SHOULD EVERYONE LEARN ANYTHING?: THE QUESTION OF COMPUTER LITERACY

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In developing a new area of knowledge, one of the most difficult problems is working out a framework in terms of which to define the area. The emerging subject of "computer literacy" is a case in point. What should colleges and universities teach about computers? And to whom? Rather than beginning with such "computer literacy" issues themselves, we start with the more basic question of how educators make any decisions about the appropriate content and audience of higher education. The question of teleology in higher education is examined in terms of four conceptual categories: acculturation, economic considerations, social mechanisms, and mental discipline. These four categories offer one plausible framework for crafting rational procedures for deciding what to teach college students about computers.

key words: computer literacy; higher education;

I. DEFINING THE PROBLEM

Reinventing the wheel appears to be a favorite activity in American higher education. Every few decades, our colleges and universities decide that the education they require of students is all wrong. Curriculum committees then set about trying to decide what every modern educated graduate should know. Most such committees labor seemingly unaware that their forbears worried over precisely the same questions. As a result, the past is rarely taken as prologue.

The newest candidate for the curricular grist mill is so-called "computer literacy". Should we teach it? If so, to whom? This question is currently worrying faculties and administrations at practically every college and university in this country (not to mention their counterparts in lower education).

What should we in higher education do about the teaching of "computer literacy? Should we teach it to everyone? To only some students? And what is it that we are proposing to teach? Do we intend to teach students about computers? to teach them programming in BASIC? multiple programming languages? machine hardware? ethical implications of computer use and misuse? Each of these possible definitions of computer literacy (and their various permutations) has been proposed by one curriculum committee or another. Suffice it to say that there is little agreement.

Joining the debate, this paper will examine the question of what we should teach about computers, and to whom. However, rather than beginning with the issues of "computer literacy" itself, we will first ask a more basic question: How do we make any decisions about the appropriate content and audience of higher education? I suggest that by stepping back from the particular issue of computer literacy and considering the broader question of teleology - that is, the rationales behind decision-making - in formal education, we can construct a methodology that will enable us to work out defensible arguments for policies about computer literacy.

How does such an argument work? We will begin by talking not about curricular requirements, but about the rationales that underlie our educational policies. Drawing upon the history of higher education in the Western tradition, we will come to recognize very precise (and often surprising) rationales underlying the types of formal education we have offered to (or required of) students

through the ages. The arguments we will be looking at are grouped into four main categories:

A. Acculturation
B. Economic Considerations
C. Social Mechanisms
D. Mental Discipline

We will look at each of these categories in turn, offering definitions and historical illustrations. This framework can then be used for examining rationales for curricular decision-making in particular contemporary instances--such as the teaching of computer literacy.

A few caveats before we begin. First, when I speak of "curriculum", I am primarily interested in higher education. Yet, the issue of higher versus lower education tends to become muddled. Much of what we now teach in universities used to be taught in lower education (e.g., beginning Greek and Latin), and some of what we are now teaching in colleges may soon be moved back to lower education (e.g., computer literacy). Second, my listing of rationales does not imply I agree or disagree with these arguments. My attempt here is to be as unbiased an historian as possible. Third, the list is, I am sure, incomplete. Some of the most glaring rationales missing here are "aesthetics" or "personal enjoyment". Their omission does not imply they are unimportant. Rather, they are absent because these sorts of arguments have historically been offered in defense of learning in general rather than in defense of explicit curricular content. My concern in this paper is with rationales for specific subject matter.

A fourth caveat concerns my distinction between "individual" and "communal" educational goals. It is often difficult if not impossible to separate the two. Yet much of our educational rhetoric espousing the personal benefits of learning subject X is actually a recasting of a socially conceived goal. Religion teaches the personal importance of morality, but personal morality also helps prevent social breakdown. Scientists of the 1960's labored to instill within us an individual sense of wonder at the physical universe, but their government contracts promised to beat the Russians to the moon.

A fifth and final caveat acknowledges that some of the rationales I am presenting here may not have been openly articulated by the people who, I am suggesting, employed them. Such silence, however, does not automatically disprove the attribution. Hindsight often brings clarity that is not possible in contemporary situations. Moreover, historical rationales may be forgotten by contemporary practitioners. And finally, official spokesmen are often loath to reveal publicly the actual motivations behind decisions.

