How to Not Teach Physics

by Denis Rancourt / January 2nd, 2013

No one learns physics from being taught physics. Therefore, the best way to teach physics is to not teach physics.

It took me twenty years of teaching university physics to finally learn this about teaching physics.

I would kill myself trying to explain the concepts, patiently and step by step, repeating and re-casting, and on and on. I would grasp any sign as a proof that my efforts were being rewarded. I would read books about teaching and about interesting demonstrations, and go through all the stages of improving my method.

But, in the end, there was a final exam, which I had painstakingly tried to make as clear and as graded in difficulty as possible, to allow all to answer to some degree. And then I would look at the examination papers for hours, for days, for weeks, looking for evidence that someone had understood something or could communicate some idea that showed something about physics…

Or even just show me that they had understood my question. I told my students that if they could explain the question, explain what it was about, something about the conceptual context, then they would pass.

And, well, year after year, I found that no one learned anything from my courses. The few exceptions who did well on the final examination would have done equally well, in terms of understanding and reasoning, on the first day of class, and learned what they learned from engaging on their own terms with the subject, not from my classroom presentations and antics.

And half-way through I found that there was a whole research area called “physics education research” (PER) which proved that the students really do not learn anything, no matter what traditional methods are used. And the PER researchers tried to refine methods that were expected to work better. So I tried several of these. But I found that there were no improved results, not really.

I still had a sense that students were not getting it, not understanding the concepts, and not caring about the ideas. Even if I trained them to describe the concepts with proper words and alerted them to the importance of understanding the concepts, still nothing. Even if they got better at answering multiple-choice problems, still nothing really. Even if they could do the math to get good answers by practicing a lot with similar problems. Most who could, could do all this without ever really learning anything.

I mean, how many students sit down and figure things out? And which method catalyses such behaviour? How does reasoning develop in a life of artificial stimuli?

So I thought: “They don’t learn from being taught. That’s the mega-lie. So let me try not teaching. I mean really not teaching. Go in the other direction to let the learning do the walking…”

It’s frightening when you first think of it because you might not know all the material you are not going to teach. You can’t even predict what material you don’t know that you are going to have to not teach. Frightening.

But I was so tired of living the lie that I decided to swallow my fear and boldly move forward. And this is what I did in my introductory university physics course, winter 2007. Little did I know, it was going to be the last time I would be allowed the privilege of “teaching” first-year physics students.

I told the students to close their books and not read them, unless they thought they might find something of interest in there that they wanted to know. I told them they could look anywhere they wanted and ask anyone questions to find what they wanted.

I told them that first we needed to figure out what was worth knowing, and what it means to know.

I got blank stares. They worried about how they would be graded in such a system. They wondered what I really meant and what did I want them to do. But they gave me a chance and, luckily, I didn’t know what I was doing, so it was quite authentic.

So I said: “Let’s see. There must be every day things that we want to know, that we can understand…? Things we are curious about?”

They couldn’t find any. Some of them said they had a lot of work to do in their other classes so they did not want me to be too demanding. Many shared that view. But as the conversation continued and as it became clear that, well, it was a conversation; they relaxed. But they still could not think of anything they wanted to know, beyond the latest homework in the other courses. Sad really.

So I said: “Why is the sky blue?” “No really, how does that work?”

Well many of them had heard something about that in high school so we started a class-wide discussion about how and why the sky is blue. And for every answer that did not quite work, we were able to find a flaw in the answer, or a dead-end, where the word answer was not really explaining anything beyond “something something”.

I told them that it maybe had something to do with why the evening sky can be red and also asked why clouds are white, when they are not red.

So this led us to what is light…? Now you can spend a lot of focused time asking yourself what light is if you want to know why the sky is blue. So I discovered… I helped them see, through questions, what it was to truly know or understand something versus just repeat the words… that they could search and explore and critique themselves. So they did.

To achieve this, however, I needed to boldly risk humiliating or challenging or teasing or pushing each one of them, at various times, with a “Really?” “How do you explain that?” “Does that make sense to you?” And others would come to the rescue with “He means this I think…” or “No, that can’t be because…”.

And they could see that I really enjoyed the conversation and that, well, I was a good person even though I was frightening, in a good way. So we developed a relationship in physical phenomena. And well things just took off. There were almost fifty of them. They researched on their own and brought new ideas back to class.

We moved from topic to topic and never really finished anything. A very difficult one was “Why is it cold on mountain tops?” That question is rich with possibilities. I mean rich. And, is it hot in a deep mine shaft?

We learned about molecules, electromagnetic waves, perception, … always coming back to things we wanted to know. And we kept explaining it to each other to test if we really understood. And we did simple calculations to see if it made sense. And, well, if you pardon the expression: No child was left behind!

The teacher assistant (TA) was asked to fully participate and observe the classroom dynamics and individual reactions, rather than do mindless grading of cookie cutter assignments. She was fascinated by the positive student reaction to the experiment and left physics soon after to do education, something she already loved.

The students were bringing their friends into class and telling their parents in glowing terms about the physics course.

And we had a final examination. And, honestly, it was like no final examination I had ever seen before. It was the opposite of depressing and fun to grade. It was full of intelligence and independent thought and evidence of significant research. I had a sense that the students had understood things, could explain them, and owned their knowledge.

I went back to the previous year’s examinations and saw a huge difference. I lent the two piles of examinations to the TA and she concurred that, yes, there was a significant qualitative improvement that could not be denied.

Now know that I was not comparing “bad” teaching to “anything would be better than that”. I was considered one of the best traditional method teachers, by the usual standards. So I was comparing certified bad teaching to something much better.

That was the only year that I felt I had done a good job in first-year physics. And they never let me teach introductory physics again, after twenty years. As soon as I figured out how to make it work, they deprived me of practicing my hard-earned trade. And I was fired from my tenured full professorship two years later, under the false pretext of fraudulent grading in one advanced physics course.[1]

I found out several years later that the chairman of physics wrote to the dean of science that he had heard I was doing something unusual and that the dean should probably know about it. They never asked me about it or brought it up during that magical year of not teaching first-year physics.

I would have been pleased to tell them about my discovery: Avoid all teaching. Class time is too precious to waste on such a numbing activity.

1. “Statement by Denis Rancourt Regarding His Dismissal by the University of Ottawa,” and “This is what targeting a dissident tenured professor looks like in Canada.” [↩]

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