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Practice of Science (and Mathematics)

Everyday teachers are debating on how they should teach their class. Textbooks are a very effective way of giving facts and statements very efficiently, but is the manner the material is presented in textbooks way too boring? Will constantly reading from a textbook dull the students’ senses until they no longer would like to pursue studying this subject? On the other end of the spectrum, should teachers run through in depth experiments to teach their students the facts and how the facts were derived. This would be far more interesting, but there are time and money restrictions that may limit this. If a teacher went through every experiment in depth then they could not cover near as much as they could if they taught from textbooks. Both of these methods of teaching have their pros and cons, but which single one or combination of both will teach the kids effectively while keeping their interest so maybe one day the kids will pursue and career in the field?

One example that comes to my mind is my 10th grade geometry class. Almost every single class we would have a proof. I enjoyed the proofs because I enjoy doing things step by step and realizing why I did each step before finding the answer at the end. I feel that going through this process is the most effective way of teaching because kids cannot just speed through to find the answers; they have to go through steps in order to get full credit. Much to my dismay, there was more than just doing the proof this way. The other side of the proof was writing it all down, step by step. This was a very tedious process because each little step had a different name, and each process had a different name, and everything had to be done in a certain order or else points will be taken off. Although doing this made me despise proofs a little, I now realize why we had to go through this process. Many times, when I was doing the proof without writing things down, I left out critical points. The process of writing the proof down helped me become more disciplined in my work and overall made me better at doing proofs by not leaving out details. I do believe that proofs are probably one of the most effective ways of teaching the material because it is a happy medium between the boring textbook work and the tedious experimental work.

There also should be a significant difference between the material in the research articles and the material in textbooks. In Grinell’s book he says,

“In summary, science comes in three different versions: (i) the facts- statements found in the specific textbooks- with little if any explanation of their source; (ii) the linear model- found in research publications and used by researchers to establish the credibility of their work and to influence the work of others; (iii) everyday practice- what really happened, a view rarely glimpsed by outsiders” (10).

Research articles should contain a huge amount of detail and should cover where all the information comes from. The textbook’s information should contain all of the main points and facts of the research article, but just not have all of the origins of the information and extra “fluff.” The reasoning behind this is the fact that research articles are usually based on a single topic. There is much room for extra information in these research articles because only one topic is talked about. Textbooks on the other hand usually teach a full subject that has numerous topics. If a textbook were to go over the information in the manner that a research article does then the textbook would be thousands of pages long and impossible to teach in a few years, let alone in a semester.

Mathematical techniques probably fit more into the textbook form of teaching. Usually a formula is given to a student to memorize and to use in certain situations where it is needed. This technique is used because mathematical formulas are often derived from very intricate steps that many people cannot understand. Giving someone a formula gives them the tools to figure out complicated problems much easier.

I believe that Statistics needs to be both discovery oriented and credibility oriented. Grinell says,

“I place the individual scientist in the center. She engages in two conversations, one with the world to be studied, and the other with other members of the research community. The former conversation gives rise to the circle of discovery- learning new things. The latter gives rise to the circle of credibility- trying to convince others that the new findings are correct” (4-5).

The main part of Statistics that is discovery oriented is the beginning experiment that serves as a foundation for the credibility side of things. The credibility side of the diagram is the flow between individual scientists and the research community. Grinell says, “Interactions within the research community depend largely on cooperative and competitive behavior” (5). In statistics results are taken from experiments that scientists have already completed and then organized and analyzed in order to find different characteristics or patterns. This means that the community taking the results from a previous experiment in order to find different patterns and characteristics. The community will also search for different confounding factors that may affect the final outcome of the experiment. By eliminating all of the confounding factors, the true and untainted results can be derived. This new information will continue to flow around and around the diagram with new researchers and scientists making more discoveries. This whole side of the diagram is basically scientist starting something and others building on it to make it better until it is completely flawless.

I believe that the most effective way of teaching is a particular combination of experiments and textbooks. Learning straight from the textbook would cause students to become very overwhelmed by all of the information being thrown at them and it may affect their decisions to pursue that subject in the future. Learning by doing only experiments also may also overwhelm the students by the specificity of the information and will limit the amount of areas they can cover because so much of the time would be spent going over one little area. One or more of the areas not covered by this could be the field that is the best fit for the student. The best alternative is using both of these methods to teach. A teacher should introduce the information by textbook and then practice the newly learned material in different experiments. This causes the students to become familiar with it right away and then to become comfortable using it. The main similarity amongst all of these thing that were discussed is a combination of both is needed in order for everything to work out the best (they share a synergistic relationship). Experiments and textbooks are needed together to keep interest while covering a good amount of material. Research papers and textbooks are needed together to provide the whole mass of information and the narrowed sense. Also, discovery and credibility are needed together to provide a foundation for other scientists and the community to build off of. All of these are effective on their own to a certain degree, but when combined with the other they are much more powerful.