II. THEORETICAL ARGUMENTS FOR CURRICULAR DECISIONS

A. Acculturation

The first of the four categories of curricular motivations I want to talk about is what I am calling acculturation. By acculturation, I mean teaching members of a society an existing set of norms, beliefs, or cultural artefacts such that new members of the society, by learning them, can participate in cultural traditions. We are familiar with such acculturation in our normal socialization activities. Children are acculturated in the native language of the community, in society's aesthetic conventions, in its folkways (from accepted responses to death to the right feelings about Darth Vader).

But acculturation has also been a goal of formal education. In 5th century (B.C.) Athens, a vital component of a young man's education was learning by heart the Iliad and the Odyssey. The poems were seen as embodying the personal and social values which grounded a citizen's behavior and beliefs. In 20th century America, we teach our own version of acculturation: "Survey of Western History", "Introduction to World Literature", "Art from Cave Painting to Cubism". In offering (or often requiring) such courses, we are saying to students, "to be a functioning member of this society, you need to be familiar with the cultural presuppositions underlying our social activity. Understanding references to Shakespeare's King Lear or Picasso's Guernica is as important to successful social integration as knowing which side of the street to drive on, or recognizing the difference between a dog and a hot dog".

B. Economic Considerations

My second category of curricular motivations is economic considerations. By this I mean, designing curricula with the explicit purpose of bettering the economic prospects of individuals, institutions, or societies.

1. Individuals

Perhaps the most forceful curricular example of economic motivations that directly affect individuals is the medieval English university, an institution that is often assumed only to have engaged in learning "for learning's sake". A brief sojourn into the history books reveals that 13th century Oxford was far more pragmatic in its curriculum than popular academic lore would have it.

There was, for example, a whole program of study called ars dictaminis that trained young men to handle the written affairs of the reigning (though illiterate) nobility (Morison 1935). There was also a program for preparing students to become managers of noblemen's agricultural affairs, and the curriculum included such down-to-earth topics as business management and the relative merits of alternative forms of crop rotation (Oschinsky 1971).

2. Institutions

Another little known (or acknowledged) domain of economic considerations in curricular design is the needs of the educational institutions themselves. Many of us are familiar with President Charles W. Eliot's radical reformation of the Harvard University curriculum in the 1870's, whereby he gradually threw out all course requirements and made the curriculum entirely elective (Butts 1939). In fact, almost 20 years earlier, President Francis Wayland attempted to do the same thing at Brown University (Wayland 1850). What is not generally known is why Presidents Eliot of Harvard and Wayland of Brown were willing to consider such a radical rejection of the entrenched required classical curriculum. While the motivations were, as you might expect, complex, they were also--as you might not expect--at least partially economic.

Brown University's President Wayland was acutely aware that newly-emerging schools of agriculture and engineering were luring away students from the liberal arts colleges whose curricula were restricted to such traditional subjects as Latin, Greek, rhetoric, and moral philosophy. Wayland argued that if Brown didn't begin offering such practical electives as mechanics and chemistry, it risked bankruptcy (Wayland 1850; Rudolph 1977).

The case of Harvard University was slightly more involuted. While Eliot's initial motivations for the new undergraduate elective system were overwhelmingly pedagogical, the plan dovetailed with growing economic expediencies. In the early 1870's, Harvard began offering graduate-level specialized education. While there were few graduate students in the early years, Harvard still needed to hire a number of new faculty members. But who would fill their classes (and thus justify their salaries)? The new undergraduate elective system freed undergraduates to enroll in the specialized courses offered by the new graduate faculty, thereby providing these new faculty members with respectable teaching loads (Hawkins 1972).

3. Society

The last of the three subcategories of economic considerations is curricula that are motivated by broader social concerns. An obvious example of this (though not in the realm of higher education) is the birth control education programs found in poorer countries that can't afford their current rate of population growth. Moving into the domain of more formal (though again, not "higher") education, we might consider the economic necessity of having a nation's work force speak the same language--and hence the emphasis upon the teaching of grammar both in the outposts of the Roman Empire and, nearly two millenia later, in immigrant America.

Less transparent are the national economic policies underlying higher education. Yet such motivations are often nonetheless present. A particularly rich example is the university curriculum underlying the administration of the British Empire. A thorough grounding in the making and administering of the Roman (and what was mistakenly identified as the Greek) empires had obvious value for the colonial administrator attempting to manage the "barbarians". Motivations behind university programs in non-western languages or in tropical diseases should also be self-evident. In fact, one prominent anthropologist, Melville Herskovitz, has argued that the development of British social anthropology itself is the direct outcome of the British Empire's need to understand the local customs and beliefs of the people it was attempting to govern.

