The past years have witnessed the apparition of one of the largest educational revolutions of our time: many prognosticators trumpet how MOOCs and flipped classroom models are one of the most promising educational approaches of the last century. From every walk of life, individuals ranging from politicians to teachers to venture capitalists seem to be thrilled by the new doors opened by these innovations.

Paradoxically, those so-called “innovations” are incorporating none of the educational research produced over the past decades.

Educational researchers and National Academy Reports have argued for years that students aren’t simply vessels waiting to be filled with knowledge. Students construct their view of the world using their prior knowledge, they actively integrate new information with their existing cognitive structures and they think critically about the content taught when given opportunities to do so.

In numerous controlled and rigorous experiments, educational researchers have described how “tell-and-practice” classroom instructions are well-suited for supporting memorization of facts and procedures but prevent students from developing critical thinking and transferring their knowledge to new situations. MOOCs and flipped classrooms are merely recreating the same pedagogical structure without questioning the scientific validity of this model.

The alternative is to put the “practice” in front of the “tell”. Learning scientists call this movement “Constructivism” because it emphasizes the fact that students build new knowledge in ways integrated with their existing cognitive structures.

This approach is notoriously difficult to implement. This is not about throwing students in a room and letting them figure things out by themselves. It takes time to carefully engineer good exploratory activities for learners. The pay-off, however, is worth the effort. According to educational researchers, students develop higher critical thinking skills and have a better conceptual understanding of an idea when they let them figure things out by themselves. It takes time to carefully engineer good exploratory activities.

Our lab at Stanford supports this approach by developing technology-enhanced manipulatives and creating spaces in K-12 schools for creative exploration of science and engineering disciplines. We build “tangible interfaces” (i.e., physical objects augmented with virtual information) that support students’ explorations of a domain. Think of this approach like Lego kits on steroids, augmented with digital information that can be projected on them.

One of these systems, BrainExplorer, is an interactive tabletop learning environment that simulates how the human brain processes visual images. It features polymer reproductions of different regions of the brain and two eyeballs, spread across the interactive surface of the table and networked by infrared light and cameras. Students then use an infrared pen to manipulate and explore the neural network. By severing and reconfiguring the connections, students can see how perceptions of the visual field are transformed.

In a controlled study conducted in our lab, we found that, compared to traditional text learning, performance increased significantly with the use of these tangible, interactive tools. We found a 25 percent increase in performance when open-ended exploration came before text study rather than after it. Our results show that the participants who used BrainExplorer better remembered the terminology of the
domain, scored higher on conceptual questions and were better able to transfer their understanding of the brain to new situations.

In addition to these published findings, we have been presenting follow-up studies at various academic conferences in which we use video instead of text and test different content topics other than neuroscience, such as mathematics and science. The results are always the same. The study buttresses what many educational researchers and cognitive scientists have been asserting for many years: the “exploration first” model is a better way to learn. You cannot have the answers before you think of the questions.

These findings flip the “flipped classroom” model – in which students first watch videos or read and then do projects in the classroom – on its head. Our results suggest both that students are better prepared to understand and appreciate the elegance of a theory or a principle when exploring the domain by themselves first and that new technologies, tangible toolkits and interfaces, in particular, are especially well-suited for that purpose.

With this series of studies, we are showing that research in education is useful and important because sometimes our intuitions about what works are simply dead wrong. The flipped classroom goes in the right direction: we need less lecturing and more exploration. However, by failing to pay attention to the research, we were applying what is possibly a good idea in the wrong way. That’s why research in education is crucially important to improve our schools. Intuitions are good, but science is better.

- Bertrand Schneider, Paulo Blikstein, Roy Pea

Bertrand Schneider is a doctoral student at the Graduate School of Education and a master’s student in computer science.

Paulo Blikstein is an assistant professor of education and, by courtesy, of computer science.

Roy Pea is a professor of education and, by courtesy, of computer science.

Tagged with: EDUCATION FLIPPED CLASSROOM INNOVATION MOOC TECHNOLOGY

Unlikely a debt, gratefulness isn’t beholden to any particular institution – whether it be a person, school or state. Therefore, for my Senior Gift, I donated to the CCSF scholarship fund. Its students deserve it more than we do.

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And that just may be the reason why. What works in real life and what people actually want is not the same as that conjured up in the ivory tower of ideal model students.

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> opportunities to do so.

Right. Educational researchers and the National Academy have been bastions of the left for years too — no wonder that their output is full of self-enabling, politically correct feel-good stuff. Sorry, but in the real world the idea that students will figure out the solutions themselves is a fantasy. Research is hard. Discovery is slow. Most students do not have the time and many do not have the talent to succeed without direction.

I have always felt (I know that ‘felt’ is substantially less rigorous than performing and analyzing studies) that often we don’t need technology or anything fancy to improve learning. Just teach kids how to study: 1. Read the chapter before class, and do some assigned review exercises. 2. Go to class, listen, and ask questions. 3. Go home and reread the chapter and do the hard and synthesis exercises. 4. Seek help for whatever you can’t do at office hours.

Indeed, here I want to go on a slight tangent and argue (again, without any specialized knowledge or experience; I’m just flapping my fingers here) that the idea that we need expensive electronic, device-oriented (e.g., electronic tables and “Legos kits on steroids”) learning environments to support effective learning is profoundly pessimistic. That would suggest that students in resource-rich environments will increase their knowledge gap over those in resource-poor environments at a time when we need that gap to decrease (by lifting the bottom up, of course). I don’t believe it. I think reading decent textbooks (even if they are decades old), solving problems, and learning from those who have mastered a subject, combined with a student’s desire to learn and strong willingness to work, are all that is needed, and these latter resources are far more widely available than are specialized electronic ones.

IMHO, YOU are correct! Thomas’s “Calculus” hasn’t changed since 1978. Calculus hasn’t changed (it pre-dated Thomas ;o) It is absurd to suggest that a customized, probably over-priced Microsoft Surface be used to teach kindergarten through 12th grade students about neuroscience. That’s what this article emphasized. Mathematics and science were acknowledged, as an afterthought. After Jonah Lehrer’s neuroscience deception, I suspect that neurologists, psychiatrists and brain surgeons are the only genuine neuroscientists!

For the authors of this post: You (three) shouldn’t waste your valuable time with Stanford’s department of computer science “by courtesy”. You are bona fide professors (and a doctoral student) in the department of education! You contribute much more than the plethora of mobile payment start-up’s and social media tools that are Stanford CS’s recent output e.g. Clinkle. Your expertise as educators is important, especially now. I truly wish society and capital markets valued you more highly, in status and compensation.
learning, gametization, and embedded remedial education.

edward m lenert · 11 months ago
Nice essay. But ... I'll go with, "Science is better when you can measure."
It is very difficult to measure 'learning' ... and 'science' in the sense of rigorous quantification of inputs and outputs is not always the best way to assess constructivist learning.

know nothing too · a year ago
Why Flipped, Flipped Classroom?