22 Cultural Ecology: The Transfer of Technology in Education Between Cultures

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This chapter examines the question of technology in education and its proper treatment. Special emphasis is placed on communication technologies as sources of learning and as a renovation of the educational system. A general analysis of the concepts of science, of technology and of educational technology is followed by the consideration that some minimum technology is essential in education in connection with curriculum, teaching staff, student demography, adult education, and evaluation and research.

A distinction is made between transplanted, transferred and appropriated technologies. Whereas the first must be excluded in transitional and in developing societies or primitive cultures, the other two are indispensable to a steady modernization and to a narrowing of the gap between such countries and those with more advanced technology. This transfer of technology is even more essential in Education since the teaching-learning process not only involves the study, analysis and evaluation of all the technological advances, but must also have recourse to many of them to do its mission. To transfer technology to education, the three constituents of technology must be assessed: technology that is expressed in information, that which is expressed in processes and programs, and finally the aspect of the hardware involved. Then, especially for education in deprived or developing areas, appropriate technology should be developed in keeping with the cultivation of endogenous resources and aptitudes.

Various limitations and pitfalls are indicated, however. The argument is based on the possibility and indeed the advisability of achieving unity from diversity. The diversification of cultures is the only way in which man may enhance his inventiveness and achieve greater freedom. One of the most serious risks facing mankind is that of cultural uniformity. But this does not imply any increase or strengthening of nationalism. To transfer technology expresses no challenge to the principle of interdependence if this is two-way and genuine. Our idea presupposes that cultures and societies must **think globally and act locally**. Of course the incorporation or transfer of technology from one culture to another does not necessarily lead to modernization since it may intensify the use of resources to maintain, strengthen and multiply the very systems, educationally undesirable, that they are intended to eliminate.

Science and Technology

Science does not come into existence by spontaneous generation. Scientific knowledge is not only an inheritance from the past but also the intellectual activity of the future, the only dimension of time that belongs to mankind. To know scientific facts is part of the teaching-learning process, but to generate knowledge is an integral part of the future of science. But science is not created; it is discovered. The scientific fact is there, alongside mankind, not only after it is revealed. The laws of science have existed since the beginning of

time; man has merely verified their existence. Laws of nature are not necessarily linear. They can be part of instability, fluctuations and chaos. Indeed, order and chaos can be the consequence of natural laws that are not linear. Classical mechanics, quantum mechanics or relativity have been related to science's ultimate goal which is reaching certainty. But recently new developments on complexity can also relate science to uncertainty in which laws of nature no longer describe certitudes but possibilities (Prigogine and Stengers, 1996). The applications originating from these scientific principles—linear or non-linear—are the heritage of man in alliance with his environment. Thus, while science is an accumulation of possible facts regardless of man, technology is the application of scientific principles to a specific environment or culture.

Therefore while science is not transferable from one culture to another since it is universal, not the heritage of any one culture but of mankind, technology on the other hand is an adaptation, made by man, of the scientific fact to the culture or the environment in which he lives. "Technology is not neutral. It conveys social values and relationships" (Thành Khoi, 1986). Imported technologies, therefore, need to be transferred from one type of culture to another so as to confirm that cultural survival is not threatened and that on the contrary its use may help to raise the standard of living.

This transference becomes even more important when the development gap between the cultures producing the technology and those importing it is very wide. The latter cultures have generally been called Third World countries, poor countries, or developing countries. For the purposes of this chapter, the third description is the most suitable, but we would even prefer to call them **countries in transition** since this conveys a strong sense of faith and hope for their integral growth. The term also embraces all the countries with unequal and moderate endogenous development, formerly classified under an ideological heading as in the case with most of the Eastern- and Central European countries and some Latin American countries.

There are of course some connotations of the term educational technology which imply a critical attitude that cannot be overlooked. In cultural circles in the importing countries, such technology has come to be associated with mechanistic theories of learning and seen as no more than a teaching aid, or else it has been censured as a mechanism ensuring dependence on more highly developed countries from a political and social standpoint.

There are justifications for such negative attitudes; some experiments have not been successful. But alongside these criticisms there is a certain uncritical acceptance of claims that technology is sufficient in itself to ensure development, bringing the educational system of developing countries up to the level of those more advanced. In fact the situation is much more complex.

As a starting point for further analysis, the precise meaning of educational technology should be clarified. A first definition may be found in the etymology of the word. For the Greeks, *Tekne* was the equivalent of "art" as distinct from knowing how to do something purely from personal experience (*empeiria*). *Technique* would mean knowing how to do something over and above the level of personal experience, on the basis of accumulated collective experience, and in which the principle of efficacy is inherent in the survival and diffusion of such interpersonal knowledge or skill. When thinking analysis or study (*logos*) is added to technical knowledge, then we have *Technology*, so that this would be the theory of technique. Technology, therefore, is half-way between purely speculative science and applied technical knowledge. One can go further and say that those branches of science that lead inevitably to practice or performance may now be classified as **technological science**, and obviously Education comes into this category (Escotet, 1992).

The purpose of technology is to apply scientific knowledge systematically to the solution of practical problems. Such application, however, is carried out reflectively, so that scientific and theoretical knowledge is valid so far as it solves and explains these problems. This consideration of technology as the science of action does away with the frontier between theory and praxis in a logical continuum of thinking/ action and action/ thinking or in a complex system.

