Make Them Scientists – Redirecting the Science Instruction Paradigm

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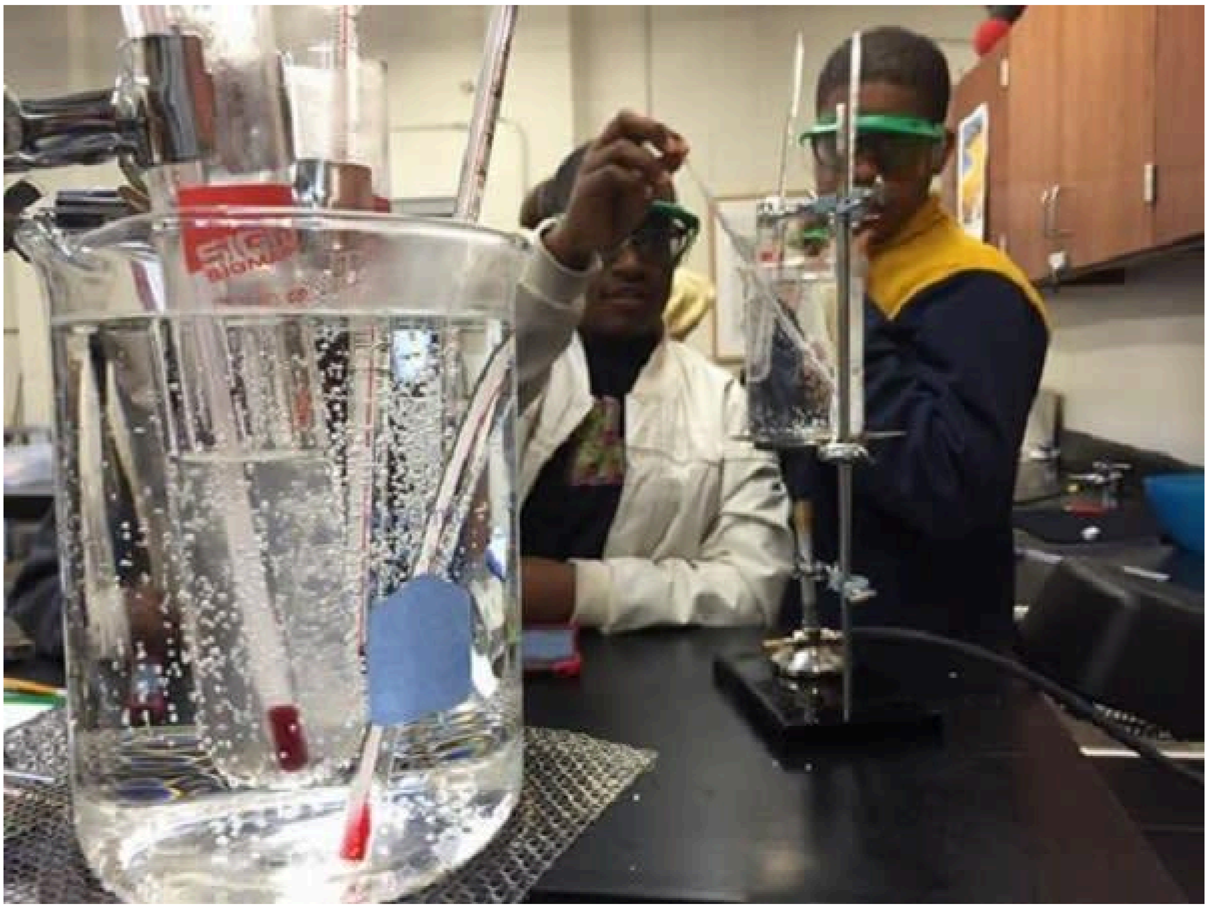

Critical thinking and problem solving, in all fields of study, often requires looking at an old problem in a new way. The ability to observe a phenomenon with fresh eyes is a key first step in divergent or “out-of-box” thinking, which is, in turn, essential for innovation. These skills are especially important in STEM fields, which have garnered much attention and focus in 21st century education.

