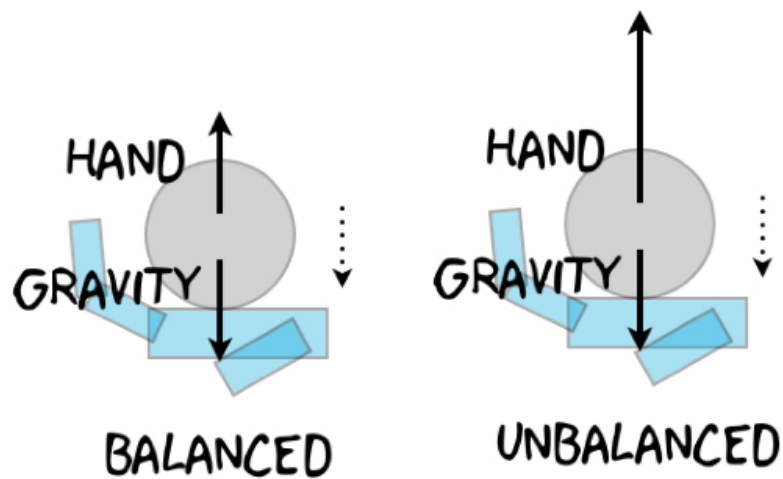


Telling You the Answer Isn't the Answer

THIS IS A story from my (Rhett Alain) class. The course is a physics course designed for elementary education majors. Really, it's a great course using a great curriculum – Physics and Everyday Thinking. The basic idea is that students work in groups to collect evidence from different experiments. They use this evidence to build models about force, motion, energy, circuits and stuff like that.

One of the important parts of the course is that students have a chance to build ideas and struggle with the model-building process. For the most part, they start off hating this part of the course.

Here is how a typical discussion might go. In this particular class, students were trying to figure out the forces on a ball as it is moving down and being caught by a hand (so moving downward and slowing as it goes). The class is looking at two different ideas for this case.



The hand is blue for no real reason.

The discussion then goes something like this:

Student 1: I think that if the ball is slowing down, it has to have unbalanced forces. Since it is moving down, the greater force would have to be from the hand in order to make it slow down.

Student 2: I'm not so sure. If the ball is going to stop, then there needs to be balanced forces. I think the gravitational force and the force from the hand have the same strength in order to make the forces balanced to stop the ball.

Student 3: Both of these ideas seem reasonable. Which one is right? Dr. Allain, can't you just tell us the answer?

It happens every semester. Why don't I just tell them the answer?

THE STRUGGLE IS LEARNING

This is the first point I always make. Students are under the impression that when they are stuck and

confused, they are doing something wrong. Think of it this way. What if you went to the gym to work out but you didn't get sweaty and you weren't sore or tired? You would probably feel like you really didn't get any exercise. The same is true for learning. Confusion is the sweat of learning.

If I just tell them the answer, that would end the struggle. What if a person was having trouble doing a pull up for exercise. Instead of giving them some other exercise, I could help them by doing the pull up for that person. Right? No, that wouldn't actually be useful. However, if I push on the person's feet a little bit they can still struggle and still exercise. This is what I try to do in these discussions. Instead of flat out answering the question, I often ask other questions for them to consider.

LEARNING ISN'T WHAT THEY THINK IT IS

It's not their fault, but students often visualize learning as a series of things they can put on flash cards. Their version of learning goes something like this:

- The instructor is gate keeper of knowledge. The instructor has all the answers.
- During class, the instructor hands out answers to students who then write these answers down.
- After a while, there is a test. During the test, the students return the answers that the instructor gave them.

Why would students think like this? Probably because all too often this model of learning agrees with what they see.

When I don't tell the students the answer, they think it's a messed up class. It's just like Daniel and Mr. Miyagi (from the original Karate Kid). In case you haven't seen this fairly awesome movie, here is a quick synopsis.

- Daniel gets beat up.
- Mr. Miyagi knows karate.
- Daniel convinces Mr. Miyagi to teach him karate.
- Johnny sweeps the leg.
- Crane kick TO THE FACE.

When Daniel first shows up to Mr. Miyagi's posh residence, Mr. Miyagi has him do all sorts of crazy stuff. You know, wax the car, sand the deck, paint the fence. Finally Daniel gets fed up. This isn't the way you teach karate! This is how you get dumb kids to do all your chores.

Of course, it turns out that Mr. Miyagi does indeed know what he is doing. In fact, he is like the Yoda of karate. Daniel learns some awesome karate moves and wins the tournament.

I'm Mr. Miyagi. Students need to wax the car.

TELLING THE ANSWER DOESN'T WORK

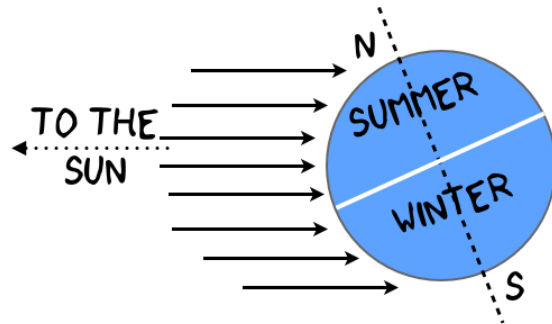
Students still don't believe me. They think that if I just tell them the answer then all will be right in the world. They are wrong. Well, they are right if the questions are silly. However if we just use real questions then I can't tell them the answer. Here is my favorite example of that.

When do students learn about the cause of the seasons? The answer depends on when the student went to school and in which state. However, this is one "standard of science" that is in just about every list of things students should know. Often it will appear multiple times throughout a student's academic career. So it's a safe bet that at some point they have been "told" what causes the seasons.

A typical middle school science textbook might give the following explanation for the seasons.

As the Earth orbits the Sun, it also rotates about its own axis. This rotation axis is tilted 21° away from being perpendicular to the Earth's motion around the Sun. Because of this tilt, the Northern hemisphere will receive more sunlight during the summer months than during the winter. At the same time the Northern hemisphere is warm, the Southern hemisphere is colder.

It will probably include a diagram like this:



The point is that this has been covered before. The students mostly like have been “told” the answer. Now ask them this question.

Why is it warmer in the summer than it is in the winter?

If you leave it as an open ended question, these will be the common responses.

- The tilt of the Earth.
- The Earth is closer to the sun during summer than during the winter.
- Some other answer.

Oh! But tilt of the Earth is correct, right? Well, let's ask a follow up question. How does the tilt of the Earth make it warmer in the summer? This is a tougher one. Very few students understand what really happens with the seasons even though they have been “told” the answer. I don't want to talk about the seasons anymore. If you want to hear a better answer (even though I just said it might not help) here you go. But don't worry. Even graduates from Harvard get this question wrong. Check out this classic video.

https://www.youtube.com/watch?v=TrXaQu_qGeo

The video also shows students in a class sharing their ideas about the seasons. The point is that they were told the answer but still get the wrong idea.

If learning were as simple as me telling the answer to students, I would surely do that. Instead, I am Mr. Miyagi. And do you know what's really awesome? That moment when students realize they don't really need me and they know the answer and they know WHY they know the answer.

From <http://www.wired.com/2013/10/telling-you-the-answer-isnt-the-answer/>