Technology requires a systemic, comprehensive concept of the problems it tries to solve, in such a way that the solutions will not give rise to new problems. Technology is not an end in itself since it is not progress if it is considered as a logical course of action which includes the process of analysis, the choice of the most suitable strategy, the application of relevant solutions and the evaluation of results; in other words, technology refers not to products but to processes, so its value is purely one of interrelation with social and cultural life.

We must avoid being dazzled by technological products which are simply alienating unless they are used to improve human life, whether personally or collectively. To overcome such alienation, available resources must be built up, and conditions created for the development of new resources to provide proper solutions adapted to each culture and society. And this is particularly necessary in the case of education where one is acting on the human being himself, unique and inimitable as an individual and forming part of a social group with its own tradition and culture.

All over the world there is concern about the consequences of the indiscriminate application of destructive technical products, harmful to the environment and the cause of new burdens for mankind; in the case of education there is, in addition, the anxiety over the ideological analysis we have already mentioned of the type of world and the type of learning that could be the result of this lack of foresight.

The Framework of Educational Technology

What has come to be know as educational technology sprang from behaviorist psychology and philosophical positivism and gradually came to include the theories of systems and of communication (Skinner, 1968; Chadwick, 1987). However, the different incidence of each of the contributions in each place, and the passing of time, have shown all too clearly the shortcomings of the atomistic and mechanistic formulations adopted by educational technology and which are now totally incompatible with new learning systems, more comprehensive and tending to foster the inventiveness and personal involvement of the students.

Present-day studies of educational technology include models of cognitive and epistemological learning as opposed to the purely mechanist forms; systemic-cybernetic concepts, open and interactive as opposed to closed systems, two-way communication processes instead of one-way educational communication. In other words, the revision of educational technology has covered every aspect from the old fondness for behaviorist aims right up to the principle of effectiveness as the ultimate goal of technology.

The restriction of educational results to operative objectives, the feature of educational technology which gave rise to programmed instruction, reduced the process practically to the acquisition of behavior patterns, psychomotor skills and very elementary knowledge, reducing education more or less to a model of instruction. Quite rightly this has been one of the arguments against certain programs that overlooked such objectives as the development of a capacity for criticism, personal inventiveness, a personal integration of culture, the acquisition of cognitive and metacognitive strategies (Chadwick, 1987), all of them essential targets in the conception of education as the integral development and growth of the individual.

These fundamental goals are the beacon lights of education, but it must be remembered that they are reached only step by step. Personal responsibility, critical capacity or inventiveness are not achieved immediately; they are approached by successive approximations, ticking off intermediate objectives along the way, some of them operative and concrete. This means that the technological program for ambitious final goals cannot overlook the interrelations leading to them.

As far as effectiveness goes, it is obvious that this cannot be understood as attainments that simply strengthen or confirm undesirable situations in the learning relationship, nor as a process of irrelevant learning for personal or collective advancement. The principles of pragmatism and efficacy so widely heralded by educational technology up to now must defer to the higher claim of the noble aims of education, and to this end the nations must follow the path of greater social justice and greater personal dignity.

The moment has come to say to researchers in education, to those familiar with educational technology, that their knowledge must not be used indiscriminately. Since the 1950s when the first activities of educational technology appeared, we have seen how few of them have been of any use at all to collective progress. It is time to analyze who is being really helped by programs of educational technology and draw the relevant conclusions as to how they can be placed at the modernization of the society. (Postman, 1993)

There is already talk of a new technology but the name is unimportant. What does matter is the use to which it will be put in the future, which cannot be other than the improvement of education, by which we mean the fullest development of each individual in a social milieu providing freedom, justice and opportunity for everyone. The deep-rooted problems of education in developed and developing countries, and the new ones arising from the force of history, still need technology for their solution, but it must be a renewed, an appropriate technology, able to respond adequately to these needs. This will be discussed towards the end of this chapter.

However, the rise in criticism of the negative consequences of the misuse of technology in the past—misuse which may even extend into the future—leads some people to oppose its application in the field of education. Their argument is that this will protect the educational system from the dangers of alienation, dependence and so on which have beset other social sectors.

It seems obvious that the education system cannot be kept out of the social context. To renounce the use of technology in the educational system would make sense only in a society that renounces it wholesale in all the other sectors: health, nutrition, production, communications, etc., and this for a very obvious reason: the system of education is a means of preparing for full incorporation into social life.

Mankind could have chosen other paths of progress and might even have stayed put. The choice, however, was for industrialization and technology. The force of history makes this process all but irre-

versible although it can and must be reorganized. As the developing countries opt for their incorporation into the mainstream of nations, they have to accept and adopt technology. Otherwise they will remain wedged in unjust social structures or in a permanent state of dependence. More than a question of whether or not technology is worthwhile, the problem is to decide which type of technology is suitable and how it can best be incorporated.

The critical attitude that should be adopted towards the indiscriminate use of technology must not lead to the preservation of obsolete school structures that cannot satisfy the demands of modern life. It could be that just as there was an uncritical importation of technological proposals in recent years, totally unsuitable to the cultural reality of the poorest countries, now there might be an importation of criticism of this technology in education, criticism that arose in the more developed countries after a massive application of their own technology but that could acquire a different meaning among educators in countries in transition. For wealthy societies, technology may even be a luxury; for those less developed it is a necessity.

