

What Is Technological Literacy?

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The Conventional View

The need for technological literacy is obvious once you think about it. We live in a technological world, and in a democracy everyone should have the competence and comprehension to deal with it. Supported by the NSF and NASA, the International Technology Education Association launched a huge project and came up with standards for technological literacy (International Technology Education Association 1996, 2000). The foreword rightly deplores wide-spread ignorance of technology and calls for the educational efforts a democracy requires. (International Technology Education Association 2000:v,2). “Technological literacy,” the authors say, “is the ability to use, manage, assess, and understand technology” (International Technology Education Association 2000: 9). And what is their understanding of technology?

Broadly speaking, technology is how people modify the natural world to suit their own purposes. From the Greek word *techne*, meaning art, or artifice, or craft, technology literally means the act of making or crafting, but more generally it refers to the diverse collection of processes and knowledge that people use to extend human abilities and to satisfy human needs and wants (International Technology Education Association 2000:2; also 9, 22, 23).

If this strikes you as innocuous, you have to consider that this project of technological literacy has engaged the cooperation and comments of more than a thousand persons and of dozens of institutions (International Technology Education Association 2000: 227-35). Circumspection was a necessity, and blandness was the price of getting the project done. But perhaps it wasn't a price worth paying. Do people in

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fact have “their own purposes?” Are not those purposes, wants, and needs profoundly informed by the technological culture they live in? The dubious view that technology is a value-neutral instrument dominates the *Standards for Technological Literacy* (International Technology Education Association 2000:58, 59, 60, 67, 74).

(1) *The Beginnings of Theory and Expertise in Ancient Greece*

There is a conventional wisdom at work here that is as plausible as it is questionable. Perhaps a turn to cultural developments in ancient Greece will help us to break through the surface of the prevailing opinions. The developments I have in mind converged on the foundational cultural event that began in the Greater Greece of the sixth century BCE and culminated in the Athens of the fourth century BCE. It may have been part of a wider turn of events, of the axial age, so called (Jaspers 1983 [1949]). It had, at any rate, a distinctive shape and gave rise to distinctions that set something new against something old so that from then on what was old seemed limited and insufficient in light of what was new. Most often the distinctions emerged between terms that previously had overlapped with one another. *Mythos* vs. *logos* is one such distinction (Nestle 1998 [1940]). Others are *empeiria* (experience) vs. *nous* (reason), *doxa* (opinion) vs. *episteme* (knowledge), and, important for our purposes *technē* (competence or the art that artists and artisans have in common) vs. *sophia* (comprehension or wisdom). Underlying it all was a shift from piety to curiosity.

Just how these distinctions emerged, interacted, went dormant, and re-emerged at the beginning of the modern era is a complex story (Schiefky 2007). But they surely played a central role in the life of Socrates and in the thought of Plato and Aristotle. Socrates urged the insufficiency of the traditional ways of taking up with the world. The *Apology* is the great monument to Socrates’s impatience. When in search for wisdom among his fellow citizens he finally turns to the artisans (*cheirotechnai*), he finds them proficient in their trade (*technē*), but lacking in wisdom (*sophia*), the comprehension of all the other important matters (*talla ta megista*) (*Apologia*, a 22 D-E). Here as in the *Republic* wisdom is no longer the know-how that comes with competence in a trade, nor is it the larger conventional knowledge of the city, the seasons, the heavens, and the divinities (*Republic*, 427 E-429 A). It is the knowledge that Plato unfolded in the dialogues and that came to be systematized as ontology, epistemology, and ethics. Similarly, in the

Nicomachean Ethics Aristotle acknowledges that wisdom can refer to expertise in a trade, but then sets the term apart to denote “the chief knowledge of the most valued things” (*Nicomachean Ethics*, 1141a-b; see also the *Sixth Letter*, ascribed to Plato, 322 D). For Aristotle too, those things are the principles (*archai*) of philosophy rather than traditional knowledge.

