Technology Literacy: What Informal Education Has to Offer

Alan J. Friedman, Ph.D.
Director, New York Hall of Science
47-01 111th Street
Queens, NY 11368
afriedman@nyscience.org

*Technically Speaking: Why All Americans Need to Know More About Technology* makes a convincing case for creating a technically literate public. The report stresses what the formal education system is doing, and what it could be doing. But the report also acknowledges strongly the potential of informal learning to contribute to this literacy.

As *Technically Speaking* reports, over 70% of Americans are not in school. Even those who are enrolled in school or college spend a great deal of their time outside of the classroom, and not all of that doing their homework. A back of the envelope calculation would suggest that 92% of any individual’s lifetime is spent engaged in pursuits other than formal, curriculum-guided education. So informal learning is not only a supplemental channel we can enlist in the service of technology literacy; it is potentially a major player in a national effort.

Informal learning is already a billion-dollar industry. In the United States there are more than a thousand public science and technology centers, museums, children’s museums, botanical gardens and zoos. A decade ago science, medicine, technology, and natural history programs on television crossed the boundary between noncommercial and commercial channels, so that you can now find a program about bridges, cars, dams, telescopes, computers, genetics, medical devices, airplanes and other technologies twenty-four hours a day. Of course there is the World Wide Web, with sites devoted to any technology with more than a dozen practitioners, detractors, or fans. Any large bookstore will reveal the latest crop of books and magazines on current and historic technologies and their impacts on society.

The public, to a large extent, avails itself of these opportunities for informal learning. As surveys cited in *Technically Speaking* reveal, 120 million people visit science-technology centers each year, and equal or larger numbers visit related categories of museums, watch science and technology programs on television, and read books and magazines on technological subjects. If you’d like to read popular accounts of trade-off, cost/benefit analysis, and ingenious precision measurement, I recommend any issue of *Consumer Reports*, that great publication of technological assessment.

On the train down today I’ve been reading Sam Florman’s new book, *The Aftermath*. Sam is a distinguished engineer, member of the National Academy of Engineering, and his influential non-fiction book, *The Existential Pleasures of Engineering*, is in *Technically Speaking*’s recommended tool kit. *The Aftermath* is an adventure, a science
fiction novel, and it has caused me to realize that nearly all of the “science” fiction I’ve enjoyed for fifty years has actually been “technology” fiction. The heroes, whatever their titles, are acting as engineers, applying knowledge and skills with great creativity to solve a human problem (save humankind from invaders, reach other planets, replenish the Earth). This too is informal learning about technological people and civilizations.

So why are we still talking? Isn’t all the activity of informal learning, by hundreds of millions of citizens every year, already producing a technologically literate society? *Technically Speaking* reveals that we don’t know a lot about the state of technology literacy, but what we do know suggests that we are far from achieving what we believe is essential for a healthy democracy in a highly technological world.

Many of the reasons why informal learning isn’t getting us there yet are argued in *Technically Speaking*. For example, technology is a relatively minor component of science-technology centers like my own, the New York Hall of Science. It is a distant third behind the physical sciences and the biological sciences. Technology on television is most often focused on what technology does, for us or to us, and there is precious little on how the process of technology works, how people create and maintain their technologies, and the ways of thinking and acting that technologists must have to be effective.

What are the impediments to carrying out *Technically Speaking*’s urging that we increase the efforts of informal education to improve the nation’s technological literacy?

**Lack of Pull:** there are not nearly enough engineers and historians of technology involved in informal education, and where they could pull the industry in the direction of technology literacy.

It is very difficult for even the most sympathetic informal educators, including physicists like myself, to be effective in creating technology education unless they themselves live and breathe technology. When the first two dozen science-technology centers in the United States organized themselves into the Association of Science-Technology Centers in the early 1970’s, nearly all the leaders were scientists. They were very good scientists, like Frank Oppenheimer, Mac Laetsch, Dixie Lee Ray, and Tuzo Wilson. But I don’t believe there was an engineer in the group. So the earliest and most successful exhibits, which have served as models during the rapid growth of informal science and technology center education, were not surprisingly almost all devoted to physical and biological sciences.

