RECOGNIZING & TEACHING THE SCIENTIFIC METHOD ACROSS ALL FIELDS, NOT JUST THE NATURAL SCIENCES

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Introduction

Abstract: Science education in American schools conflates two disparate definitions of "science," thereby leading students to assume science and related concepts are the exclusive domain of the natural sciences. Ultimately, natural sciences are privileged in schools as real sciences and social sciences are often marginalized with very real consequences. This article argues schools should teach students about the application of scientific methods broadly across fields in both the natural and social worlds around them to see all as legitimate pursuits of knowledge.

Key Words: Science Fair, STEM, Social sciences, Interdisciplinary, Model-based inquiry

Science fairs have long been used as vehicles to spark students' interest in science, providing an opportunity to apply classroom concepts to a real-world project. In the spring of 2017, my son Hart participated in his school's STEM fair. Leading up to the fair, the school made it clear (with both its use of the STEM label and written instructions on how to participate) that student-led projects applying science principles were encouraged across a variety of areas. Hart describes his project below.

"In 4th grade, I participated in my school's STEM fair. For my STEM project, I chose to find out which gum had the longest-lasting flavor. The reason I chose this question was because I wanted to know which brand could actually claim "we have the longest-lasting gum." There were three brands in my project: Orbit mint gum, Extra watermelon gum, and Trident bubble gum.

To collect data, I tested 12 people, asking each the same question about how long the initial burst of flavor lasted. I gave them each of the three pieces of gum to chew, timed them with a stopwatch, and recorded the times on a paper. After collecting all the timing data, I made some graphs of my results and presented them on a big poster board. I learned nobody really liked Trident best and it had the quickest times of all of them. The winner was Orbit, the mint gum.

Also, my dad and I did a display of a chewed gum timeline. We chewed gum in 15-second intervals and put the gum on the poster board. We wanted to study the chewed gum and see if it changed in color or appearance when it was being chewed – but it didn't.

If I were to do this experiment again, I would keep all the gum flavors the same. I realized afterwards that maybe many people preferred the mint gum because of the flavor, not the brand. Also, I would hide the brand so people don't know which gum they're chewing."

Discussion

Being a social scientist, I (Michael) was pleased to learn of Hart's interest in applying scientific inquiry to a squishier question of consumer preferences and I encouraged him in the process. Yet, his project was an outlier in the STEM fair, where most projects focused on magnets, growing plants, or electrical currents. Many students and parents browsing the completed projects in the STEM fair and asking questions of participants also did not immediately see why this question was a science project. Through this experience, it was clear to me that science as currently taught in our schools omits some useful details about the broad pursuit of knowledge.

Schools often conflate two disparate definitions of the word "science" to students' detriment. Courses in elementary and early secondary schools that teach content from the natural sciences are generally referred to

simply as "science" courses. Yet, another definition of "science" refers to systematized knowledge in any domain, which includes a number of fields both inside and outside of the natural sciences.

A common result of using the same word for two different ideas is that students mistakenly assume that "science" and related concepts like the scientific method are the exclusive domain of the natural sciences. Typically, courses in social science fields are not introduced until late in secondary grades or later and, consequently, many students are likely missing formal instruction in broader conceptualizations of science. This late or missing exposure to other scientific fields outside of the natural sciences is certainly related (whether as cause or effect is unclear) to the hierarchical categories often applied to distinguish the "hard" and "soft" sciences [1]. In effect, natural sciences are privileged in schools as real sciences and social sciences are often marginalized with very real consequences in public perception (and funding).

Modern approaches to science learning and application do not appear to correct this omission. The current interdisciplinary focus of STEM initiatives also fall prey to a similar narrowness, where the "S" in the ubiquitous acronym is generally considered to refer to natural sciences exclusively, not social sciences. Similarly, the Next Generation Science Standards label the conventional natural sciences (physical science, life science, earth and space science) along with engineering and technology applications as Disciplinary Core Ideas.

Even the methods of inquiry themselves are not neutral. The scientific method—with a heavy reliance on developing a hypothesis, testable predictions, and experimentation—is generally prioritized as the primary means to produce scientific knowledge. Yet, schools' use of the scientific method has previously been criticized as an overly narrow construct to produce evidence; instead, model-based inquiry is arguably more broad and appropriate for school-age students to directly apply [2]. Further, testable predictions and direct experimentation are less commonly used in social sciences for a number of reasons, thus favoring model-based inquiry in schools would help to show how scientific inquiry can be broadly applicable across many fields inside and outside natural sciences.

Final Thoughts

I argue schools should teach students sooner about the application of scientific methods broadly across fields to help them see how scientific principles can elucidate both the natural and social worlds around them. Students currently learn social studies and history, though the scientific pursuits that created this knowledge are often not explicitly stated, nor is it clear that many of these methods may be shared with the natural sciences. I encourage scholars in science education to train teachers, write textbooks, and develop curricula in ways that help students connect these concepts across many scientific domains.

References:

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