C. Social Mechanisms

The third, and most diffuse, of my four major categories of curricular motivations I am calling social mechanisms. These provide a means for society to meet its individual and collective needs. Obviously, this description encompasses both acculturation and economic considerations. However, I would like to reserve the term "social mechanisms" to refer to those arguments that involve other than the basic types of acculturation, and arguments that are not strictly economic. Needless to say, there will be much debate on what constitutes "basic" acculturation, or a "strictly" economic argument.

1. Make Citizens Able to Function Well in Society

There are at least four subcategories of social mechanisms we might identify. For the first, I have coined the admittedly awkward label make citizens able to function well in society. By this I mean, teach people those skills that are not part of basic acculturation (like knowing how to eat with a fork or knowing who Napoleon was), but which increase one's chances of attaining a personally

satisfying and productive life. Obvious candidates here are the more advanced courses in history, literature, and art. But there are other examples which are more distinctive.

In 4th century (B.C.) Athens, citizens had to defend themselves in all legal matters (i.e., there were no "professional" lawyers), and Athens was becoming an increasingly litigious society. The training provided by the sophists flourished as a means of enabling the average citizen to develop the rhetorical skills necessary to win favorable adjudication. A more contemporary example is the educational policy of most western European countries of making their citizenry at least bilingual, given the multiplicity of languages spoken in such a small geographic space.

2. Work out Social Problems

A second type of social mechanism argument is one that designs curricula to help work out social problems, now or in the future. Contemporary courses on the Vietnam War or on nuclear disarmament fall into this category. But so, too, do at least two major curricular revisions in 20th century American higher education. Following World War I, a group of faculty members at Columbia University expressed dismay that highly "educated" European societies could have conducted such a savage war. A set of required courses--on the humanities and on western civilization--was Columbia's response. If students could be taught to reflect on the ways of good and evil in times past, they might help avoid such human tragedy in the future (Bell 1966). With much the same motivation, following World War II, Harvard University commissioned a group of faculty members to consider what would be an appropriate "General Education in a Free Society" (General Education in a Free Society 1945). Although many of the recommendations were actually aimed at secondary schools, they were later incorporated into Harvard's famous "general education requirements".

3. Establish Differential Status

A third--and radically distinct--sort of social mechanism is the establishment of differential social strata through education. As you know from reading the Republic, the idea that education might be used to distinguish between classes of citizens is not a new one. While contemporary Europe has perpetuated various versions of this model through "school leaving" or "school entering" examinations, American education has generally moved towards democratization of educational opportunity. Homer and Hume are proffered to millions of students across the nation each year, a practice unfathomable in much of the rest of the world.

4. Defrocking the Priesthood

The last subcategory of social mechanisms I would like to mention is what I call defrocking the priesthood, that is, educational policy explicitly designed to undo the kinds of status inequities we have just been talking about. Statistically, perhaps the most important example of this has been the teaching of literacy as a result of the Protestant Reformation.

D. Mental Discipline

Thus far we have looked at acculturation, economic considerations, and social mechanisms as factors motivating curricular decision-making. The last of the four categories I want to address is that of mental discipline, that is, the argument that learning subject X (a discipline or skill) will simplify the student's learning of subject Y .

There is no time here to discuss the details of what popularly came to be known as the "mental muscle" theory. Suffice it to say that from the 18th century to at least the end of the 19th, it was all but universally agreed that the teaching of Latin developed mental acuity that could then be applied to the learning of specific content areas. Other favorite 19th century candidates for transferable mental improvement included mathematics, logic, and rhetoric (Kolesnik 1958).

III. MOTIVATIONS FOR TEACHING COMPUTER LITERACY

Thus far, I have suggested a framework for talking about motivations for curricular decisions in higher education. The question now is, does this framework help us make decisions about whether anyone (or everyone) should learn "computer literacy"?

To answer this question, let us consider once again the four categories of curricular motivations we have just been discussing. Our aim will be to identify some of the rationales that might be used for advocating the availability (or requirement) of the teaching of particular kinds of knowledge about computers.

