Scientific Literacy: Lives Could Depend on it!

CHARLOTTE MOSER

Carl Sagan famously said “We live in a society exquisitely dependent on science and technology, in which hardly anyone knows anything about science and technology” (Sagan, 1990, p. 264). As demonstrated during the COVID-19 pandemic, all adults need to make decisions that require scientific knowledge and understanding. In some cases, lives will hang in the balance. High school science classes offer one of the last formal opportunities for students to become scientifically literate. However, knowing how science is done isn’t sufficient. Students must also develop the skills to apply that understanding in their adult lives. For this reason, educators can benefit from consideration of how adults learn and make decisions.

Content

We live in a world built on a foundation of science. As such, we will need to make decisions that are—or at least should be—informed by scientific knowledge and understanding. COVID-19 demonstrated that these decisions can be less than optimal. Sometimes the science hadn’t matured to the point of being as useful as it could have been (e.g., COVID-19 boosters in fall 2021) (Akst 2021). Other times, the science was there, but for various reasons, it was not used, or other factors outweighed its importance (e.g., masking in summer 2020) (Lopez 2020).

As scientists, we like to think that if someone knows the science, they’ll use it, but that’s not always the case. Despite this, as science educators and communicators, we must ensure that everyone not only knows the science but also is equipped to understand and use it if they so choose. This gets to the heart of scientific literacy, defined as “familiarity with the enterprise and practice of science” (National Academies of Sciences, Engineering, and Medicine (NAS) 2016). The three-dimensional nature of the Next Generation Science Standards (NGSS) emphasizes scientific literacy by ensuring attention to how science is done (practices) and reinforcing broad central concepts, like patterns and cause and effect (crosscutting concepts) (NGSS Lead States 2013).

Adult learning

One of the most popular theories of adult learning is Knowles’s theory of andragogy (Friederichs 2018). Although it is based on six assumptions, perhaps the two most important to consider when teaching high school students are (1) the self-directed nature of adult learning and (2) reliance on accumulated experiences. These experiences, positive or negative, serve as entry points for future learning and memory consolidation.

As we’re bombarded with information, both accurate and inaccurate, the ability to evaluate its quality and sources is essential. Even though these skills can be gained in many courses, science classes offer a natural environment for their development, particularly as several scientific areas, like vaccines and climate change, suffer from concerted misinformation campaigns. Leveraging these topics, using lessons like “Spread and Accuracy of Online Information: A Case Study Related to Vaccines” (Vaccine Makers Project 2022), builds both necessary skills and entry points for subject matter that students will undoubtedly encounter as adults.

Decision making

Science classes are also a natural fit for helping students develop decision-making skills they will need as adults because decisions involving science-based information, like which treatment to receive during a medical crisis, are often considered “ill-structured problems.” These are complex problems without a single, “right” answer, and as such, they engage an individual’s epistemic cognition (Kitchener 1983). Epistemic cognition, or “how individuals determine what they actually know, versus what they believe, doubt, or distrust” (Greene and Yu 2016, p. 46), is informed by three factors: a person’s epistemic disposition, skills, and beliefs. Science classes commonly strengthen one’s epistemic skills through practice evaluating the reliability of sources and claims, using hypotheses and experiments to learn things, and consulting multiple sources for justification.

However, science education should also contribute to the maturation of one’s epistemic beliefs. Most models describe four phases of development: realist, absolutist, multiplist, and evaluativist (Greene and Yu 2016). Young children begin as realists, viewing knowledge as obtained “simply by asking,” but the goal should be to progress to evaluativists, recognizing that knowledge can be objective or subjective and requires critical thinking to sort out varying views. In today’s complex society, understanding that different types of knowledge exist and being able to critically evaluate competing arguments is imperative.

In sum, we live in an increasingly complex and ever-changing world, and everyone should have the knowledge and skills to understand and make
sense of it. Because much of global progress is science-based and the skills needed to navigate the fast pace and high volume of knowledge are natural extensions of science, high school science classrooms have an important role to play. Not only are these classrooms the last opportunity for formal education related to scientific literacy, they are also the last opportunity for many students to develop the skills needed to apply that knowledge as adults. Lives could depend on our success.

REFERENCES


Charlotte Moser (moser@chop.edu) is Co-Director, Vaccine Education Center at Children’s Hospital of Philadelphia Philadelphia, PA.