The demands of philosophical comprehension were not an invention of a school of thought that began with Socrates, unfolded in Plato, and found completion in Aristotle and that toppled the establishment and beat out the competition. It was an unforethinkable event, the culmination of the Ionian Enlightenment, that over time has changed the human condition from the ground up. In light of that event, traditional competence seemed to be mere know-how (*empeiria*) that was inferior to a craft illuminated by theory (*technē meta logou* or *logon echōn*) as Plato taught (*Gorgias*, 465 a; *Laws*, 720 b-d and 857 d-e) and Aristotle (*Metaphysics*, 981 a30-b5). There is a medieval echo of this principle in the saying that’s been attributed to the master mason Jean Mignot: “Ars sine scientia nihil est.” From then on, facing up to the requirements of reason and wisdom has been a moral obligation.

(2) *Recovering Democracy and Comprehension*

Let me now narrow my focus, first on the elements of reality and literacy and second on contemporary technological literacy.

For Plato and Aristotle philosophical wisdom was comprehension of the world in all of its dimensions. Thus it included the question: What is the world ultimately made of? What are its elements (*stoicheia*)? Both Plato and Aristotle departed from the then conventional Empedoclean view that there are four elements – earth, water, air, and fire – and both proceeded from there in opposite directions toward ultimacy, Plato to immaterial structures (in the *Timaeus*) and Aristotle to structureless matter (in the *Metaphysics*). For our purposes, Plato’s position is more instructive. His elements were the regular solids or perhaps the triangles from which they can be composed. Plato, moreover, on occasion used *stoicheion* for a new kind of element, the letter, requiring a new kind of competence – literacy – which he regarded with evident ambivalence.

Turning now my focus on contemporary technological literacy, I can put my concern as a suggestion and a question. My suggestion is that today’s conventional

conception of technological literacy promotes competence without comprehension, *technē* without *sophia*. The question is whether elementary comprehension is possible today. Plato and Aristotle would no doubt answer in the affirmative because *sophia* was for them the privilege and obligation of an elite, and clearly we have experts today who understand the ultimate constituents of reality with unprecedented precision and rigor. In a modern democracy, however, where in the most important regards we're all equals, literacy has to be common.

Thus technological literacy today should go beyond mere competence and meet two challenges – the challenge of comprehension and the challenge of democracy. Together these two constitute the challenge of general education. Ancient Greek craftsmen and Athenian society failed to take on the task of general education, but there were good reasons for that failure – a lack of time and resources. We too have failed, but we have no excuses. So why the failure?

The situation of an ancient Greek tradesman, say a carpenter (*tektōn*), provides the foil for an answer. His world on its terms had a perspicuity and eloquence ours has lost. He could comprehend his world all the way down to its elements (*stoicheia*), earth, water, air, and fire, and he understood that in combination they produced the source of his raw material – trees. The Athenian carpenter fully grasped the structure and function of his tools, of an adze-plane, e.g., a “broad but thin blade attached to the bottom of the handle” (Ulrich 2007:18). And of course he knew how to sharpen it and how to run it with the grain of the wood to smoothen a board or a post.

When Plato and Aristotle demanded more of art (*technē*) than know-how (*empeiria*), they probably did not have full-blown wisdom (*sophia*) in mind as the standard a tradesman should meet. But they did call for some sort of theory (*logos*), and it's plausible to assume that the theory in question was the predecessor of those other *Elements*, Euclid's *Stoicheia*. As the *Mechanical Problems* of the Peripatetic School have it, “the how becomes clear through mathematics” (Aristotle, *Mechanical Problems*, 847 a). What the treatise says about the wedge could have been developed and applied to the adze-plane. It would have made it clear (*dēlon*) why the blade had to be thin and sharp.

The mathematical knowledge, presupposed and applied in the *Mechanical Problems*, is no more difficult than what we expect from high school education. Thus the extension of an Athenian carpenter's competence to theoretical comprehension would have been cognitively achievable if not also socially or economically. Such comprehension, to be

sure, is less than wisdom, but knowledge is a condition of wisdom as Aristotle pointed out (*Nicomachean Ethics*, 1141 a; *Metaphysics*, 981 b-982 a), and mathematical knowledge, if we can trust a Hellenistic source, was a crucial and liminal condition for Plato who let no one unschooled in geometry enter the Academy (*Mēdeis ageometrētos eisito*).

