"Technology is not new in education, but today, it is sometimes students, rather than teachers, who are the innovators . . ."

Computers—Their Growth and Meaning for Man*

by

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This paper will discuss the state of computer technology in the country, guidelines on the use of computers for the improved welfare of society, and some observations regarding the use and application of computers in Third World countries.

What is educational technology?

David G. Hawkride (1), professor of applied educational sciences at the Open University in Great Britain defines "technology" as the materials, tools, systems and techniques proper to an occupation, while "educational technology "refers to the use for educational purposes of inventions, manufactures and processes, which are part of the technology of our time.

In this regard we agree with Michael Clarke (2), Director of the Audio-Visual Centre of the University of London, that educational technology should not be made to imply that, because so many of electronic and audio-visual devices are technological in origin, there exists a "technology of education", much like we have technologies of refrigeration, radio assembly, and paper manufacture. Educational technology is not a system of control, resembling automotive or aeronautical technology, so that for a given input and a given design, there is a predictable given output. Education as an integrated intellectualism and effective process builds and protects human freedom and stays away from any form of precision control and robotism of the human person.

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It is good to note here that even in the far past, new inventions and devices have been adopted by teachers or students as soon as they proved themselves appropriate in function and price. Technology is not new in education. But today it is sometimes students, rather than teachers, who are the innovators. In industrialized nations, where the price of electronic devices has been steadily falling, it is often the child who is the first to bring four-function calculator into the classroom and pose the teacher with new educational problems.

Today the outstanding growth of the computer industry is a good example of the "knowledge explosion" which in the 50s and the 60s doubled every ten years, but now is doubling every seven years. If the automobile industry had achieved what the computer industry has done since 1951, then a Rolls-Royce would be priced at $2.50 and get some 3,200,000 kilometers per 3.7 liters. Yet as unbelievable as the progress has been in the past, the new two decades will see more. IBM has already announced a new super-conductor that can improve speed and performance by a factor of 500 over the next seven years. The initial computer at Columbia University had a calculational capacity not much greater than a $30.00 hand-held calculator of today.

Computers are electronic machines able to process information in a variety of ways and at almost instantaneous speeds. They can be programmed to handle very large quantities of information with great reliability and accuracy. In this way they can perform tasks which are not possible even in highly labor-intensive organizations.

Together with computers, there are two other technologies that have given rise to the so-called "new information technology". They are microelectronics and telecommunications.

Microelectronics depends on miniaturization. This is the process of making unbelievably small, the components and circuits of electronic devices including computers. This has given rise to the silicon chip of only a few square millimeters in size. These silicon chips are manufactured in bulk, by the tens of thousands, so that a single chip costs very little, much less than a school textbook, yet contains all or many of the information-processing components needed by a computer or calculator or digital watch. Today, a single silicon chip may contain as many as one million elements and their circuits. One single video-disc the size of a playing record can carry the information contained in 40,000 pages of books. The set of the Encyclopedia Britannica is 24 volumes of about 1,000 pages per volume. That means that in one playing record size video-disc, you can imprint the equivalent of more than two full sets of that British encyclopedia.

Telecommunications or distance communication, has developed in two areas. One in new transmission channels and the other in new ways of sending information through those channels. An example of the former is the optical

fiber cable – fibers as thin as hair yet able to send pulses of light generated by lasers. Those pulses can contain coded messages.

New devices and systems of information technology are appearing almost monthly. These range from small personal computers to talking wrist-watches, to TV wrist-watches to bank accounts used by push-button telephone to computerized library systems.

Note that information technology was with man long ago, way back in the days of writing on wood or stone. But today, that technology is *new* and fast advancing. It is one of the great stimuli to the Third Wave of change described by Alvin Toffler. Its potential in primary education may be revolutionizing.

A well-known American educational researcher, Michael Seriven, foresees that the three R's as we know them will not be taught the same way in the future. Take reading, for instance. The new information technology even now is providing us with optical recognition of characters and speech synthesis. That is to say, the printed words on a book page can be "read aloud" by an electronic gadget. This recognizes the printed words and then changes them into sounds easily understood by a child. Soon a small device will be invented (the size of a credit-card calculator) which when a child runs across a printed page will read that page aloud to him.

Three factors among others will make this new information technology very attractive to educators – falling prices, low energy demands, and pressures on school budgets to reduce costs. Yet educational technology is facing some problems, actual and potential.

Since the 1930s (roughly when technology began to grow) teachers were not, and still are not, that sold to educational technology. They are not at home in their use nor in the new roles required of them by technology. They still rely heavily on their own tutorial and teaching powers more than on what technology provides.

Then there is little evidence, from any evaluative studies that there has been substantial increases in the *rate* of *learning* by students in classrooms served by technology when compared with those not so served. If there has been such increases, these have rarely been detected by cognitive tests. The rare exceptions simply prove the rule.

