

Is Technology “Just a Tool”?

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Faculty teaching in liberal arts colleges and grappling with rapid changes in computers and information technology often respond in a conservative and even defensive manner by arguing that technology is “just a tool.” At most, they assert, technology affects how we accomplish our goals but does not affect what we want to do. Technology, therefore, is only a means to an end and does not shape or define the ends themselves. Educators in liberal arts colleges need make only minimal changes to accommodate information technology. Seeing technology in such instrumental terms helps preserve the conclusion that human values are autonomously developed through a system of rational debate and discussion, and rarely change in important ways. A conservative reading of human relations would have us conclude that not only does technology have a limited impact on human purposes, it **should** only have such a role.

However, there are times when this view of technology must be discarded, because it can be terribly wrong and lead us to a fundamental misunderstanding of the significance of technology in social, political and economic change. Sometimes technical advances alter not only the patterns of human interactions but also shift the possibilities and therefore the ends of human life. Common now is the proposition (made by serious scholars, not wannabe dotcom billionaires) that digital technologies are profoundly reshaping economic, social and political relations. If we are correct in estimating the significance of the changes underway, the impact on education – perhaps especially, higher education – will be substantial. This paper attempts to outline some of the main instances and consequences of technological change in the past, mainly to assess the view that technology is “just a tool.” Further, we seek to demonstrate that contemporary technical changes are on the same scale as those of the past and suggest some of the ways education in the liberal arts can be affected.

It is relatively easy to find ways in which technological changes have altered human activity, purposes and interaction in the past. The development of agriculture about 11,000 years ago generated a far larger amount of edible calories and permitted an increase in human populations. What’s more, the humans adopting agriculture shifted from a nomadic, hunter-gatherer existence to one of more permanent settlements. The resulting stored food fed non-agricultural producers who specialized in the various tasks associated with creating a complex society.¹ About 1800 BCE, the combination of the invention of the war chariot, spoked wheel, friction-reducing axle, and compound bow had profound effects on military advantage and thereby on the basic structure of class

¹ Jared Diamond, *Guns, Germs and Steel*, New York: W.W. Norton, 1998, 88-90.

relations. The high cost of production and high skills in the use of these weapons led to a narrow elite dominating society. About 600 years later, technological changes in the ability to make tools and weapons cheaply from iron expanded the economic, military and political power of ordinary people. The relative ease in the ability to fashion iron plowshares increased production of food, and this food was controlled by a much wider stratum of people. These same people could produce and equip an army of men with metal arms and armor, and this army could defeat the warrior elite armed with chariots.²

There are many other examples, from paper, electricity, the printing press, the telegraph and railroads, to the invention of mechanical spinning. Each had profound consequences for the formation and development of values and society. This argument about the impact of technology does not depend on a deterministic logic; human institutions must emerge for technology to generate large consequences. Put another way, technologies are embedded in institutions that can nurture or impede change. These institutions shape choices, support or resist innovation and the dissemination of new ideas and values, and provide the means to amplify or retard technological development.

What is it about some technologies that lead to such large consequences? The power of technology in redefining values comes primarily from its impact on the material aspects of life and the consequent effects on other realms of human activity. Each of the great technologies of the past had some combination of four qualities: first, the technology dramatically expanded what we could do in areas that mattered; second, the technology did so in a very cost-effective manner, and usually at a declining cost; third, the technology had extensive externalities and spillovers affecting wide areas of human life; and fourth, the application of the technology fed on the effects of the first three to generate positive feedbacks or increasing returns to scale. To pick agriculture, the development of the technology for growing food offered a much better version of an essential requirement for sustaining human life and it did so at a cost that was much lower than the hunter-gatherer strategy. Agricultural populations not only increased, but were healthier and able to develop a host of additional institutions.

How do the changes in digital technologies measure up to the transformations of the past? Can we conclude that the effects of digital technologies will rival railroads and agriculture? There are several characteristics of digital technologies that point toward profound effects. Digital technologies operate globally and in a near-ubiquitous manner and have fundamentally altered the nature and role of information and knowledge in society. Complex and richly textured information flows have become globally pervasive, because creating and distributing information is so inexpensive. Somewhat ironically, though the cost of obtaining and disseminating information falls by 35% per year, the actual value of information is increasing when it can be used to develop knowledge. When the cost of doing something important falls exponentially while the capabilities for accomplishing it rise exponentially, material relationships are rapidly and radically restructured.

² William H. McNeill, *The Pursuit of Power*, Chicago: University of Chicago Press, 1982, 9-13.

Unlike television, digital technologies are both a product in themselves and the key technology responsible for changing the process and organization of production. More and more economic activity revolves around production based on or enabled by digital technologies, and the processes are increasingly global. Real-time information flows create new systems of management. Governments are hard-pressed to cope with a now borderless world, while many new political actors have come into existence because of inexpensive global communications. The conduct of war and the threats to national security are defined by the ability to use digital technologies most effectively. And the network effects that arise from increasing usage mean that the value of having a larger network increases exponentially.

Beyond the powerful consequences for production, politics and war, the information revolution spawned by digital technologies has numerous, and perhaps even greater, effects in other areas. The mapping of the human genome and the developing science of genomics depend on powerful but inexpensive computers. Likewise, nanotechnology³ – the science of building things at the molecular level – and neurotechnology⁴ – the biological and genetic manipulation of the brain – depend on advancing digital technologies. The intersection of these efforts – stem cell research, creating human organs that are part biology and part machine, developing computers from DNA – help define some of the intensely important externalities and spillovers from digital technologies. Innovations have begun to cluster and interact in ways that speak to the scope and significance of the present and coming transformations in technology and society

What can we anticipate as the consequences of digital technologies for liberal arts? Prediction about the future is very problematic, especially in cases of radical technological change. This is because the interactive dynamics associated with technological change and innovation generates emergent characteristics that cannot be predicted from initial conditions. Several scholars have argued that 95% of the changes in our lives from digital technologies lie ahead of us. Moreover, the institutions of society – including liberal arts colleges – can affect the trajectory of change. At the very least, liberal arts colleges must address the profound questions raised by this era of extreme change. To fail in this regard is to relegate liberal arts colleges to irrelevance.

Because digital technologies have such pervasive consequences, virtually all disciplines must make a contribution. A much greater scientific literacy is essential to making informed choices; social sciences need to clarify the consequences of this new world; and humanities and the arts can help us see this situation from new perspectives. At the same time, simple practicality means students must become highly competent technologically in order to do their jobs. And faculty must become adept at both understanding the technology and using it in teaching.

³ *Scientific American*, Nanotechnology @ <http://www.sciam.com/nanotech/>

⁴ *The Economist*, “Open Your Mind,” May 25, 2002, 77-79.

The powerful force of critical understanding developed in liberal arts can matter best if our students understand the nature of technology, information and knowledge from the inside. Students must be equally adept at: accessing, identifying, and evaluating information; creating and disseminating digital information; using technology to develop knowledge from information; using technology to define and enable collaboration; and bringing to bear their historical, analytical and evaluative knowledge on innovation and the purposes to which information and knowledge are put.