(3) *Breaking the Hold of Technological Illiteracy*

Consider now a typical tool of contemporary culture, the iPad. It's widely used by professionals and has been introduced in many a classroom. Surely one should be competent in its use. But such competence is quickly and easily acquired. Toddlers can learn in a day the essentials of manipulating it and calling up what information they like. Of course there is a wealth of information on the Internet that is unintelligible without long and disciplined application. At the same time, the Web offers much of the instruction that is needed to master demanding information. Is the iPad then the portal to knowledge and wisdom? It's rather like a magic mirror on which people can summon whatever they desire, email, games, social networking, books, and music.

Like a mirror, the world of technology presents itself as an impenetrable surface though not a uniformly flat or shallow one. The surface of potato chips has texture and taste, but it does not have the depth or perspicuity that would allow you to trace a chip to its oven, from there to a table, a knife, and a potato, and from there back to a cellar, a harvest, a planting, a plowing, all the way down to earth, water, fire, and air.

We realize of course that these pleasurable surfaces are not the result of magic. They are produced and maintained by a machinery that we know first-hand from work. But it's narrow knowledge that quickly trails off into the *terra incognita* of the supplier on the one side and of the customer on the other. Typical skills today, unlike *technē* in Athens, no longer focus and illuminate a world entire. To be sure, work is far less onerous and perilous and much more lucrative, but it is no longer embedded in a widely intelligible context. We have allowed a world to come into being that favors a profound illiteracy.

The iPad can stand as the paradigmatic device that conceals and indulges our illiteracy through the glamour and variety of its content. It also invites through its structure the question: What are the paradigmatic elements of our time? Picking up on Plato's twofold meaning of *stoicheia* we can ask: What are the elementary particles and letters of an electronic device? The particles are atomic and the letters Boolean. Can

ordinary people learn to comprehend them? The particle that owes its name to Greek amber (*ēlectron*) and has lent it to today's paradigmatic device is the electron. The Boolean letters are one and zero. The grammar of the electron is quantum mechanics, and the grammar of ones and zeros is Boolean algebra or symbolic logic. Nothing more than high school geometry, algebra, and trigonometry is needed for a rudimentary understanding of quantum mechanics; and not much more than what is taught in high school is needed for the Boolean algebra of logic gates.

It's defeatist to give up on algebra and high school students. What is needed are teachers whose expertise and enthusiasm generate the leaping fire that kindles the light of comprehension (Plato, *Seventh Letter*, 341). In their recent book, *The Quantum Universe*, physicists Brian Cox and Jeff Forshaw have shown, if less than elegantly, how to start with a single electron, go on to atoms, the elements, semiconductors, get to the transistor, and finally show how the transistor can be seen as the materialization of the simplest logic gate, the inverter (Cox and Forshaw 2011).

If such knowledge can be assumed, it's possible to break through the surface of technology and the superficiality of conventional wisdom. You can show that at the bottom of reality and technology there is an elementary order of wonderful simplicity and beauty. While it's always possible to reach those elements from the top by way of reduction, it's impossible to construct the everyday world in a continuously comprehensible and comprehensive order by derivation from the bottom up. Summary terms and features emerge from rising complexity, and that emerging world has to be recognized as it reveals itself.

(4) *Conclusion*

What incisive technological literacy needs most is a comprehension of the distance between the appearances on technological surfaces and the appearance of actual things. *Within* the background of microphysics a tree on an iPad and a tree on a rocky slope come down to the same things – molecules, atoms, particles. But *against* the background of quantum mechanics and logic gates and in the world of emergent phenomena, the two trees differ greatly in intelligibility and presence. A child can see a tree on an iPad and touch it, but she can touch a bird as easily and in exactly the same way. Let's say the tree is a ponderosa pine, and on touching it the child is showered with

the treasures of dendrology. But all that information comes from nowhere and disappears into nothing. So with a bird, a Steller's Jay say, and ornithology. Layered on the indifference of the microphysical substructure is the indifference of the technological substructure. Against that background the commanding presence of shining things reveals itself, the pine that has been growing here for three hundred years, shows the scar of many forest fires and shelters this jay with its unearthly blues and blacks and its indignant scolding.

We are not living in a dichotomous world, with natural things on one side of a divide and electronic devices on the other. Reality today is continuous between extremes. We find rocky slopes next to gardens, violins next to the gardens, the violins next to Fender guitars, those guitars next to laptops and iPads; and all of this emerges from particles, atoms, molecules, compounds, tissues, and materials. So to see the world and one's place in it is not quite wisdom, but perhaps it's a beginning.

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