Thirdly, evidence on *costs* tells us that technology does not bring lower costs per student except in very exceptional cases as Eicher et al have shown (3). Instead, technology is likely for the moment, to be an added cost with the inevitable consequence that it may be regarded as a luxury rather than a necessity particularly in developing countries.

Fourthly, with the exception of educational radio broadcasting, technology is far from being spread throughout the educational system, formal and non-

formal, around the world. Its spread has been slower than many have predicted.

These reasons have prompted many decision-makers to be cautious about promising that children will learn faster, that costs will drop or that every child will have access to the benefits of educational technology once it is installed.

Add also the fact that we do not as yet know enough of the cultural impact or the impact of indirect teaching produced by educational technology. We do not know, too, nearly enough about some other aspects of the utilization of that technology in the actual school environment. Technological problems, such as fluctuating or even non-existent power sources for television sets can be solved quicker than organizational and personal ones. Large bureaucracies like ministries of education and even individual institutions are complex and throw many obstacles against technological innovation.

What about the cooperation or the resistance of *trade unions* in pushing through successful educational technology moves? That cooperation is a must if technology utilization is to be effective and widespread in education. And the problem faced by individuals whose careers will be changed by technology cannot be ignored.

There are a few other items on this generalized assessment of educational technology that we have to keep in mind. Human beings, will be more and more dependent on computers. But this means that authority and responsibility (that is to say, accountability) will be placed on the machine rather than on the human will. Accountability in the use, abuse and reliability of the control networks as was shown for instance, in that one million-peso computer error in a Filipino couple's banking transaction, or the Three Mile Island accident in the U.S.A.

We shall also have to cope with a growing sense of *remoteness* in a highly technological society. In the past, the assembly line worker was distanced from the final product but could at least see the results of his contributions to the finished product. But in the new information technology, the worker is pulled further back and loses touch with the results of his efforts. The worker may never see the product he is helping manufacture. Only rows of dials and reels of magnetic tape make him aware that a manufacturing process is going on.

This means that a "de-skilling" process is going on, and this on account of the growing distance between the worker and the product. Sensory-motor skills are gradually lost and with it the ability to teach it to others. The skills are gradually allowed to atrophy. Highly skilled professionals, such as air line pilots, spend more time pushing buttons, than developing their flying skills. And yet, they are expected to take over from the computer in an emergency. Is the pilot's present level of skill up to such a challenge?

The new information technology, specially in education, has resulted in

more and more information being at the disposal of fewer people. A technologically literate elite is emerging, while the illiterate majority has decreasing access to information and the consequent power.

And this is true of nations, not alone of individuals. Nations with a small technical elite are at a serious disadvantage relative to nations or large transnational corporations with a greater access to vital information *and* to methodologies for interpreting the data. That "and" is most vital if the information is to be at all meaningful and relevant. There is danger that poorer countries will be at the bottom of the informational pyramid and will simply fall farther behind in the technological race.

The Brazilian professor of organizational sociology and education, Joao Batista Araujo e Oliveira, has well summarized the key points responsible for the failure of educational technology in developing countries specially. The professor stresses that education and educational technology must not be considered in isolation, as independent variables. In a social context, educational activities are indeed complex. Learning is affected not only when teachers are underpaid, lazy and/or incompetent. Learning is impaired when the school is not communicating anything relevant; when the learners are hungry and with many unsatisfied basic human needs; when the educational system is so structured as to perpetuate injustices, regardless of methods used or technologies introduced.

Precisely because educational technology problems are complex, they should be approached not hurriedly, but slowly and with sufficient time to be studied, owned and assimilated by those dealing with their solutions. This may take quite some time, but it is the only way out. Otherwise, the locals, the importers of the technology, will be left out of major decisions affecting not only their careers but a society's life. The hasty timetables of funding agencies should not be allowed to replace the needed time-lag for local people to master the requirements of project management and control of new technologies. (3-A)

Are there some *guidelines* to help us use computers and other forms of technology profitably for the human being rather than impoverish him and the societies of which he is a part?

To start with, we assert that work is a "fundamental dimension of man's existence on earth". (4) The history of the science of man – anthropology, palaeontology, history, sociology, and psychology among others – all seem to bear witness to this reality in a clear way.

But for those who have the Faith, who believe in divine revelation, that conviction of the mind is also a conviction of faith. Divine revelation, specially as recorded in the Book of Genesis (5) that man is on earth to work. And in this way subdue, dominate the earth. In carrying out this mandate of the Creator, man reflects the very action of God Himself who is ever active preserving the universe in being.

