



Encouraging Authentic Learning Experiences

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Not long ago, I attended a Congressional luncheon in honor of a real-life genius. The Center for Excellence in Education (CEE) presented one of their own, Dr. Terence Tao, with the Joseph I. Lieberman Award for his contributions to mathematics. In addition to being on Wikipedia's list of child prodigies¹, Dr. Tao has received many other exceptional distinctions, including the Fields Medal—the mathematical equivalent to the Nobel Prize—and the MacArthur Fellowship, which is sometimes called the “genius award.” Dr. Tao spoke about the opportunity he was afforded at a very young age to perform scientific research and the impact that had on his professional life. Not everyone there could claim to be a child prodigy like Dr. Tao, but other successful men and women spoke at the luncheon about how research experiences motivated them during their formative years.

As a high school life science educator, I had the opportunity to involve my students in authentic learning through botanical research. Thanks to grants from Toyota Tapestry, National Environmental Education Foundation, and ING, my students and I built an aeroponics lab, which combined the science of botany with engineering practices. Students grew plants aeroponically using a system that gently sprays plant roots with a nutrient mist, eliminating the need for soil. Employing open-ended investigations, my students designed and implemented experiments, analyzed data, and shared their results with our community. The outcomes included deeper student understanding of the interconnectedness of agriculture and engineering, stronger mastery of research skills, and more positive attitudes toward the field of botany.

The newly released Next Generation Science Standards (NGSS) tout the refocus of K-12 science education as reflecting how real-world science is practiced². Understanding concepts must be coupled with application of content through authentic learning experiences, the kind that come about from research and inquiry. This ideal moves away from a rigid employment of the scientific method³ and toward the reiterative process of asking questions, designing investigations, analyzing data, constructing explanations, using evidence to build arguments, and communicating results. Implementing this investigative process fosters on two potential outcomes: deeper student understanding of science and increased student interest in science⁴.

What many refer to as “inquiry” learning is in essence the heart of scientific practice and research⁵. Scientists engage in the five “essential features” of inquiry, which include: 1) engaging in scientifically oriented questions, 2) giving priority to evidence in responding to questions, 3) formulating explanations from evidence, 4) connecting explanations to scientific knowledge, and 5) communicating and justifying explanations (p. 29). As a result of these types of experiences students show gains in both cognitive and non-cognitive dimensions. Students participating in inquiry-based practices enjoy the open-endedness of learning, and feeling more involved in the classroom⁶. In addition to increasing positive attitudes toward science, students of various backgrounds and contexts develop better conceptual understandings^{7,8}.

Implementing authentic learning experiences in the classroom, like research, often poses challenges. The curricular and administrative demands of state assessments sometimes burdens the time educators have. Financial strains can limit access to research instruments and professional development opportunities that support educators applying these concepts. Programs like CEE's Research Science Institute (RSI) present students with unique opportunities free of financial snags that nurture passion and learning in the sciences through research. While RSI serves roughly 80 students each summer, other learning avenues exist through partnerships with local universities, informal education institutions, and industry. Gains in student understanding only begin to describe the benefits of authentic learning experiences.

The Journal of Experimental Secondary Science provides students with at least two important components of the investigative process: rigorous critique of work and an outlet to share valid research with a scientific community. The honor of publishing legitimate work incentivises the pursuit of scientific endeavors in the classroom. It is not a wonder that students that get “hooked” on research go on to do more work in science, engineering, and mathematics fields, like Dr. Tao and the top two Intel Science Talent Search Winners, all of which participated in RSI. As someone recently implied, appropriate learning experiences do more than just identify talent; they develop it⁹.

References

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