What is Science Literacy?

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Science literacy has long been championed as vital to the health and prosperity of Western democracies (Hodson 2003; Levinson 2010). What science literacy can and should look like has been debated by governments, academics, school boards, private companies and activists since the mid-20th century. These debates necessarily overlap with debates about what constitutes citizenship and democratic participation in highly developed technological and scientific nations. There is, however, a growing concern that “science literacy” has failed to live up to the goals of its proponents, and has revealed itself to be little more that a catchy slogan or a failed utopian dream (Shamos 1995).

Concerns about science literacy have been crucial to the development of what has been called “Science, Technology and Society” education reforms. We will call this movement “STS ED.” Proponents of STS ED have called for an approach to fostering science literacy that trains both aspiring scientists and nonscientists in K-12 education to take responsibility for their role in technological and scientific debates and decision-making procedures This involves an understanding of the technical components of scientific and technological fields, as well as an appreciation of the social, political and cultural contexts in which they are developed. However, it is rarely clear how and in what capacity scientifically literate non-scientists can or should be able to meaningfully participate.

Unsurprisingly, in order to address this final point we need to develop strategies for helping students understand the complexity of concepts like ‘democracy’, ‘citizenship’ and ‘political participation. This is made further difficult because current discussions around science literacy are increasingly advocating for turning students into “global citizens”. Significantly, large-scale scientific and technological innovations are not developed in just one nation. These projects, and their subsequent impact on, for instance, the environment, move across local, regional, national and transnational scales. In order develop “global citizens” students need to be sensitive to the fact that science and technology are developed and used in places where democracy looks much different than it does in the United States or might not exist at all (Mansour 2009). The course we’ve developed at CTY might offer some clues for how these issues might be addressed in your own classrooms. To understand the novelty of this course, however, it is important to explore more deeply the history of science literacy in North America.

1. ***A Brief History of Science Literacy***

Though its origins can be traced back as far as the late 19th and early 20th centuries (Shamos 1995; Laugksch 2000), “science literacy” was first introduced in the late 1950s, and it is generally assumed that Paul Hurd was the first to coin the term in his 1958 book, *Science Literacy: Its Meaning for American Schools* (Laugksch 2000). The early goals of “science literacy” were tied to concerns about national identity and the supremacy of American R&D. The concept, from the very beginning, was directly tied to questions about democracy, citizenship, nationalism and general education.

By the 1970s, concerns about science illiteracy deepened, both for critics and proponents of large-scale technological and scientific innovation. There was an increased tension surrounding the diminishing economic and industrial leadership of the United States ( Laugksch 2000; Shamos 1995). This was partially due to the economic and technological rise of countries like Japan and South Korea. The increased competitiveness of technological and scientific innovation at a global scale changed the goals of science literacy.

Yet, how this general education was supposed to look differs depending on who you talk to Broadly speaking there are two schools of thought regarding the goal of science literacy initiatives. On the one hand, government bodies tend to emphasize a brand of science literacy that assumes that the public can never fully appreciate science and technology, and must therefore not have a major role to play in shaping science and technology innovations and policies. The approach that our course at CTY has been designed to emphasize is different. Inspired by the work of STS ED reformers, we champion the fostering of a “critical science literacy” founded first and foremost on the principles of deliberation and social responsibility.

1. ***What is “Critical Science Literacy”?***

Following World War II, it was increasingly clear that large-scale technological and scientific developments had the potential to destroy bodies and environments as much, if not more, than they would benefit society (Shamos 1995). The post-war period saw the rise of a much more radical group of people concerned with the growing scientific illiteracy of the general public.

Since the 1960s and 1970s, education reformers identified with the STS ED movement have advocated for a brand of science literacy that emphasizes “social responsibility” as its first and foremost purpose. The impetus for this focus on “social responsibility” is a concern that society is being thrust into an increasingly risky and uncertain scientific and technological future (Hodson 2003). For STS ED reformers, the public needs to possess more than just a basic understanding of textbook science. They should feel obligated to actively engage in meaningful debates and deliberations about controversial technoscience (Hodson 2003). STS ED reformers have called for the personalization and politicization of science curricula from grade school to undergraduate education. The ultimate goal is for the public to lead more open and deliberative forms of democratic life in technological and scientifically advanced 21st century societies.

This is best referred to as a form of “critical science literacy”. This is a form of science literacy that is founded on the idea that scientists and nonscientists alike need to take responsibility for the use and development of technological and scientific innovations and policies. This has been made increasingly difficult due to the global nature of many science and technology innovations and policy debates.

“Social responsibility” is our first and most important goal. To foster this STS ED situates the learner as a responsible agent, a young citizen, in a world increasingly dominated by the impacts of science and technology. Responsible citizens take responsibility for the impacts of science and technology on society, the economy and the global environment. A science education founded on concerns about social responsibility and individual political agency is necessarily a “critical” form of scientific and technological literacy (Pedretti and Hodson 1995). However, one still needs to question what, exactly, we are asking students to be critical of.

In recent years, there has been a push to develop what is called an “issues” or “action” based approach to STS ED, where students are introduced to local, regional, national and international controversies and disasters. How they engage with these controversies requires students to become increasingly sensitive to the diversity of cultural contexts and practices that drive global science and technology development. These are ambitious goals, and the only way to meet them is to focus on ‘constructivist’ approaches to teaching and learning, as opposed to ‘behaviourist’ approaches. In the behaviourist approach, “the transmission of information from teacher to learner is essentially the transmission of the response appropriate to certain stimulus” (Mansour 2007: 294). This is the model followed in most North American elementary and high schools to this day. One reads, memorizes and responds with the appropriate material. Perfect, of course, for standardized tests. In the constructivist approach, however, “learning is viewed as the active construction of knowledge in gradually expanding networks of ideas through interaction with others and materials in the environment” (Mansour 2007: 294).

The goal of constructivist teaching is to turn the classroom into a collaborative space for teachers and students. It is a space where the individual thoughts, concerns and beliefs of both can be, if not outright embraced, put on the table. To fulfill these lofty and ambitious goals means turning the classroom into a space of democratic deliberation. However, even action and issue-based approaches to STS ED seem to rely on vague and unrealistic understandings of what democratic participation and deliberation can and should look like. In fact, we worry that this call for a scientifically “literate citizenry” that leaves out the institutional and financial frameworks that make scientific and medical knowledge available in the first place.

***References***

Hodson, Derek. 2003. “Time For Action: Science Education for an Alternative Future”, *International Journal of Science Education* 25(6), 645-670.

Laugksch, Rüdiger. 2000. “Scientific Literacy: A Conceptual Overview”, *Science Education* 84(1), 71-94.

Levinson, Ralph. 2010. “Science Education and Democratic Participation: An Uneasy Congruence”, *Studies in Science Education* 46(1), 69-119.

Mansour, Nasser. 2007. “Challenges to STS: Implications for Science Teacher Education”, *Bulletin of Science, Technology and Society* 27(6), 482-497.

#### Mansour, Nasser. 2009. “Science, Technology, Society (STS): A New Paradigm in Science Education”, *Bulletin of Science, Technology and Society* 29(4), 287-297.

Shamos, Morris. 1995. *The Myth of Science Literacy.* New York: Routledge