns requires deep understanding. We need to understand many different types of questions, and approaches to them, in order to distill what they have in common or what is truly important about each situation. The greater the variety of topics we understand, the easier it is to draw connections between seemingly distant ones and the more powerful our generalizations become.

Once the correct definition of *Mathematics* is accepted and understood, I believe that more students will find that they do actually enjoy mathematics (and find it useful as well). With luck, the correct definition will also help teachers improve *Math class*. These two changes will, in turn, give students the right approach to studying and learning math, which will improve their mathematical abilities. Those abilities will help them decipher and solve problems in whatever careers they eventually choose. So now – assuming that I have convinced you – we need to do a better job selling *Mathematics* as a mindset. Who will be our salesmen and where do we send them first?