Nick Foster

Prof. Little

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Identifying Patterns

Science is not as cut and dry as one might believe. The scientific method is taught as the rational procedure to approach scientific queries. It is a step by step process which guides a scientist or researcher from a question or a hypothesis to a potential answer. Or this is what people are taught to believe. Frederick Grinnell would like to contest otherwise. Grinnell suggests that scientists almost never follow the scientific method to the letter. Science tends to be less of a strange line and more of a circular process filled with many more failures than successes. In his book *Everyday Practice of Science*, Grinnell discusses the true nature of science and how scientists actually operate in society. He states that what is finally placed in science textbooks as accepted facts can no way show what actually occurred in order for the scientists to make that discovery.

Grinnell discusses the fact that many of the discoveries are accidental, or at the very least were unexpected. Experimentation is exactly what its name implies. It requires an extreme amount of trial and error. Grinnell cites the word serendipity, or in essence encountering things that you weren’t necessarily looking for. He states on pg. 30, “Experimental design frequently tests unintended questions as well as those questions explicitly under consideration”. In this scenario, usually what one might find at the end of an investigation is in no way related to what one originally intended to discover. So now the investigators note book will look completely different from what is published in a text book, or even what is published in a lab report. A lab report will show purely an experiment related to the final result. It will show a procedure going from a hypothesis related to the conclusion and the steps to achieve that result. A text book will show purely the conclusion, and will probably not display anything about how this conclusion was achieved. The scientist’s note book will best exemplify the journey the scientist’s journey from initial thought to final conclusion. It will indicate what the original question was, document the first experiment that was conducted to test this original thought, and in all likelihood the failure to reach any sort of sufficient conclusion to prove any hypothesis. This will not be a complete failure, as now the investigator can take the data he or she did produce and wonder why their experiment didn’t work and what they can do to improve their design.

This is far different from just reading the answer in a text book. A text book does not do justice to what a scientist experienced. Text books cannot document a thought process. A thought process is very important to understand, as each person’s thought process is different, as Grinnell suggests. No two people with think exactly the same about a given situation, especially in the area of attempting to solve a scientific problem. Other scientists and investigators should be able to look upon a scientist’s notes and thoughts, giving them the ability to derive new experiments off of the original experiment to either refute or expand the conclusion reached by the original investigator.

It’s also important to not only have other scientist expand on your ideas, but to validate them from their perspective. Grinnell speaks about how, regardless of how well a person attempts to be objective in their work, scientists will always be biased on one way or another. People can be shaped by their culture, their upbringing, and their experiences and can make them think differently about a situation, as stated before. They will be biased, maybe in believing they found something they didn’t and made an important discovery. Therefore, the studies done to achieve these results need to be replicated. Grinnell acknowledges this fact on page 15 of his book, saying “Because Professor Particular cannot avoid the possibility of error, including self-deception, her initial discoveries should be thought of as protoscience. For protoscience to become science, the researcher not only must turn to the community to convince peers of the correctness of the new findings.” In order to have other scientists replicate an experiment, they would need to have the exact process that the original scientist followed. It’s also much easier to justify your findings if you have the process in which you achieved the data that is the basis for your conclusions. Just simply stating what your conclusion is without backing of solid data from an experiment, it will almost impossible to have your observations and discovery justified by peers in the scientific community.

This requirement for justification by the rest of the scientific community leads right into the issue of credibility. Credibility relates directly to a scientist’s note books and research articles. These need to be presented to the rest of the scientific community before a scientist’s discovery is even considered to be a legitimate discovery. A scientist’s peers need to be able to rationally understand the process of the scientist’s discovery. If they cannot understand how a scientist came to the conclusion he or she did, then the discovery is disregarded and the conclusion is dispelled as a truth claim.

Not only does the procedure of finding the conclusion matter in the credibility process, but so does the raw data that the conclusion is based off. For something to be considered true, it needs o have empirical data that points of the direction of that conclusion being true, whether the data is capable of being repeated or not. If the data is easily achieved but in no way supports the discovery that the scientist claims he or she found, then it actually does more to disprove the conclusion than to prove it. These results need to be published in the scientists note books and research articles.

In this way, a scientist’s note books relate directly to the diagram that Grinnell creates on page 5 of the book. In the middle is an individual scientist. On the left is the natural world to be studied with the two joined by a circle representing a perpetual interaction between the two. On the right side is research community, joined together with the individual scientist by a similar circle. The circle on the left shows the discovery process of science, and the right circle shows the credibility process. In essence, a scientist’s notebooks follow a similar pattern. As he or she studies the world, they create a notebook of their observations and results. This goes through the whole discovery circle and goes to the research community in the form of a research journal or article that organizes his or her notebook into a organized form that can be presented to the research community and hopefully achieve credibility. Beyond that, the scientist hopes that their discovery is considered to be truth, and will be printed into a text book.

Essentially the three ways of representing research are not better than one another; they are simply different steps along the line, with notebooks being the beginning and text books being the final step. Notebooks are better for showing the struggles scientists face in working toward researching a question, while text books just display the information a scientist succeeded in proving to be true.

Grinnell ultimately prefers the notebooks over the textbooks. Grinnell enjoys the thrill of the chase and the pursuit of knowledge over just having the information. He doesn’t just want to learn things; he wants to learn them through discovery. He states on page 22,

The emotional thrill that accompanies discovery in science comes above all from the feeling that one has solved a challenging puzzle and is the first to know something new about the world. The intensity of that experience ranges from the commonplace to what sometimes are called “eureka moments…Eureka, by contrast, comes after reading a long and complicated novel in which loose strings hang out everywhere and confusion reigns until a single piece of information allows everything before to be reconstructed into a coherent framework­- “brilliant!”

Grinnell is correct in saying that discovering something on your own rather than it being dictated to you. It helps someone to understand it better when they can see it happening before their eyes rather than just having it dictated to them what should happen, especially if you find out something new on your own. The new discovery becomes “your” discovery. It personalizes it. Now that it’s essentially your possession, it makes it easier to be passionate about it. It’s the same as in a high school geometry class. A student could easily just look in a text book, find a proof, and learn it. At that point it’s completely memorization. But if a student actually figures out a proof, he or she will get the concept and the reasoning behind the proof, making it far easier to understand, as well as giving the student a sense of accomplishment that they were able to figure out the proof on their own.

Overall, a scientist notebook should look like what it represents. The scribbled notes and the apparent lack of organization display a scientist’s almost “unscientific” approach. Constant failures surrounded by accidental discoveries. This is what scientist love, according to Grinnell, the challenges of solving puzzles. The textbook on the other hand, written in a very black and white language in an unambiguous nature, represents what scientists ultimately search for; concrete truth claims.