Technological Needs for Education

It is beyond doubt that the modern world is one of industry and technology in which participation is made inevitable by the force of history. The only alternative is isolationism which is not only detrimental but even impossible. Development calls for a mastery of scientific progress, and this presupposes an understanding of the processes, of the languages of communication and of its tools. Only with this mastery can there be a qualitative buildup of communication between developing countries and the rest of the world. It is a question of singling out and creating the right strategies of modernization; it is just not possible to turn one's back on development. And there arises a concept that has given rise—and is still giving rise—to controversy: what is meant by **development**.

Social, Educational and Economical Development

The concept of development has been used in economics and education under different ideological labels and for a variety of planning purposes. However, the main reason for singling out education as instrumental in development is its role in producing the skilled manpower required to meet a country's socio-economic needs. Thus education has come to be regarded, in our view wrongly, as a supplier of human resources; it has been turned into a formal institution concerned in practice with the immediate provision of trained skills and aptitudes, in which human beings are perceived as agents of production, their social, cultural, affective and civic roles being relegated to the background. (Escotet, 1986; 1993).

In addition, the economic theory of development has now become obsessed with the attainment of economic indices of expansion in as short a time as possible, without pausing to analyze the effect of these changes on the lives of men and women. Greater emphasis is set on the production of goods than on the creators and users of these goods, on the assumption that production will indirectly benefit society. But the primary axis of development is women and men. Development centered on human beings and reflecting the limits of her/his capacity for creativity and self-improvement.

Thus by development is meant integral and harmonious development which makes it possible to promote human creativity by providing the basic means of subsistence that are essential to the achievement of democracy. With this school of thought, man becomes the focus of all planning in a democratic system which seeks a radical reform of existing social and educational structures. The foundations of democracy, assumed from the Utopian point of view to be perfectible, will become unshakable provided that education responds to the very highest possible ideal in its task of forming minds; creating in men and women a sense of critical awareness and responsibility in respect of both themselves and their physical and social environment, so that they can work together to build their own future. (Escotet, 1986; 1992a).

This conception of development—humanistic because it is centered on man—brings together and harmonizes in man as its focus the substances of his native culture, realizing their value as a token of the heritage of each community and their significance to the whole world; science as a corpus of experiences and thinking of all the peoples of the world, together with their local traditions and customs; their own resources backed up by long experience, and then the means afforded by the elaborate technology of the more advanced countries. Development must always proceed from within, assimilating alien constituents step by step.

In view of these considerations, development has to be totally unrelated to false nationalism and ethnocentrism. Bonds between North and South, between East and West, between majority and minority groups must be part of development. In a certain sense this comes down to grasping the whole and acting on the parts. We insist, however, on the need to break the ties of exclusive dependence by which the most highly developed cultures overpower the others. Such inequalities exist, of course, among the regions and

social groups of each country, producing the same states of dependence.

Teacher Education and Educational Technology

Education alone cannot transform society in depth. This is generally acknowledged, but it is true that together with political drive it becomes a driving force and a catalyst of change, of progress. For this role, education has to use technological progress to lend force to its action, to reach the most outlying areas and all those involved, by whatever means are available, and always, of course, with the direct action of the educators who are the real achievers of the changes of attitude that are required.

The relationship between educational technology and teacher education has two aspects. The first is the obvious need to provide general education and competence if teachers are to face the challenges of education in the 90s (Nuccio, 1990). In some countries, 70% of the primary school teachers are untrained. Various methods have been used to try to reduce this shortfall: intensive courses, distance education, summer schools, etc., but the results fall short of the demand. Unless the education programs include all the available technology, allowing the setting up of individualized systems as well as those for use by large numbers, the problem will not be solved. Educational technology, therefore, must be seen as a valuable aid in the education and updating of teachers.

The second aspect of the relationship between technology and teacher education is that of specific preparation in the technological field, and this point has a direct link with the next: the renewal of the curricula. How can teachers undertake the preparation of the new generations to live in a technological world if they themselves are not prepared for this? It is true that many demands are made on teachers to carry out the task of providing a comprehensive, critical and responsible education, elevating the individual and improving society. They need not all be mentioned here, but it is obvious that it is possible to prepare students to create, evaluate, use and modify technology in keeping with the needs and possibilities of the community only if teachers have the necessary preparation for this task. In other words, teacher education curricula should lose no time in incorporating this subject, whether in initial education or in further education. It should be remembered that it is the teacher who will need to judge, and to judge with sufficient capacity, whether or not the technology available is appropriate. In a sense, it is a question of educating a teacher able to combine technology with humanism to **help the student to learn**, to **help him/her to be** and to **learn to care**.

It is more than twenty years since a UNESCO report stated that "the stream of information received nowadays by young people outside the classroom raises doubts about the whole content of the school programs". (UNESCO, 1974). And of course the means of communication are only one part of a world in which technology imposes its rule with more or less intensity, but whose future is beyond doubt.

