The Scientific Method: An Educational Train Wreck?

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When educators try to inculcate children with the scientific method, the main legacy of traditional science, the outcome is often an educational train wreck. As Jeremy Rifkin, author of *The Empathic Civilization*, puts it:

> [T]he scientific method [is] an approach to learning that has been nearly deified in the centuries following the European Enlightenment. Children are introduced to the scientific method in middle school and informed that it is the only accurate process by which to gather knowledge and learn about the real world around us ... The scientific observer is never a participant in the reality he or she observes, but only a voyeur. As for the world he or she observes, it is a cold, uncaring place, devoid of awe, compassion or sense of purpose. Even life itself is made lifeless to better dissect its component parts. We are left with a purely material world, which is quantifiable but without quality ... The scientific method is at odds with virtually everything we know about our own nature and the nature of the world. It denies the relational aspect of reality, prohibits participation and makes no room for empathic imagination. Students in effect are asked to become aliens in the world.

In Rifkin's view, the way science is currently defined and taught is a profound violation of how today's youngsters -- and an increasing number of scientists -- see the world. Although he does not use these words, the way kids are taught science these days constitutes a form of child abuse. It involves the forced infliction of a false identity. There is an unfortunate precedent -- Native American children who were once forced into white-run schools and forbidden to speak their native tongue or wear native clothing. They were required to become something they were not. Many Native Americans who endured this experience were psychologically scarred. They recall their experiences as a nightmare and speak of them with deep bitterness. Similarly, many young people see themselves as foreigners in the world of science, strangers in a strange land. No wonder they do not fall in love with science and seek it as a career. The separateness, distance, and aloofness required to do science is a repudiation of the relational, embedded, networked way they view their place in the world. They simply are not psychologically geared the way their forebears were for the past 200 years, a fact which many science educators have a hard time accepting.

And not just science educators. All of us are locked into comfortable, personal learning styles that stand us in good stead over the years. We become biased: the learning style that works for me should work for you as well. I bumped into my own learning prejudice recently, while on tour for my book *The Power of Premonitions*. Following a talk at a bookstore, a woman and her teen-age daughter came forward. The mom said her daughter was fascinated by premonitions and wanted to ask me a question. I listened. She was obviously very intelligent and I was pleased to have touched a young mind. There was a long line of people behind the pair, so I answered her question briefly and concluded, "Thanks! Sorry we can't talk longer, but it's all in Part One of my book." At that point the teen gave me a look suggesting I was demented and said, "You mean like a book. Like you want me to read a book. Like a real book?" The disconnect was painful. For a moment I felt like an old fart about 1,000 years old.

The prevailing image of science as an individual, solitary endeavor is largely inaccurate. In today's world, research problems are tackled by teams of scientists working collaboratively. Scientific papers commonly have dozens of authors. Yet this collaborative image does not come through to teens contemplating science, particularly young women. "Girls steer away from careers in math, science and engineering because they view science as a solitary rather than a social occupation," according to Jacquelynne Eccles, a senior research professor at the University of Michigan Institute for Social Research and the University of Michigan Institute for Research on Women and Gender. Eccles and her colleagues found that young women were more likely than young men to place a high value on occupations that permitted flexibility and did not require them to be away from their family. The young women also valued working with people. In contrast, young men were more likely to value jobs that required them to supervise others. Eccles concluded, "We as a culture do a very bad job of telling our children what scientists do. Young people have an image of scientists as eccentric old men with wild hair, smoking cigars, deep in thought, alone. Basically, they think of Einstein. We need to change that image and give our children a much richer, nuanced view of who scientists are, what scientists do and how they work."

No wonder kids are confused about how science is done in real life. The science community seems to go out of its way to conceal the collaborative, cooperative, team approach. Nobel Prizes are given to individuals, not to teams. In medicine we emphasize individuals -- e.g., Jonas Salk and his polio vaccine, not the research group that helped make it a reality. It's not that individual achievement in science is bad, but that it's an incomplete view that is increasingly off-putting to a generation of young people who are more sensitive than their predecessors to mutual, shared endeavors.

Additional stereotypes prevent girls from entering science, such as the widespread belief that females don't have the innate mental abilities that boys have, and therefore aren't able to compete successfully in the so-called STEM fields (science, technology, engineering and mathematics). This is a hot-button issue because evidence suggests that if young women are told they can't hack it in science and math, the result can be a self-fulfilling prophesy. The belief in the inferiority of women for STEM fields is widespread, even in academia. Lawrence H. Summers, then the president of Harvard, ignited a firestorm in January 2005 when he suggested that "there are issues of intrinsic aptitude, and particularly the variability of aptitude" reinforced by "'lesser factors involving socialization and continuing discrimination" that account for the paucity of women at the highest levels in science and math. The respondents in the Bayer Facts of Science Education XIV survey, which polled 1,226 female and minority chemists and chemical engineers in 2010, gave the U. S. K-12 education system a "D" for the job it does to encourage minorities to study STEM subjects and a "D+" grade for encouraging girls.

Mae C. Jemison, a chemical engineer and the first African-American female astronaut, who works with Bayer's science literacy project, says, "My professors were not that excited to see me in their classes. When I would ask a question, they would just look at me like, 'Why are you asking that?' But when a white boy down the row would ask the same question, they'd say 'astute observation.'" Gender disparities are glaring at the upper academic levels of science and math. Commenting on a 2010 report on the underrepresentation of women in science and math by the American Association of University Women, Nancy Hopkins, an M. I. T. biology professor, said, "Harvard just tenured its first female [math professor], after 375 years."