But although work is a *bonum arduum*, a difficult task, for man to accomplish, it is a good thing for him to undergo. "Work is a good thing for man – a good thing for his humanity – because through work, man not only transforms nature, adapting it to his own needs, but he also achieves fulfilment as a human being and indeed; in a sense, becomes "more a human being." (6)

Work then is for man an obligation, a duty, flowing from both a mandate from the Creator and his own humanity. Man also must work out of regard for others, specially his own family; as well as for the society he belongs to, the country of which he is a child, the entire human family of which he is a member. All this makes up the moral obligation of each person to work.

Technology, computers in particular, cannot and should not altogether displace this aspect of man's activity on earth. They should facilitate it, make him enjoy his work better, but not fully replace work, manual or creative. Or as the present Pope puts it, work in the new era of technology finds a powerful ally in the computers and other products of that technology. They facilitate work, perfect it, accelerate and increase the productivity of work.

But there is a danger that if such a technology is not adequately handled from an ally, it turns out to be man's enemy. This happens when for instance, the mechanization of work supplants man and takes away all personal satisfaction; when mechanization and technology suppress creativity and responsibility and reduces man to the level of a slave.

All technology, educational included, and computers in particular, have also a deep, spirit-level dimension. The reason for this is the very integral nature of man himself. The human person is a well-coordinated composite of mind, will, and spirit; of flesh and soul; of the material and the spiritual. And every one of man's activities partakes of this duality of matter and spirit. His life reaches both time and eternity. Nothing he does or fails to do affects only his time element. It does too his eternity.

The Second Vatican Council itself describes this spiritual aspect of human activity as flowing from man's participation of God's activity:

> ". . . While providing the substance of life for themselves and their families, men and women are performing their activities in a way which appropriately benefits society. They can justly consider that by their labors they are unfolding their Creator's work, consulting the advantages of their brothers and sisters, and contributing by their personal industry to the realization in history of the divine plan." (7)

This awareness and knowledge that by his work, technical included, man shares in the work of creation is a most profound motive for undertaking it in various sectors of human activity. In this way secular and scientific and tech-

nical activity are permeated by a spirit which promotes justice, responsibility, peace and genuine love for others.

Such a vision of the values of human work, whatever it be, or in other words, such a spirituality of work, explains more fully what we read in another part of that same encyclical regarding the correct meaning of progress:

> "A person is more precious for what he is than for what he has. Similarly, all that people do to obtain greater justice, wider brotherhood, and a more humane ordering of social relationships has greater worth than technical advances. For these advances can supply the material for human progress, but of themselves alone they can never actually bring it about." (8)

Finally, technology (computers are part of it) is but one aspect of human culture. Man is the author of his culture. And since the close of the Second World War, there has been a universal and growing sense of responsibility that, culture be used for the good of the human, global family, and not just for the self-serving interests of the more developed nations. It is our duty to help build a better world based on truth and justice. This is the source of that growing new humanism which defines man first of all by his responsibilities towards his brothers and towards history. The new humanism concerned that technology of any kind be so directed as to promote such a world culture in freedom and the justice that begets genuine peace.

The new humanism is concerned not only that computers optimize industrial outputs, but also that it touch for the better the lives of the fishermen in Lingayen and the herdboys in Lesotho. That it somehow improve their chances of securing even a modest education commensurate with living in the twenty-first century.

We still do not know all the ways that the new technology of computers will affect education whether in the North or the South. But certainly, we cannot afford to miss the opportunities to find out. We can learn from what happened yesterday, or even today, in this field. For tomorrow, we are at the beginning of something altogether different, more exciting but also more threatening.

We need to know all we can about it for our survival, lest we become victims and servants of our own inventions. Much more when considering the impact of computers on education on our children and their children's children. Education in its essence seeks neither to feed, clothe, nor entertain, but to "lead out" the best in the learner unto the maturity of the person who is free but responsible.

Can modern technology and fast growing computers really facilitate the formation of such men and women? That is the ultimate criterion of its success.

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(3) Eicher, J-C, Hawkridge, D.G., McAnany, E., Mariet, F., and "*The Economics of New Educational Media:* Overview and Synthesis," 1982, Vol. 3, Paris Unesco (Educational Methods and Techniques, I.

(3-A) Araujo E. Oliveira, Joao Batista, *"Making Good Use of Educational Technology"*, in Prospects, Vol. XII, No. 3 (1982), 345.

(4) Pope John Paul II in his Encyclical *Laborem Exercens*, No. 4, 1981.

(5) Gen. 1:28 *"Be fruitful and multiply, and fill the earth and subdue it."*

(6) Pope John Paul II, No. 9.

(7) Second Vatican Ecumenical Council, Pastoral Constitution on the Church in the Modern World *Gaudium et Spes*, 34.

(8) Ibid., 35.