But these mass media have hardly been integrated into the system of education. Their capacity as a teaching aid has not been put to use, and in most schools throughout the world they are little more than a decorative piece of teaching equipment. A parallel school has been allowed to grow up, that of radio and television, especially the latter, which glorifies violence, physical charms, acquisitiveness, the importance of material gain rather than any spiritual value. A new school that just ignores minorities and threatens the most valuable reserve our world contains: its cultural diversity which is the axis of freedom, of inventiveness, of change and of progress. Apart from that, fiction and reality are all mixed with no regard for the different contents so that fallacies are often learnt, especially by young people and those with little education, and the damage is magnified by the faith of these people in the mass media (Escotet, 1988; 1992a). The rational way for the school not to fall into either an irrational isolationism or into a fetishist submission to technology in general and to the media in particular is precisely to make them an object of study and of responsible use.

Another basic need that is going to affect the developing countries is the increased demand for schooling. By the end of this century the most advanced countries will have fewer children of school age than they had at the beginning of the 90s. But this will not be the case in the rest of the world. In Latin America, for example, it is expected that at the beginning of the twenty-first century there will be relative increase of 42% and a real increase of 65%, figures that may be even higher if the health programs become more successful in their fight against children's diseases. And there are more extreme cases in other parts of the developing world, as it is the case in Africa (World Bank, 1995).

This situation is sufficient in itself to justify a quest for some means to boost the human resources and materials available. Some of the means will have to be provisional while awaiting the reversal of the population trend, but even so they cannot be postponed without the risk of increasing the ranks of young illiterate adults.

The application of technological systems of teaching is a possible means of coping with the mass of students who in the immediate future will crowd the secondary and upper levels in schools, levels for which

the adequate education of teachers is even more difficult. The adoption of self-learning systems would appear to be not merely a possibility of supplementing the system but indeed the answer in many countries to their primary needs.

Formal and Nonformal Education Innovations

Distance education, for example, is a technological system that can bridge the gap between scientific production and its reception by the people. (Escotet, 1980). A formal educational system relying simply on the student-teacher interaction could not possibly impart knowledge at the amazing speed at which this is generated by scientific and technological research. Distance education is a way of adapting the education process to present-day and future technology. Its rapid expansion in more or less poor countries augurs well for a new profile structure of education. It promises well, but even while defending it we must be on guard against dangers in its development and orientation.

There is no guarantee that an innovation in a process will in itself give rise to an innovation in the product, and this is the danger. With revolutionary media and systems we can produce the most conservative men and women. On the other hand, when the conventional system is able to provide all the places and grades required by the community , distance education can play a part by serving those sectors of the adult population who are not able to attend a center every day or do not require it.

Considering only the problem of illiteracy, for example, one sees that the conventional systems are not sufficient. Only with a mobilization of a whole country in a revolutionary situation has it been possible to organize a successful literacy campaign by means of small groups with a teacher. In the developing countries, the percentage of illiterate adults is still high; the number is estimated at around a thousand million. (UNESCO, 1990; 1994). (See Table 22.1 for projections of the illiteracy rates by category of countries).

Some people consider, of course, that it is unnecessary to teach all adults to read and write, alleging that to do so is an infringement of their freedom and of their culture. The illiterate are not free, however, to participate fully in social and political life where the written word preserves the sum and substance of laws, documents and information. If writing implied the passage from prehistory to the historical era for mankind as a whole, then it is a prerequisite for active participation in modern life. Respect for the native language, the method of teaching to be adopted, and the role to be played by the written language in the awareness of each community, are problems of a different nature.

The eradication of illiteracy, which is given priority by governments and a host of experts, is not something that can be achieved independently of other equally important conquests in the social field. It is one step further in achieving human dignity and in the process of raising the standard of living of the community, and the national conscience must be aroused if the campaigns are to be successful. Once the community becomes aware of the importance of literacy, then it will be possible to introduce technological systems, either in the form of planning and design of the curriculum or through the incorporation of technological material and the mass media.

Literacy, however, is only one of the possible fields for the application of educational technology. From the stage after learning to read and write up to the further education of university graduates there is a whole range of requirements that cannot be met by conventional methods of teaching. The aims of adult education—though limited to special aspects and groups—are beyond the capacity of the school system and call for non-conventional methods in which technology plays an important part.

To boost permanent or continuing education implies a build-up of self-learning programs, a habit of taking advantage of all the information services provided by the community, and an effort to adapt the education process to the situation and the possibilities of the individual or group. And all of this calls for technological organization as in the case of distance education. Another aspect of permanent education of adults is that of the understanding, evaluation and adaptation to the present and the future of the life we have to lead. The immediate future is not the exclusive patrimony of the children of today; the expectation of life will enable a great number of today's adults to live into the next century, so education also has to prepare a whole adult population for living together in a technological society.

