Guest Article

Technological Literacy Reconsidered

Walter B. Waetjen

In recent years, the term *literacy* has led a life of its own, particularly as it has become linked with certain programs and catchy slogans. There has been no dearth of attempts to promulgate literacy of all kinds — cultural literacy, adult literacy (read that as *ill*iteracy), computer literacy, geographic literacy, ecological literacy, critical literacy, visual literacy (the study of film), scientific literacy and, yes, technological literacy. Those are all honest intentions to have people become more conversant with the wealth of information about the world and the way in which people should function in it. The difficulty with some of them is that the term is used as if the user knew what it meant. *Saying* a term and *knowing* it are entirely different kinds of human behaviors. To be more pointed, because one uses the term technological literacy does not, in any way, carry with it an understanding of the meaning of technological literacy. Is there any danger in using terms unknowingly and indiscriminately? "Unless we are emphatic in what we advocate... we will have another round of failure.", says Hawkins (1990, p. 1) in discussing the roots of literacy.

Much as we may want to deny it, people can, and do, live without the faintest notion of the nature of technology. They may use technology and its products; but, by no stretch of the imagination could they be described as knowledgeable consumers of technology. Perhaps we need to start over and quiz ourselves as to what a literate person is, forgetting, for the moment, modifiers such as cultural, geographic or technological.

Many attempts to develop literacy carry with them the connotation that literacy, in general, is going to hell in a hand basket. That is not true. For the last century and a half, literacy has been increasing in the United States. In 1850, only one in ten persons could read and write. Now we think it is a tragedy if everyone can't read and write. Statistics prepared by the U.S. government indicate that the literacy rate in the U.S. is in the high ninety percentage range. We know that it is not the case, for many students leaving high school cannot read or write. The difficulty lies partially in definitions. From a governmental point of view, anyone who has completed fifth grade is literate.

Walter Waetjen is Interim President, Ashland University, Ashland, OH.

Any educator knows that is a faulty definition. The governmental definition of literacy may serve political purposes, but from a functional point of view it is useless.

Stripping away the verbiage, literacy is the ability to encode and decode a message. If one encodes and decodes very well, he is well-educated at most, or at the least, he can read and write very well. In other words, there is a minimum level of attainment if one is to be literate, but at the same time, there is a range of literacy. The same conditions must apply to technological literacy. That is, technological literacy requires the ability of an individual to code and encode technological messages.

Encoding and decoding means what? The answer is easy in regard to language. It means being able to understand and use words and their meanings. However, let us be certain to make the distinction between orality (speaking a language) and literacy (being able to read and write the language as well as speak it). It's equally easy to define a person who is *numerate*, for that person can code and encode in numbers and form. In discussing literacy, Csikszentmihalyi (1990, p. 119) provokes thought about what technological literacy might be when he says, "Literacy presupposes the existence of a shared symbol system that mediates information between the individual's mind and external events." What is the symbol system, if any, that characterizes technology and describes its essence? But first, for purposes of clarification, let's examine what is meant by the words "shared" and "symbol."

Symbols and Literacy

A symbol is any entity that refers to any other entity that may or may not be present. Those entities may be material or abstract and include such things as words, numbers, pictures, diagrams, maps, and almost anything so long as it is interpreted and used as representing some kind of information. Symbols are to be found alone or arranged in a system.

> Symbols can function alone as meaningful entities; but very commonly, they enter as components or elements in a more highly elaborated system. Thus, words figure in spoken or written language; numbers and other abstract symbols in mathematical languages; gestures and other movement patterns within dance systems; and the like. And a considerable range of meanings can be effectively conveyed when entire symbol systems are used; mastering the deployment and the interpretation (the 'reading' and the 'writing') of such symbol systems constitute a major task for every growing child. (Gardner, 1983, p. 303)

A shared symbol system is simply one that has common meanings and communicates much the same information to a group of people. The group may be large or small, but the symbols have similar information value. Both symbols and symbol systems attain their greatest value in terms of their symbolic products such as: poetry, stage plays, stories, rituals of all kinds, and problem solutions. Could we add the products of technology or the processes of technology to the list? Is there a limit to the number of symbol systems, or can any symbols be arranged into a system? Those questions are key in trying to understand technological literacy.