Strangely enough, class instruction in STEM often shortcuts “observational learning.” A professional scientist observes, with deep curiosity, a phenomenon at hand and hypothesizes potential answers before testing these educated guesses through experiment. In classrooms, however, many hurried educators flip the formula—presenting the answers (laws and formulas) first and then illustrating these concepts through experimentation.

This tell-and-show approach to science may save time, but unfortunately saves children from critical thinking. In a time when pressure is mounting to help American students excel in STEM subjects, we need to approach science teaching in radically different ways from our old standard. We must allow students the time to become scientists and pique their curiosity. This means making time for observing a phenomenon first, with fresh eyes, in order to reach their own meaningful understanding—regardless of whether observations lead to previously known principles.

To illustrate the point, let's consider a conventional lesson illustrating Snell's Law or the law of light refraction. In a traditional classroom, it might begin with a teacher saying, "Today we will look at how light travels at different speeds in different mediums." The teacher might drop in a ruler in a glass jar with oil and water to show students how the ruler appears to bend. And then might say, "But really... what is bending?"

Perhaps, clever students will infer and then hear the answer, "light," and everyone moves on. But the concept, shown in this way, provides marginal relevance, interest and retention to the students. Students in this scenario do not need to use their critical capacities or insight to understand refraction, but can instead simply follow the teacher's logical argument. This type of instruction keeps science abstract and irrelevant to most children.

Waldorf science educators have long used an observational, also called a phenomenological, approach to science to pique student's curiosity and understanding. To expand on the example above, a Waldorf teacher might instead gather students around a set laser pointer shining upon a distant piece of paper. One chosen student would use a pencil to mark the point of light. Then individual students would chose from a collection of different slabs of material to place at an angle in front of the laser, such as glass, plastic, gelatin, etc. Each student would carefully observe the laser's position on the paper as it passed through substrates and mark the change.

As the experiment progressed, the teacher would ask students to explain what they were seeing and how what they saw varied from substrate to substrate. Students would be encouraged to personally manipulate the experiment any way they desired, allowing their curiosity and insight to run its course while teachers continued to facilitate each student's experience with the experiment and encourage them to think relationally.

Some educators might protest the amount of time this one experiment is taking to illustrate refraction. But, it will soon enough be a point of relevant reference for students as they learn about refractive indices and also tie this new knowledge into mathematical instruction on angle measurement. Taking time to bring relevancy and curiosity to this experiment brings a deeper understanding to the information in all of the related lessons to follow.

But the lesson is far from over at this point in our theoretical science classroom. The open-ended observations students make from this phenomenological method is not where the method of study ends. Next, Waldorf Educators bridge the gap, between phenomenology and scientific method through Socratic inquiry—a method where teachers guide students to question what they see and draw out connections through critical thinking. Observation must happen first, however, before this kind of curious inquiry-to-insight can occur.

As a next step in our current example, after observation and manipulation winds down, the teacher might ask, “We noticed the dot moving to different places on the paper. Can we come up with some reasons why this might happen?” Socratic inquiry begins as the teacher leads questioning and debate, so that it expands critical thinking and leads toward recognizing patterns. Once the students are close to the right conclusion or have realized the pattern, the teacher can have them perform the experiment again, fill in any knowledge gaps and explain Snell’s Law.

The real beauty of the phenomenological approach is that it turns students into scientists. For scientists are motivated to trial, error and continuous inquiry through their own obsessive curiosity, observation and experimentation. This is the real formula worth emulating in scientific study. We must endeavor not to abstractly separate students from the subject being studied. Starting at the end robs students of the very part of science that might convince them to seriously consider it as a choice of ongoing study and career.

Photo credit: Academe of the Oaks

Sources:

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