To free genuine popular humanitarian culture from the yoke of the alienating mass culture imposed by the mass media, requires a critical perception that provides a defensive mechanism against the attack of consumer advertising. Nobody can be more critical of the overwhelming technology that is swamping society than those who have managed to use it for well-founded purposes. It might be said that if in fact technology in general and the mass media in particular have had the deplorable results that are there for all to see, this is largely due to the effrontery with which they operate simply because the recipients lacked the necessary preparation to confront them critically. If education takes up the challenge, there is no doubt that future generations will be less susceptible to the pressure of advertising; in the meantime, there are

Table 22.1
Projections of the Illiteracy Rates by Category of Countries, aged 15 and more

	YEARS			
	1990		2000	
CATEGORY OF COUNTRIES	NUMBER (IN MILLIONS)	RATES %	NUMBER (IN MILLIONS)	RATES %
More developed countries	**17**	**2**	**14**	**2**
Developing countries	**865**	**34**	**898**	**28**
Africa	165	48	168	35
Asia	659	32	693	28
Latin America	42	15	38	11
Least developed countries	**25**	**62**	**138**	**51**
All countries of the world	**882**	**25**	**912**	**23**

SOURCE: Projections and estimates based on data of the from UNESCO (1994) *The Statistical Yearbook*, and (1990) *Compendium on Illiteracy Statistics.*

urgent measures that should be taken with the adult generation.

All of this justifies the fact that many authors dealing with the subject of illiteracy have begun to refer to other languages apart from the written language. A literacy campaign, therefore, should include the audiovisual languages if the aim is to facilitate thinking by means of a command of words. Illiteracy in the face of the mass media does not suppose in this context the inability to understand them—as is the case with the written language but rather the incapacity to discern the alienation produced by the uncritical acceptance of their messages. Here again, to make literate is equivalent to reintegrating the personality, or as is said in other contexts "de-programming" the individual.

Finally, progress in education is closely linked to the development of research, perhaps more so than in other branches of scientific knowledge, since education has to be bound up with the social structure it is to serve. If one accepts the idea of education as a theoretical-applied discipline, it follows that any research in the subject must be closely allied to educational practice, which in turn comes from the principle that the student is directed towards an ideal. Educational science differs in this way from other social sciences in that the description of the phenomenon is merely a previous step on the way to deciding models of procedure.

This modus operandi in education will put forward a series of strategic norms to follow, such as:

1. A diagnosis of the situation at the outset.
2. A forecast of the state it is hoped to achieve (pattern).
3. The choice of actions to make this goal possible.
4. A control of the process so that corrections may be made as required.
5. A comparison of the results with what was aimed at.

All of this will be carried out in conformity with previously investigated laws and theories already a part of the scientific patrimony of education, together with new and better solutions being incorporated. It is therefore educational practice that ratifies the norms. The steps mentioned above justify the classification of education as an applied science, and educational action as a technological process according to the meaning given to the term in this study. Educational-technological action appears as the antithesis to routine behavior which always perpetuates the *status quo*, repeating outworn models and merely following personal intuition.

Qualitative and quantitative research in education requires reflection about the reality around us and then about questions such as: What is the minimum time required to reach the goals? How can the available resources be used to the greatest advantage? What are the consequences of the educational aims proposed? How can they best be achieved? etc. In fact, it is a question of applying a critical, a technological mind. Of course there are many levels of educational research, from the so-called higher research carried out in technical laboratories and with all the requirements typical of research in the social sciences, to investigation to solve a specific problem. It is all necessary to scientific progress in education, and all the levels should be related so that information may circulate and reach all those concerned.

To link the need for educational research with the need for teacher education referred to earlier, we would mention the type of research closely linked to reality, through which there is direct intervention in that reality. This is the so-called action research which, unlike conventional investigation, aims at the production of knowledge to guide practice, and implies the modification of a given reality as part of the process of the investigation. In a way it is a kind of action evaluation—a form of constant modification of the educational process, essentially dynamic.

Some Technological Sources for Learning

Traditional Technologies of Communication

The instructional materials such as the blackboard, maps, pictures, slides, audio tapes, all the material for observation and practice in science, etc. are the subordinate media over which the teacher has complete control. According to the technological approach, planning and control of the process of education take precedence over materials as we have said before. So any teaching aid, however simple, may be used in a technological manner—or not—. Hence the importance of ensuring that this intention lies behind any supply of educational materials to schools. There must be many countries in which the supply of materials has had no effect because this condition was not fulfilled.

With this kind of preparation, teachers may not only make use of commercially produced materials but may also produce most of their own, and these have the double merit of being cheaper and of being better adapted to specific needs.

Another point is that in spite of the pessimistic forecast of MacLuhan, the printed word is still the vehicle or medium of social communication. The cultural level of a people is still measured by the number of books, newspapers and journals that are read inasmuch as the written language is still the great treasury of universal knowledge. It may be that in the future the screen may partly take over from the sheet of paper as the conveyor of written language, but for a long time paper and print are going to be the main carriers of information, especially since the systems of printing and reproduction have become so fast and cheap. Besides this, **reading** is still the most personal and individual manner of learning, and the written language the most suitable for reaching a high level of cognitive development, abstraction and creative imagination. Economy and aptness, therefore, favor the advancement of the printed word as the guarantee of the viability of permanent education and collective communication, and the key to understanding among nations and to the plurality of ideas.

In the sphere of formal education, there is still a real need for serious investigation of suitable materials for educational purposes, from textbooks for the traditional school system right up to self-instructional materials for other forms of learning and all the complementary materials in between.

Contemporary Technologies of Communication

The progressive fall in price and rise in efficiency of radio receivers and transmitters have given new possibilities to this medium which now has the double dimension of mass-media and self-media. Used for teaching it can be a supplement to group classes of literacy as well as to programs of further or permanent education, and of course it can integrate multimedia operations of distance education.

