

# Improving the Teaching and Learning of Mathematics

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Everyone knows that something is wrong with the present system of mathematics education. Each year the average grade for the state exam is declining. Last year it was about 35%. Pitiful. There are many known suggestions to help remedy the situation. One side says, “we need higher standards.” The educators say, “we need more resources.” Most of the opinions are wrong. The only people who understand what is going on are the ones most often blamed: the students. In their opinion, “math class is boring and useless,” and they are right.

Mathematics is *the* science. One might even consider it the antitheses of art. Right? Well, not really. The first thing to understand is that mathematics is an art. The only difference between math and the other arts, such as writing and painting, is that our culture does not recognize it as such. Everyone understands that musicians produce works of art, and are expressing themselves in sound. So what is the barrier that keeps the society from recognizing mathematics as working artists? Part of it is ignorance. Nobody has the slightest idea what it is that mathematicians do. But that is not even the worst part. What is far worse is that they think they do know what math is about. They see maths as a tool for scientists and technology, that it is somehow useful to society. So if mathematicians do not just multiply large numbers or calculate the areas of triangles, then what do they do? Who else is to describe what a mathematician is than a *real* mathematician? In the words of G. H. Hardy:

A mathematician, like a painter or poet, is a maker  
of patterns. If his patterns are more permanent than  
theirs, it is because they are made with *ideas*.

(A Mathematician’s apology)

The next question that logically arises is about the nature of the ideas and patterns involved. Are they something grand concerning culture? Mostly not. The governing principle in mathematics is that *simplicity is beautiful*. The simplest things are imaginary. No real world square is perfect. There will always be limitations on the precision we can measure something, even without considering the fact that real objects are everchanging as their atoms move. The mathematicians square is perfect because he wants it that way. That is the whole aesthetic of mathematics; there are no ugly considerations of real-world details. So mathematicians get to imagine whatever they want and ask questions about them. How does one answer these questions? After all the object of interest does not even exist! Here is where it differs from science. There are no experiments to be run to tell the truth about a fictitious object in our imagination. The only way to get the truth is to use our imaginations, and that is hard work.

“The main problem with school mathematics is that there are no *problems*,” is the way that Paul Lockhart describes maths education in his essay (now expanded to a book) *A Mathematician’s Lament*.

A teacher gives their students a formula to memorize and asks them to “apply” it over and over in the exercises. The whole thrill is gone. There is no discovery, even the frustration that one feels in the creative act. So to supplement this lack of excitement, the teachers try to make math interesting. But that is not necessary! Math is more interesting than anyone can handle. The whole reason it is fun is because of its irrelevance to our lives. There is nothing wrong with facts, but that should not be the main goal. What matters are the ideas behind these facts. As discussed earlier, they do not appear from thin air; they were discovered. To drive this point home, Lockhart again gives a great analogy, “It is like *saying* that Michelangelo created a beautiful sculpture, without letting me *see* it. How am I supposed to be inspired by that?” But the situation is actually worse. Here it is understood that there *is* a sculpture to be appreciated. When only facts are given the complete story is omitted and the existence of the beauty or idea behind the mathematical fact is left uncertain. Mathematics, in a way, could also be categorized as the art of explanation.

The correct problem to give a student is one which he does not know how to solve. Of course it also has to be within his grasp for the problem to be fruitful. This is where a teacher steps in. He is the one who can evaluate the difficulty of a problem. The teacher can guide the student in the right direction, if the situation calls for it, but it should never be rushed! Art, and in turn mathematics, is not a race. The problem arises from the fact that mathematics is hard creative work. It is a slow, contemplative process. To really practice mathematics the student should struggle. The teacher should step in only when the student is desperate.

The sad truth is that all of this is virtually impossible. Even if it were, not many would want such a personal connection with their students. Not to mention the amount of work that needs to be put in such a responsible task. It is a lot easier to be a passive tape-recorder that just follows a given set of instructions from a standard textbook. What this achieves is just a trained monkey that can reiterate the solution to an already solved problem. It’s a sad way to learn mathematics. As Lockhart puts it, “It is simply the path of least resistance.”

The current education reform is proof that something is rotting. The key here is to finally give up on trying to save the Titanic. It is a lost cause. By making the curriculum “relatable” and “important”, the whole spirit of mathematics is killed. One must accept the fact that mathematics is a form of art and should be treated as such. Since Babylonian times math has existed purely for pleasure. So the resolution to improve maths education is to actually teach mathematics.