

Science Outreach: Too little, too late

[\(audio link\)](#)

Presentation given by Eric Mazur at the 10th Science and Technology in Society Forum in Kyoto, Japan on 7 October 2013

I don't like reviewing education books.

But I also have a problem saying 'no,' so when a friend of mine, Alan November, asked me to review his latest book — "Who Owns the Learning?" — I said 'yes.'

The manuscript flew with me in my briefcase all over the world, from one continent to the other. I used every excuse to avoid reading it but when I had run completely out of other things to do, I picked up the manuscript. The first sentence hooked me right away. It said:

Have you ever experienced something that made you re-think the very essence of something you believed to be true? I couldn't stop reading.

Alan recalls a time when he was a high school teacher in Lexington, Massachusetts in the eighties. He was in charge of the computer classroom, which in those days was a complete novelty. On a Sunday morning at 7 a.m., he received a phone call from the Lexington police department. Somebody had broken in, in the computer classroom. He got dressed, drove to the high school. Looked at the high school from the outside; no windows were broken. He went inside; the door of the computer classroom had not been forced open. None of the computers in the classroom were missing.

There was just one strange thing. There was a student sitting at one of the computers. So he walked up to that student and said "Gary what are you doing here?" Gary looked up at him and said "I want to learn how to program the computer". That's when he realized that when somebody wants to learn something, they'll do *anything*, even break the law and break in.

Anybody who has dealt with small children has undoubtedly noticed that they're born — we all are born — little scientists with an innate curiosity about the world around us, constantly asking "Why?" and wondering about things that occur around us. Contrast that with my personal experience as a scientist. When I go to a party and I tell people that I'm a physicist I get these worried looks. "*Physics! I had such a hard time with physics in high school or in college.*"

We live in a society dominated by technology, and so we have a moral obligation to educate the general public about science. Unfortunately, I think science education is mostly aimed at generating the next generation of scientists, not at educating the general public. Even though I'm personally involved with science outreach — I frequently lecture at the Museum of Science in Boston — I'd like to make the bold statement: science outreach is too little, too late.

In most developed countries, nearly the entire population is exposed to science education, either in secondary or post secondary education, and often with abysmal effects. Rather than fueling the innate curiosity of the human mind, it turns it off and often for good.

So we really need to ponder why things are going so wrong in our approach to science teaching.

Those of you who have followed my career know that I've devoted a good part of my career to changing the approach to teaching. But recently I came to the realization that in all these years I overlooked another important part of the puzzle.

Ed Crawley made the point yesterday that he didn't know if we could teach creativity and innovation. What he *did* know was that we do a very good job at teaching people *not* to be creative. He didn't offer a reason for that; I'd like to do so.

It all became clear to me on another flight. (Clearly taking flights has a good effect on me.) I was taking a flight to Buenos Aires to give a lecture there and as I sat down next to me sat a young woman who told me that she had just obtained her degree from the University of Chicago. She told me she was working for a cloud-based education company. I had just founded my own cloud-based education company so I thought I ought to find out what she was doing. It turned out that her company was making Apps for smart phones that were sort of electronic flashcards — cards that have questions on one side and answers on the other. Now I don't believe in memorization, certainly not in science, so I had trouble not rolling my eyes. I managed not to roll my eyes, but I had just attended a talk at Harvard given by Roddy Roedinger, a famous psychologist of Washington University in St. Louis. He had explained in this lecture that he had found that when people study with flashcards they only remember 35% if you test them a week later. And another week later almost all is gone. So I thought this is important — I should show her that.

I had the paper by Roedinger on my iPad, so I quickly grabbed it and gave her the iPad with the article on the screen. She looked at it for no more than 10 seconds and then handed me back my iPad. She looked straight into my eyes and said "*But we only guarantee that they will pass the test.*"

I had never thought about it that way. Her remark made me realize that most students do not study to learn, they study to pass the test! So the assessment is in a sense the silent killer of scientific curiosity because it drives students to study in order to pass the test, not to learn. In an ideal world, of course, those two things would be the same, but we don't live in an ideal world, and as we know many people end up passing tests but not succeeding in life.

So science outreach is fine and important but we need to realize that it is a failure of science education that causes the need for science outreach in the first place. The goal of science outreach should be continued fueling of the curiosity of the mind not the reawakening of it. And I think in order to achieve that we need to re-think our approach to teaching and above all our approach to assessment in science.