The educational possibilities of **radio** have not been fully drawn on. Both the powerful national stations with a nationwide coverage and small local stations certainly have a role to play in the future, with the advantage over television and the press of a greater decentralization, proximity and participation.

It would be a grave mistake to reject the enormous possibilities of radio in favor of other more spectacular and costly media. The moot point is how to prepare people to write texts appropriate for radio and to choose the right subject matter. Normally there are enough radio stations for use in educational programs; the competition between them for a faithful audience is a guarantee of their willingness to reserve time for this purpose. Then again, radio programs are often previously recorded on tape, so they can be kept and used at any time.

Television has been the technological medium for audiovisual programs for many years now, and has gone from direct programs put out by the great chains and satellites to those on closed circuit and on videocassette. Open television programs are the only ones at present run to provide teaching in areas where there are no schools. As a complement to conventional school work, programs can be recorded, and this is more flexible and more effective from an educational point of view.

Here, as in other areas of educational technology, provision must be made for the upkeep of the hardware and for the supply of software adapted to the specific need in each case. There are cases of adaptation of foreign programs, but here again the key point is the capacity of the countries in transition to find the right solution for specific problems in education. There will always be a fair amount of informative

material for more general use, but the rest will have to be prepared for the purpose, especially when there are images in a well-recognized environment.

The fact that television is now so commonplace reduces somewhat its almost magic appeal as an aid to education, but on the other hand it calls for its incorporation—as a complementary element—into the normal educational system. And for some specific projects the latest developments in television by cable and satellite and in interactive experimental systems must be considered as possibilities in the use of the television. It is no longer in the realm of science fiction to consider the television screen as the source of interactive reception of multimedia programs at home, although this possibility is limited to certain sectors of the developing countries.

In general, these two media develop reflex responses through a vocabulary, conceptual categories and attitudes. Programs, especially in television, generate norms, values and ideological contents, explicit or implicit, which tend to reflect the dominant cultural pattern since they are part of the structure of social power and may even bring about changes in the cultural pattern in force. (Escotet, 1990).

Television, which replaces radio as an educational medium as soon as people have access to it, is not always better than the radio as a learning tool. Some of the advantages of radio are the following: (Escotet, 1980)

1. The radio is able to transmit discriminative and generalizing thought processes given that it is possible to compile and classify the spoken language more easily than the language of images, especially in non-ideographic cultures.
2. The radio fosters the imagination and mental representation more keenly than television does.
3. Words are more important for effective learning than images.
4. Television, although better able to exert perceptive influence by means of the image and the voice together, produces no interaction with the viewer and this may interfere with the learning process.

But the image and sound capture our passivity and produce a state of contemplative subjection in the student and also in the teacher. With the radio, a number of activities can be carried on without the hearing being affected. Television has to be looked at, so the subject has to put aside any other activity not dependent on touch or taste. The immobility produced by attention to the images, even more appealing nowadays in color, and the common belief that television would supplant the written text, drives many people to use it as the key medium in education, but it is not always appropriate. (See the analysis of programs of educational television in: Escotet, 1988; 1992a).

The **computer** symbolizes technological progress and inevitably was to become a consumer staple. The first point to make is that the computer is not merely an amusement or a general source of information as are radio, television, photography, etc., but an essential requirement for an advanced industrial society, much more so for the postindustrial societies. A command of computer and information science is therefore a must in a great number of production tasks and services; this is true now, and will be much more so in the future. The conclusion is that to exclude the formal education system from this main current is to confiscate all response to an obvious social demand in the future. The extent of the demand varies considerably with the levels of development of the different countries, so there are varying degrees of urgency in the application. No country or culture, however, can evade the question.

Without going into too much detail, the computer has specific features that differentiate it as a teaching aid from many others: the possibility of immediate interaction, its usefulness for repeated tasks, efficacy for learners with difficulties, the development of logical reasoning and resourcefulness if programmed by the learner himself, etc. Teachers cannot step aside, therefore, from the worldwide trend which will inevitably take microcomputers to the classroom as they are already found in many homes.

Computer experts are not often found in education circles, but teachers are taking a real interest in data processing as they come to accept its importance. Some countries already have plans which start with the appropriate preparation of teachers, who are more than ever aware of the need to enter the computer world which has already invaded the homes of their pupils, though of course this movement is directly related to the purchasing power of the families.

Among the most important applications for the computer in the teaching-learning process are:

1. **Computer-assisted learning** (CAL), concerned with learning in the formative sense and requiring previous knowledge of a certain area or content or else the instruction passed on by the computer.
2. **Computer-assisted instruction** (CAI) which includes new concepts or information, received by the student through a series of sequences which he uses to test himself.
3. **Computer management instruction** (CMI) which help teachers and managers to evaluate instruction materials by means of reports

derived from the interaction between the student, the material and the equipment.