Does technology have a shared symbol system? The question is rhetorical, leading only to speculation rather than definitive answers. Some would argue that problem-solving, so central to technology, represents a shared symbol system. Then, there are others who might claim that the "technological method" (Savage and Sterry, 1990) is the system of symbols indigenous to technology. Still others imply that the shared symbol system of technology is either a quality of consciousness, a mastery of tools, or both. The fact of the matter is that we have no clear identification of the shared symbol system that may be unique to technology and that, therefore, confuses the matter of achievement of technological literacy. The result is that there is a welter of positions regarding technological literacy.

Literature on Technological Literacy

Many people have written on the subject of technological literacy, all of whom are to be commended for their efforts to describe the complexities of the individual who is literate in technology. Hayden (1989), after a literature review, takes the position that technological literacy is having knowledge and abilities to select and apply appropriate technologies in a given context. While not revealing the source of his thoughts, Steffens (1986, p. 117-118) claims that technological literacy involves knowledge and comprehension of technology and its uses; skills, including tool skills as well as evaluation skills; and, attitudes about new technologies and their application. This insight is similar to that of Owen and Heywood (1986) who say there are three components to technological literacy: the technology of making things; the technology of organization; and, the technology of using information. Applying a Delphi technique to opinions expressed by experts, Croft (1991) evolved a panel of characteristics of a technologically literate student. Those are: abilities to make decisions about technology; possession of basic literacy skills required to solve technology problems; ability to make wise decisions about uses of technology; ability to apply knowledge, tools and skills for the benefit of society; and, ability to describe the basic technology systems of society. Johnson (1989) conceives of technological literacy to be subsumed under scientific literacy with the former type of person having an understanding of the generation of new technology, its control and its uses. The 1991 Yearbook of the Council on Technology Teacher Education is devoted entirely to the subject of technological literacy. This volume examines technological literacy from a variety of angles: its need, as a goal, as a concept, as a program, societal factors influencing it, and in terms of curriculum organization. In this volume Todd (1991, p. 10) says, "Technological literacy is a term of little meaning and many meanings." Later in the same text (p. 11) he makes the statement, "Currently we are unsure whether we are using technological literacy to represent a slogan, a concept, a goal, or a program." The observation has merit.

The literature on technological literacy (going far beyond the sources quoted above) seems to place emphasis on conceptual material, e.g., understandings, knowledge, decision making, etc., and much less emphasis on tool skills, shaping materials, and modeling. This observation, if valid, makes one wonder how so little in the way of praxis could possibly describe a technologically literate person when the *raison d'etre* of technology education is the use of tools, machines and materials. A second inference to be drawn from the literature is the absence of recognition that until technology education has defined its intellectual domain, it is fruitless to try to describe a technologically literate person. The exception to this observation is the opinion expressed by Lewis and Gagel (1992, p. 136) who say, "...to further the goal of technological literacy, schools would seem to have two clear responsibilities; first, to articulate the disciplinary structure of technology and, second, to provide for its authentic expression in the curriculum." The remark is squarely on target and deserves further comment.

Intellectual Domain and Technological Literacy

When one thinks carefully about technological literacy, it is easy to recognize it as an outcome measure. That is, it comes as a result of what is in the curriculum and methods used by the teacher to impart the curriculum. But from whence comes the curriculum? From individual teacher whimsy? From the opinions of an "expert"? The proper answer is that "...the inherent structure of any discipline is the only proper source of learning content; ..." (Inlow, p. 15, emphasis added). Does technology education have a structured body of knowledge, of organizing concepts, of underlying ideas and fundamental principles that define it as an academic discipline? It does not. And because it doesn't, it follows that there is no valid way of determining curriculum content. "If that be true, how can we even hope that technological literacy will be achieved by students if technology education has no structured domain of knowledge. They could not." (Waetjen, p. 8)

As a profession, technology education has been preoccupied with the concept of technological literacy — or so it seems, judging by the wealth of literature of the subject. If that same amount of thought and energy had been directed to defining technology education as an academic discipline, it would be far better off as a profession. It is interesting to speculate whether technology education would have higher prestige if that had happened; or, if fewer technology education programs would have been eliminated.