Transportation and history of technology museums did much better by technology, of course. Engineers and historians were frequently involved, and were even directors. But these institutions focused on presenting the artifacts themselves, and until fairly recently, did little to treat the broader contextual, process, and social dimensions of technology which are called for in *Technically Speaking*. 
We need the extensive, even full-time, involvement of engineers and historians of technology throughout informal education if these media are to reach their potential. In many ways the problems were similar in building informal science education. There were only a handful of scientists who were deeply engaged in informal education, and when they were, like the late Carl Sagan, they experienced career-threatening criticisms from some of their colleagues. The reward systems of industry and of academia are still strongly biased in favor of producing primary product (technical artifacts, publications in learned journals, and funding), and are not very mindful of the value of communicating the essence of technology to the general public. The sciences have made some progress in overcoming these barriers to the participation of scientists in informal education; the technologies are just beginning the struggle.

?? Lack of push: there are pressure points to move informal education into technological literacy, but (until now) nobody has been pushing them very hard.

Informal educators respond to the same pressures as everyone else. Money, recognition, and mandates exist for us too. Grant program announcements from the National Science Foundation have been highly effective motivators for science-technology centers like mine. And NSF does mention technology and engineering, quite often, in its guidelines. But my perception is that there is little premium for going beyond science. Since we have a history and expertise working with fundamental science, it is more convenient and efficient for us to stick to science, most of the time (some splendid exceptions are cited in Technically Speaking). If there were an NSF grant program with funding specifically and solely for developing informal technology learning opportunities, and we knew engineers would be on the review panels, I believe new exhibits, television programs, and out-of-school learning activities on technology would be a-building in short order.

Private funders, even technology-driven companies, have also not pushed hard for technology education per se. Perhaps some of this has to do with wishing to avoid the public perception (and perhaps that of the Internal Revenue Service) that philanthropic funding is going for the selfish reason of promoting the company’s products. It is safer to support the most fundamental science education, rather than interpreting a corporation’s own immediate areas of expertise. Another factor may be that technology-driven companies see science as the first hurdle students must overcome on the way to entering technical professions, so that attention must be paid first to keeping students involved in science. Technically Speaking might serve to encourage the private sector to be more confident that support for informal technology education can be pursued simultaneously with informal science education.

The new emphasis of technological literacy in formal education advocated by Technically Speaking will also help push the informal world in this direction. If the schools need books, videos, software, and field trips to support new mandates for technological education, the informal education industry will soon be filling that need. But we should be careful in thinking that simply creating standards and guidelines will be enough. Today we are seeing high-stakes testing driving nearly every decision in K-12 education.
If it isn’t on the test, it doesn’t matter what coverage the standards or guidelines are crying out to achieve.

There is a lot to be done before the power of informal education is enlisted in this challenge. But I want to end with a note of encouragement. Informal education may already be succeeding in some ways we do not currently recognize or measure. As Technically Speaking points out, most people know very little about even the most ubiquitous technologies such as automobiles or computers. But a small part of the lay citizenry does know a lot about automobiles—car enthusiasts, who can and do rebuild antique cars and create high-performance machines. Another small part of the populace are experts on computer hardware, or software, or the technology of gardening, or knitting, or photography, or digital music, or scuba diving, or woodworking, or ham radio…the list can be extended all afternoon.

Each of these hobbies or enthusiasms involves most of the features of 1) knowledge, 2) ways of thinking and acting, and 3) capabilities, which Technically Speaking defines as being characteristic of a technologically literate citizen. Each of these passions may involve a small percentage of the population, but given the huge numbers of these “technological pastimes,” broadly defined, I would expect that the majority of the population has substantial competence in one or more of these areas.

But I don’t think we (especially those of us of academic bent) know how to evaluate this particular aspect of technological literacy, because people engaged in their technological pastimes do not articulate their knowledge in the same terms we use, for example in Technically Speaking. It is also hard to measure crossover learning. Will the photography enthusiast be able to recognize that he or she is practicing engineering “trade-offs,” “risk assessment,” and “probability analysis” every time there is a decision to be made on which lenses and film to select for a given project? Will the highly capable technical hobbyist be able to apply those skills in deciding what opinion to voice on one of the controversial public issues cited in Technically Speaking? Finding out how to translate and connect what people already know about technology to the language and issues described in Technically Speaking would be a vital challenge to issue to the informal education community.

Until we have many more of the assessment tools that Technically Speaking calls for, we will not know the extent to which we may already have a firm base from which to build. I’m optimistic that we are further along than we think toward achieving technological literacy. We are going to have fun finding this out, and moving on.

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