A. Acculturation

Consider first the issue of acculturation. Many educators today are arguing that while the general population doesn't need to know computer programming or computer hardware, we all do need to know about computers: how they function (in broad outline), how they might be used, and how they might be misused. The rationale for such universal training is

that as society's functions become increasingly governed by computers, a basic familiarity with computers will become as necessary as knowing how to use a telephone or speak the language. Already, spoken English has become rife with computer terms: I/O device, hacker, crash. Equally to the point, it is now becoming difficult to transact much of ordinary business without directly using computers. Citibank of New York, for example, has actually replaced the tellers at several of its branches with machines. If you won't use the machine, you literally cannot make deposits or withdrawals. (The only exceptions, it seems, are made for customers with especially hefty bank balances.)

The issue of acculturation also becomes significant in dealing with questions of computer ethics. Here the problem is not so much should we teach ethics, or to whom should we teach it, but how should we teach it? The recent publicity given to computer "peeping Toms" has made it clear that the ethical (not to mention legal) limits of electronic privacy are far from clear. In his 1983 Turing Lecture delivered to the annual meeting of the ACM in New York, Ken Thompson of Bell Laboratories argued that we must "indoctrinate" the young in the ethics of computer use. But how? It is difficult to inculcate a new ethical standard which contradicts existing ethical norms. Computers are increasingly used within the privacy of one's own home, and in America, activity at home that is not blatantly criminal is generally either legal or condoned. No wonder the kids are confused.

B. Economic Considerations

What about economic considerations? What can we argue about individual, institutional, and social motivations? We'll start with individuals.

1. Individuals

Today's universities openly admit that computer courses may contribute to students' future economic well-being. While community colleges and state universities have taken the lead here, the private schools are not far behind.

What kind of computer learning are we talking about? The deciding factor here is less curricular rationale than available resources. Nearly everyone in college today wants to learn programming, and not simply in BASIC. The overwhelming growth in computer science majors (added to the number of students who are turned away) indicates a clear motivation--typically economic--to learn hardware and to learn software engineering as well.

Let me hasten to add that individual economic motivations--articulated either by students or administrators--are not necessarily consonant with economic reality. College students graduating with several years of programming courses are now having a difficult time securing programming jobs, and the collapse of Osborne Computers along with recent financial disasters at Texas Instruments and Atari should warn us that the market can wreak havoc on even well-engineered hardware.

2. Institutions

Institutional arguments for computers bear more than a shade of resemblance to the economic arguments we saw from Presidents Eliot and Wayland. A number of universities are proclaiming the need for large amounts of sophisticated hardware. (Just what they want students to do with that hardware, or which of the students they want to do it, is, in many cases, still unclear). The first order of business appears to be to convince this year's crop of college applicants that Panacea U. can match the other schools they are applying to in Nobel Laureates on the faculty, number of books in the library, size of the student activities budget, and accessibility to computer terminals.

3. Society

Third, what about the larger social dimension of these economic arguments for computer literacy? The clearest trend is to provide a steady pool of data processors who will be available to handle the vast amount of data that society generates. That means teaching the programming languages that data processing departments in government and industry are using. The problem, of course, is how many people should we train, and in which languages. Despite all the talk about the ever-growing flood of data to be processed, there is unemployment among the ranks. Moreover, if the current data processing standards of COBOL and FORTRAN are replaced by C or Ada, what will we do with the thousands of "obsolete" computer monolinguals?

An even more uncertain question is the development of software and of hardware-software interfaces. Latter-day capitalism demands the continual development of new products, and the computer industry might well form the backbone of the next era of the American economy. For this, students will need to learn low level programming languages, and a reasonable amount of computer hardware. Yet before we start requiring everyone to learn assembly language, we should remember, much as in the case of data processing, that the future shape of the market (that is, "society's economic

needs") remains unclear.

C. Social Mechanisms

What about curricular arguments for computer literacy relating to what I have called social mechanisms? There are, you will recall, four different categories we might look at.

1. Make Citizens Able to Function Well in Society

What kind of computer literacy do we need to make citizens function well in society? The ability to handle applications packages is one obvious candidate--allowing us to balance our checkbooks and avoid embarrassing moments at the bank, or to produce error-free documents, thereby increasing everything from our course grades to our job prospects. Facility with manipulating data bases can put vast amounts of information at our fingertips, and knowledge of even simple programming can provide both entertainment and personal satisfaction.