4. **Computer simulated instruction** (CSI), an experimental strategy by which the computer helps the student to pose and to solve problems.
5. **Computer-based instruction** (CBI) in which the computer provides the instruction and interactive simulation, helping the teaching and learning processes through modules, courses and areas of knowledge.
6. **Cyber interactive-hypermedia instruction** (CIHI) relates to the Internet system as a tool for a multimedia dimension and an interactive distant system between people or between information, robotic systems and people.
7. **Intelligent computer-based learning** (ICBL), the latest and still experimental development which would offer a full exposition of a subject, the rules of its interrelation and a generator of reasoning for the intelligent application of complex data and non-linear models.

It is not a question of being dazzled by the consumer capacity of the wealthy countries but of drawing up a plan of action in accordance with the resources and the requirements of each country. Programs might be set up at the higher levels of education with an adaptation of the software available and the creation of appropriate programs, for which, of course, the upkeep of the materials and the due preparation of the teachers would be essential.

As the machines become cheaper, cost need not be the only factor when embarking on the first experiments, and excessive haste could jeopardize the future. There are a number of considerations and of myths to be examined but they need not rule out the use of the computer (See: Escotet, 1988; 1992a; Nader, 1995).

Technological Dependence and Cultural Transfer

The economic and social problems in developing countries are an enormous handicap. Taken together with a flagrant technological dependence, these problems lead to a situation of inferiority which clips the wings of any initiative in the technological field, be it in matters of design, manufacture, or the spread and use of technology.

It might appear that this would have a direct effect only in the industrial and scientific-technical sectors, but in fact it affects education very seriously if one considers that one of its aims is to train professional and technical people for social demand and also to meet the requirements of industry and of technology, not to mention the need to import technology for the educational system.

Even more serious was a fact expressed by Bush in the course of an investigation in 1976: in the United States, a scientific innovation or contribution takes between three and five years to be applied in agriculture or in industry, whereas in the educational system it takes an average of fifteen years, and even in some cases forty or fifty years. The same thing occurs with scientific discovery and its application to technology, which takes years to work its way into university programs of study. If such is the case in one of the leading countries in technological progress, what must the situation be in the importer nations? Undoubtedly there is an immense gap between scientific and technological knowledge and its absorption into education and into daily life.

The transfer of technology is a question as old as the relationships among human communities or cultures. It is the adoption by one cultural group of techniques developed by another to solve a specific problem, and then to control, to adapt and incorporate them into its social practice. It may be imposed when it comes about in the context of dependent relationships, the dominant society constraining the other to accept its products, organization or consumer goods and impeding any development of its potentiality.

At present it is this imposition that characterizes the transfer of technology. And to this must be added the payment of services, brand marks and patents by the receiving countries, reported by UNCTAD in 1980 at ten thousand million dollars. In Chile, for example, the proportion of foreign patents was 94%, and Colombia and Venezuela 97%. According to the *World Competitiveness Report* of 1994 and the MERCOCYT of 1995, the same countries—Chile, Venezuela and Colombia—only generated between 481 and 248 patents annually. However, two developed countries—Netherlands and Switzerland—and the emerging Taiwan exceeded the 20,000 patents in the same year. To these brand names and patents protecting products and manufacturing processes must be added the costs of capital assets, raw materials, technical assistance for the design, installation or operation of manufactures and training services, all considered as salable commodities. This model has been favored by the imposition of a new international division of labor which limits the production and distribution of the most technically sophisticated products to the most developed countries. It is a most important mechanism of exploitation, given the tremendous value of all forms of technology in the world today.

But countries in transition also buy technology from the developed countries for the fulfillment of their economic and social policies. The purchase may take different forms, from patent licenses to technical

assistance for the setting up of companies or the acquisition of equipment. Very often the results are disappointing, perhaps because the diagnosis was wrong, or the production costs or investment were underestimated, or the equipment inadequate, or for many other reasons. Sometimes, however, such deficiencies are due to a mistaken idea about the appropriation of technology. "Even when it is only a mimetic transfer, the application of a technology can only be successful if there is a gradual acquisition of theoretical and practical know-how; it calls for information and above all for new skills on the part of the users. It may be said that all technology is the outcome of a social process of production acting both in the designing of new technology from the findings of research and in its selection or application" (Perry, 1984).

So it must borne in mind that in the field of technology there is a gulf between developed and underdeveloped countries. And the problem is not so simple as to be remedied merely by a transference. There is also a danger in the impersonal and alienating character of certain projects based on so-called scientific concepts and on technocratic applications.

The education sector is enormously more delicate in that it is an essential component of the cultural-ideological universe. However, in the cultures in transition, it suffers less dependence than do other sectors. This is not true of what we might call informal education or the parallel school, normally generated by the media, which are transplanting ways of life, attitudes and values that modify their national culture, given the scant production and limited transfer of programs.

Cultural Transfer of Technology in Education

Having reached this point, we should distinguish between the technology of education and **technology for education**. The latter would be the hardware or those implements and mechanical or electronic devices supporting educational activity. The software would be the **technology of education**, that is to say the ensemble of techniques contributed directly or from other disciplines for application to the educational or curricular plan, the contents, the teaching methods, the processes themselves. But one would also have to include the technology expressed in information which could be classed as know-how.

The three elements participate simultaneously in education, but the software and know-how are more important because they allow independent progress while respecting those cultural values that should be preserved. Before any transfer of this triple technology, it must be analyzed, selected, appropriated, adapted and even produced and used in accordance with that endogenous development, not excluding, of course, an autonomous development.

