

Are we teaching our students to think?



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As a child I remember gazing at the stars and the planets through my father's telescope as he taught me about the wonders of the universe. Through the lenses of his microscope he explained that life existed in a drop of water. Household items became experimental variables when he introduced me to the laws of physics, and the changing colors of my childhood chemistry set seemed like pure magic. However, all these mysteries of the natural world had a reason, and my father taught me to always look for that reason, to think, to analyze, and to ask "Why?"

My dad is a teacher, and a scientist. Although I do not consider myself a true scientist, I do dedicate most of my free time to one of my greatest passions—teaching. I have watched my father closely and learned about his teaching technique, while at the same time adding my own twist. During my years as a teacher, I have stumbled upon a most dangerous obstacle, one that dad always talked about but I failed to see: the confidence with which students memorize facts without understanding them, without asking "Why?"

I detest memorization, especially of worthless facts. Although I accept that there are some facts that one may have to commit to memory, it is my belief that they are of lesser importance, and that they may be easily sought when needed. It is the understanding of why things happen, and the processes by which they happen which is of real importance. The curiosity to understand "why" is what fuels the mind to think, to reason, to analyze, and to discover.

We are slowly losing interest in these processes and prefer a faster "just tell me the facts" approach. Perhaps this is fueled by our fast paced life filled with standardized exams that test memorization, not analysis. Maybe we are not engaging our students to think, but rather bombarding them with facts to memorize. Maybe we are overusing the phrase, "I don't have time to explain why it happens, but it does. You can look it up on your own." Whatever the reason, students are more interested in memorizing without understanding.

I am a physician and have spent the last 14 years of my life studying. I lost track of the number of standardized board examinations I've had to take, not to mention the myriad exams in medical school. I don't remember half of the material that was taught, especially all the material I had to cram and memorize.

A few years ago, I started to question the medical knowledge I had crammed into my brain. I began to realize that I had memorized a monsoon of facts, most of which I took for granted without ever questioning where they came from. I asked myself, "Was all that cramming worth it? Or would it have been better to ask 'why?'"

During those early years in medical school, I like many others forgot the importance of the word "why." I let myself be influenced by the beast of medicine, the board exams. I am sad to say that I had become consumed by the fatal illness which we call cramming. I lost interest in asking "why?" Perhaps because time was extremely limited, all I wanted to know was what would be asked on the boards. I didn't care whether I understood it or not, I just wanted to know if it was going to be asked so that I could memorize it. It took me almost 10 years to find out how wrong I was.

The board exams

I don't blame the students for wanting to memorize facts. I believe this is something that is taught, mostly by fear. That fear, at least in medical school, is usually brought about by the boards, which test memorization.

I am all for standardization of procedures and examinations to demonstrate core knowledge, but we take four United States Medical Licensing Examination (USMLE) tests¹ (including the clinical skills), the objective structured clinical examinations (OSCE), the board for a specialty, and possibly a subspecialty board. Also, specialty boards may be subdivided in at least two different parts.

The average medical student spends thousands of dollars to take the boards, not counting review courses, question banks, review books, and travel which add even more money to the equation. The 2017 fees for the USMLEs (Steps 1, 2, Cs, and CK, and 3)² are \$3,335, not including review courses, travel, question banks, or review materials and other expenses. For the specialty board in radiology, approximately \$3,150 is added to that cost.

The board exams have become the ultimate goal in medicine. Maybe even a greater goal than good and compassionate patient care.

Perhaps medical students are mentally and physically trained to fear the boards. Most have heard the phrase, "You have to pass the boards, it is the most important thing in your medical school training. You must become board certified, with it you can secure jobs and will be highly regarded as a board certified physician."

To me a highly regarded physician is one who cares about his patients and who treats them like family. One who is compassionate and knowledgeable. A pediatric

attending physician once told me, “The most important aspect of medicine is compassion and patient care. Patients won’t care about the 25 diplomas hanging on your wall, or how many boards you have, the only thing they want to know is if you can help them in the most compassionate way possible.” She was a wonderful teacher, always explaining how everything worked.

We have placed such an importance on these board exams that our way of teaching revolves completely around them.

Board exams are important, as there must be a standard set upon practicing physicians. However, the monetary, social, and hierarchical value placed upon them dictate the way we teach medicine, which is not the same as real life, day-to-day medicine. One of my teachers told me, “Very few patients read the book, and in the majority of cases you have to sit down and think! Put all the facts together and come up with the best diagnosis. That, my dear, is what you have to learn, to think!”

I did not become aware of this fact-driven/memorization/board-oriented extravaganza until I was teaching a radiology chest trauma class. The students asked me for a copy of my presentation so that they could have it to study. I gladly obliged, and sent it to them via E-mail. My inbox quickly flooded with replies, most of which read:

There is almost no text in your presentation.
Where are the facts we have to memorize?
Where are we going to study from?
We always memorize all the slides because that is what they ask in the tests!!!!
Do you have slides with text to study from?

I replied:

Don’t worry. Just come to class and take notes. Read the chapters from the book I recommended and you will be fine.

The day of the class came, and as I walked down the amphitheater, all I could see was fear. Most of the students were flipping over the pages of the printed copies which I had sent them. Others looked at the blank pages of their iPads and notebooks, as if they didn’t know what to do. I loaded my presentation and started my talk.

I showed them a post traumatic chest CT to which half the room yelled out the diagnosis in unison, “Right lung laceration!” I then asked, “Why do you think the laceration looks bigger than the diameter of the bullet, and why is there injury to more distant parts of the lungs as well?”