The precursor to the pursuit of the holy grail of technological literacy is for technology education to take concrete steps to establish itself as an academic discipline. It will take more than strong statements or hastily conceived position papers. Those would serve only to make technology education "an enterprise of methodical guessing", to use Bertrand Russell's words. To become an academic discipline, technology education must specify four things. First, it will have to identify an intellectual domain consisting of a body of credible organized knowledge that is unique, is related to man's concerns in living, and is an array of ideas related in sequential fashion. Second, an academic discipline has a history of the organizing concepts that constitute its domain. Third, there must be a clear delineation of the modes of inquiry by which the discipline validates itself, creates new knowledge, and advances as a discipline. Finally, an academic discipline must be instructive; curriculum content must derive from its intellectual domain. (For a fuller discussion of these four elements, see Waetjen, 1992). Had technology education directed its efforts to the above four elements, it would be on far firmer intellectual ground in its debates and writings on technological literacy. It is not possible to define technological literacy, or measure it, in the absence of an agreed upon intellectual domain for technology education.

End Notes

No matter how the intellectual domain of technology and its resulting curriculum are ultimately defined, there will then be a logical basis for determining the nature of technological literacy. To speculate on the nature of the first two of those three considerations is entirely outside the scope of this discourse. Yet, they will be the genesis of the third consideration — technological literacy. Because of that line of conceptual evolution, we must wait to crystallize the full meaning of technological literacy; but, there are some things that can be said about it now, simply because it is an outcome phenomenon, a human learning.

If technological literacy is based on a symbol system of some sort (and it probably is) then, like the learning of all other symbol systems, there will be developmental variations in its achievement. A student at age ten may be technologically literate, but at age fifteen may not be. Obviously, there are implications regarding teachers' expectations in this connection and so are there implications for those who write about technological literacy and those who seek to measure it. Technological literacy is not an all-or-none learning and should not be described in those terms.

When the profession gets around to defining technological literacy according to the process described above, care will have to be taken to define it at *minimum* for any given developmental stage. The literature too often implies grandiose or maximal levels of achievement of literacy in technology. Caution is predicated by the fact that a given student, for example, may be highly literate when it comes to electronics and considerably less literate about systems of manufacture. That unevenness may be due to variations in teaching, to curriculum content, to student interests, or to a host of other reasons. Whatever the case, the unevenness is not to be decried, for it is an indication of individual human development.

In a world replete with those who swear at or swear by technology, those in the profession must use the term technological literacy with caution. It surely cannot be a neutrally intended term since it is related to educational endeavors and all such endeavors are laden with purpose or value, whether we like it or not, and whether we intend it or not. How can we possibly convince parents, *et al*, that technology education is to be included in the curriculum, and young people are to become technologically literate, if we don't have clearly in mind the intellectual domain of technology education, or the purposes served by a person becoming technologically literate?

References

Croft, V. (1991). *Technological literacy: Refined for the profession, applications for the classroom*. Unpublished paper presented at the 1991 annual conference of the International Technology Education Association.

Csikszentmihalyi, M. (Spring 1990). Literacy and intrinsic motivation. *Daedulus*, *119*(2).

Gardner, H. (1983). *Frames of mind*. London: Granada Publishing.

Hawkins, D. (Spring 1990). The roots of literacy. *Daedulus*, *119*,(2).

Hayden, M. What is technological literacy? *Bulletin of Science, Technology and Society*, *119*, 220-233, STS Press.

Inlow, G. M. (1966). *The emergent curriculum*. New York: John Wiley and Sons.

Johnson, J. R. (1989). *Technology. Report of the Project 2061 phase I technology panel*. Washington, DC: American Association Advancement of Science.

Lewis, T., & Gagel, C. (1992). Technological literacy: A critical analysis. *Journal of Curriculum Studies*, *24*(2).

Owen, S., & Heywood, J. (1988). Transition technology in Ireland. *International Journal of Research in Design and Technology Education*, *1*(1).

Savage, E., & Sterry, L. (1990). *A conceptual framework for technology education*. Reston, VA: International Technology Education Association.

Steffens, H. (1986). Issues in the preparation of teachers for teaching robotics in schools. In J. Heywood & P. Matthews (Eds.), *Technology, Society and the School Curriculum*. Manchester, England: Roundthorn Publishing.

Todd, R. (1991). The natures and challenges of technological literacy. In M. Dyrenfurth & M. Kozak (Eds.), *Technological Literacy. 1991 Yearbook of the Council on Technology Teacher Education*. Peoria, IL: MacMillan/McGraw-Hill.

Waetjen, W. B. (1992). in *Camelback Symposium*: Critical Issues in Technology Education. Reston, VA: International Technology Education Association.