2. Work Out Social Problems

How might computer literacy foster the working out of social problems? While computers themselves are impartial to war or peace, justice or injustice, they can become powerful tools for effecting social change. By learning to feel at home with turnkey systems, the general populace can dramatically increase the speed at which it can accurately transmit information. By studying natural language processing and sophisticated computer programming, specialists working with computers might actually make machine language translation a reality (thereby fulfilling some of the social goals of the creators of such universal languages as Esperanto). And by learning how to use sophisticated simulation applications packages, political and economic forecasters may be able to foresee the consequences of proposed policies before committing us to actual programs.

3/4. Establish Differential Status/ Defrocking the Priesthood

No one today speaks of intentionally using computer literacy as a way of establishing differential status among sectors of the population. In fact, just the opposite is generally argued: it is necessary for all branches of society, public and private, rich and poor, to have access to computers.

But even if this dream comes true, there is still the question of what people are supposed to do with these computers once they have them--the same problem we raised a moment ago in talking about our universities' collective drive to purchase hardware. As we have seen, there are many uses to which the omputer can be put without knowing very much about computers--how to operate them, or how they operate. In fact, the current trend towards making computers ever more user-friendly may actually result in increased gaps between classes of computer users, even though everyone has access to computers. Once again, as in the 1960's and 1970's, we may revert to "computer wizards" who actually know what is going on in the machine. But the analogy will not, alas, be precise. In the decades to come, computers will exert far more control over our lives than even the "computer wizards" of the past could have imagined. Therefore a compelling argument for requiring everyone to learn at least the rudiments of computer hardware and software is to guard against the establishment of a powerful computer priesthood.

D. Mental Discipline

Finally, let's turn to our fourth category of argumentation: mental discipline. It is curious to see how history repeats itself. In 1901, Edward Thorndike claimed to have disproven the "mental muscle" theory. Over the past 80 years, scores of psychologists have contributed experimental data on the question, and the general consensus now is that the 18th and 19th century versions of the thesis are indefensible (Kolesnik 1958). Now "computer literacy" comes along, and suddenly you can once again hear how learning discipline X (in this case, computer programming) may help in the learning of discipline Y (vaguely referred to as "thinking") (Seidel et al. 1982).

Yet there is a serious question buried here. Just as there must be some transference in human learning from one context to another (if there weren't, we literally could not survive as human beings), there may well be some useful transference of what is learned in dealing with computers to other contexts. But what kind of learning? And what kind of transference? Will flowcharting do it? BASIC? Before we can answer these questions about the teaching of computer literacy for reasons of mental discipline, we will need not only to examine very carefully the literature on mental discipline, but also to ask ourselves just what we are really teaching (or could be teaching) when we teach a person about computers.

IV. SHOULD EVERYONE BECOME COMPUTER LITERATE?

In this paper, I have attempted to develop a framework in terms of which colleges and universities can make rational

decisions about who should study what about computers. We began by considering four broad (albeit overlapping) categories of motivations that have historically been used to introduce or justify particular curricular offerings. In the course of this discussion, we discovered, I think, several things:

(1) To determine if a subject should be "required" or even "available" to a university curriculum, we first need to determine what we need to know in order to make any curricular decision.

(2) What we need to know to make these decisions necessarily goes beyond the scope of the subject matter to be taught itself.

(3) Even if we do our homework, it is unreasonable to expect that all of our curricular decisions will later be justifiable in the hindsight of history.

I then used these four theoretical categories (and conclusions) as a framework for developing precise arguments for teaching particular kinds of knowledge about computers. Let me summarize what I think we have learned:

1. The computers are coming, whether we like it or not. The sooner we (especially of the "older generation") come to feel comfortable with at least turnkey systems and simple applications programs, the better off we will personally be.

2. Learning at least simple programming (not necessarily in BASIC) will probably benefit everyone, but there is no way of establishing this now for sure. We still need to understand more about the possibilities of learning transfer and more about the directions the data processing industry is going in.

3. It definitely will be useful for at least a substantial number of people to become proficient in multiple programming languages and in computer hardware. It is also probably advisable for everyone to have some basic understanding of languages and hardware so as not to lose all epistemic grasp over this omnipresent machine.

4. Everyone will have to become acculturated in a new set of computer ethics. However, before such acculturation is possible, we will need to understand the problems inherent in defining a social ethos that in some ways is new, and in some ways actually contradicts existing canons of social behavior.

This paper has not offered a definitive answer to the question of whether everyone should develop computer literacy. What I have attempted to show is that this is really the wrong question to be asking. The more appropriate question, I suggest, begins with teleology, not requirements. If we can figure out why we want students to learn particular things about computers, the issue of requirements becomes trivial at best.

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