Complete silence ensued. I asked, “Think for a minute,

why do you think there is so much injury?”

I could here the crickets chirping, then one of them asked me, “Do we have to know that for the board exam?”

I took a deep breath and proceeded with my explanation. I showed them a video of a bullet going through ballistic gel in slow motion so that they could see the expansive and compressive forces that the bullet exerts on the soft tissues. They were astonished by this explanation. Hands went up quickly and questions of “how” and “why” poured down like torrential rainfall. The question of what is on the board exam was forgotten, and for the remainder of the class the most used word by the students was “why.”

Their questions changed from, “How does pneumonia look on a chest X-ray?,” to “Why does pneumonia look the way it does, and can other things look the same way?” That, in turn, lead to the discussion of X-ray physics, the basics that helped them think and eventually answer questions by themselves. They gained the knowledge necessary to understand how pneumonia, hemorrhage, and edema could all look the same on a chest X-ray. They were actively thinking, not just listening to me blabber out facts that can be quickly forgotten.

A similar thing happened in another class I teach regarding acute abdominal pathology. I asked the students, “What creates an air fluid level?”

“Bowel obstruction,” they said unanimously. “No,” I said.

There was silence throughout the room. Most were looking at me as if I was crazy. One student raised his hand and said, “But professor, the book said that an air fluid level means that there is bowel obstruction.”

“True,” I said, “but there are many other variables that have to come into play in order to diagnose bowel obstruction.”

I again asked them, “What creates an air fluid level,” no answer. Finally, I told them, “An air fluid level is created by gravity, it means that gravity is present.”

I took a bottle of water and showed them an air fluid level. I then showed them an X-ray of a supine patient and asked them if the patient had bowel obstruction. They quickly answered “no” because there were no fluid levels. I then showed them the same X-ray of the patient, however now with the patient standing. About 10 air fluid levels popped up in the new film. I then asked them, “Why do you think we see the levels in the X-ray with the patient standing and not with the patient lying down.”

The answer came quickly and was again followed by myriad questions of how X-rays are taken, and how the patient’s position can affect what we think we see, and don’t see in the film. They were actively thinking and analyzing. They understood what air fluid levels are, how they are

created, and why the patient's position when taking the film is so important. They understood, they did not just memorize the fact that air fluid levels could be seen with bowel obstruction.

I remember another time when I asked them a question I had seen in one of the board reviews. A question, which only tests one's capacity to memorize "How many Gauss are equal to one Tesla?" The class quickly answered, so I then asked them, "Who were Tesla and Gauss?" Again, there was silence. Then one of them said, "Some scientist guys."

It is amazing how they can easily memorize a worthless conversion which can be easily looked up, but they have no idea who Nikola Tesla or Johann Carl Friedrich Gauss were, nor do they have an interest in looking them up. Same thing happened when I asked them about Hounsfield units and Godfrey Hounsfield.

A new lesson plan

We are in dire need of changing the way we teach, engage, and test the knowledge of our students. We need to actively urge our students to think and analyze. Moreover, we have to carefully choose those essential facts that do require memorization, while leaving out those that can be easily found.

This is not a simple process. Engaging students to think is time consuming, as is preparing a class that promotes student participation and reasoning. It is easier to fill up a PowerPoint slide with facts and ask the students to memorize them than to prepare an animation or diagram and explain the processes involved. However, it is worth the time and effort.

So, what can we do as teachers to help our students think?

First, remove the fear of the boards exams. The boards will always be there, and you have to study for them. However, it's how you study for them, and how you teach the material, that makes a difference.

PowerPoint/Keynote/Google slides are not novel writing applications. Do not fill up your slides with endless information using 10 point text size, and 23 bullets on a single slide. No one will read them and you will lose the class in an instant. These programs are meant to be tools to teach a class and to guide the discussion. Use diagrams and animations that aid in the explanation of concepts.

Assign book chapters or reading materials before class, but be sure to assign something that is doable. Don't expect your students to read *Weber's Thoracic Imaging* in a single course. Divide material into readable segments. This means personally sitting down and reading the books that are assigned to the students. Reading prior to class

encourages discussion, which is the most important aspect of teaching.

Encourage discussion, do not simply hand the students the material or answers to questions. Do not make a monologue of a class. Let the students participate and think. Prepare a discussion-based class. Bring real life experiments for student participation. Make audiovisual aids beyond what is presented in the PowerPoint slides. These simple strategies help engage the students and promote discussion.

Always remember Einstein's quote, "If you can't explain it simply, you do not understand it well enough." Simple explanations go a long way and help the student understand the material much better than with a long and tedious explanation. Use experiments with everyday objects, analogies, videos, and even the students themselves, in order to explain some of the more complicated topics.

Dedicate time to prepare for the class. A class presentation is not prepared in one day. It may take weeks or months to adequately prepare a class, something that many institutions do not understand. Being a teacher takes time, much of which isn't recognized or paid for in medicine.

Take a look at the students' board question banks. Since they have to pass the boards, integrate the material on those question banks into the class. Adding board material to the class is of integral importance and helps the students.

Strive to promote and engage students to ask "why?"

Understanding, reasoning, and thinking are all integral to the development of a physician. Facts will always be there, but the capacity to reason, to think, and to analyze defines us as a species. It is what permits us to question the facts, and to decide whether they are true, or not. Let's not be consumed by our fast paced life or by standardized exams. Let's take the time to continue to teach our students this all important skill, and encourage them to ask "why?" Remember, "Give a man a fish and he will eat for a day, teach a man how to fish and he will eat for a lifetime."

References

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