With regard to educational transfer the following points may be useful:

1. Innovation has some meaning when its effect on the educational system gives rise to the production of software appropriate to the region, whether as a process or as a product.
2. Transfer may be the consequence of the interrelation of different social types and models giving birth to technological information and styles and interchanging them in what is called horizontal cooperation.
3. Transfer may be good or bad according to whether or not it creates a divergence between the desirable social pattern and the criteria by which it is defined.
4. A technological appraisal would be incomplete if only one type were studied without examining others. If carried out correctly, different components could be chosen and combined, and original elements introduced.
5. In the application of educational technology it must be remembered that it is not only a question of transferring processes and products but also the contents. This makes it even more important to evaluate the three components, that is, the technology that is expressed in knowledge, that expressed in programs and processes, and finally that of the machines or equipment.
6. The evaluation should determine the technological contents or elements that are being transferred. The different packets on offer have to be examined item by item to ensure that they are adapted to local conditions, that professional skill is available for this purpose, and that there is a good possibility of being able to negotiate or modify the technical solutions.
7. Transfer includes a work of assimilation, of coming to a thorough understanding of a technology. It will not only be used, but also reproduced, adapted and improved. Its application will be extended to other areas or problems, and, more important, the mastery acquired will allow original development, whether partial or complete, of the process.
8. There are notable differences between transfer of technology to education and its application, for example:

- In industry, inputs, processes and products can be considered separately; in education, they are much more closely related;

- In industry there are technological relationships that may be described in engineering terms; in education, this may be true of the products but not of the software which has social effects;
- It is possible to modify industrial processes by varying costs, for example, or by relating labor costs to capital flow, but this would not be the case in education where the processes are structured differently.

But these theories have not necessarily been put into practice in countries importing technology. Through either ignorance or greed, a large part of the world has been led to think that technology is connected with products and products with solutions. There is even a manifest association between change and recent technology, ignoring the fact that technology offers a means of achieving objectives but never of choosing them. Huxley pointed out with some cynicism that "even a monkey chooses his objectives, while only man chooses the means". Not to understand this is what leads a society into a situation of dependence, to import solutions and products.

The purchase of aircraft, television sets, satellites, computers or schools might give the impression that they are importing technology. When one begins to understand that technology is, in reality, a capacity to attain one's ends with one's own resources, then we might say that the possibility exists of a transfer of technology.

This confusion between the objective and the solution (or the technique) is more prevalent in non-technological societies. For example, a child's learning in the home is full of a series of stimulus phrases in which the pursuit of knowledge is almost a prior objective. Expressions such as "Listen to what your father says!, Go to school!, They don't do things like that where I come from!, Study a profession!, Learn to read!", are almost a ritual process in which the technique or the solution becomes the objective. "Learn to read" becomes the equivalent of "You will have the information appropriate to survival". Thus learning to read becomes the purpose of education.

The importation of techniques, solutions or products has become generalized in many countries, and only recently has an effort been made to place the emphasis on the process as the primary expedient of technology.

Transfer of Technology and Appropriate Technology in Education

Hence comes the movement towards appropriate technology in education, which if not a complete solution of the problem at least served to reduce costs and to make use of local resources in a simple and practical way. The small initial cost, the simplicity of the technological design and the undoubted social benefit, make it welcome in many countries. In an UNESCO international congress on the subject held in Bogota in 1979, the features of appropriate technology were summed up as follows:

1. The putting into practice of a native traditional technology,
2. The re-use of technology formerly used in industrialized countries,
3. The adaptation of modern systems,
4. The development of new technology and
5. The transfer of technological methods to the more remote areas of the least developed countries.

The search for the real meaning of the term **appropriate technology** in education has given rise to a whole ideological formulation and to an insistence on the fact that educational technology must not be confused with the mere application of teaching gadgets. This idea is still widely held, and has led to frustration and useless expenditure on inadequate materials. Educational technology may or not avail itself of technical resources; the essence, however, is in the approach, in the method.

Appropriate educational technology is that which contributes to educational and social objectives directed towards a development of critical collaboration and inventiveness on the part of individuals. UNESCO outlined the following requirements of appropriate educational technology:

- There must be full collaboration and participation of the users of educational technology in the planning, development, follow-up and evaluation of the projects.
- It must serve to carry through a wide-ranging social project.
- It must be designed to restore the mode of thought and of expression of the fringe populations.
- It must furnish an insight into and an ability to make use of technological advances by and for the bulk of the population, but especially in favor of those who have had no access to formal education or have dropped out.
- It must encourage an improved organization of the population, both in the process of education and in its aim.

To fulfill these requirements presupposes certain conditions in educational technology that fit in with

our previous observation. The crux of the matter is to harmonize the need to enter a world of technological progress with the respect due to the specific culture of each society. Obviously in these groups there may be backward-looking and disjunctive elements that should be opposed, but the mass of elements that make up the idiosyncrasy of a people are in themselves a source of social and personal growth.

Educational technology cannot be based, therefore, only on the native resources of community; such an approach could keep them out of the mainstream of progress and reduce their chance of betterment. The problem is rather to blend cultural foreign elements with the local ones, giving priority to the latter, and above all to make sure that those working in educational technology understand the cultural identity of the receiver community to whom they are responsible.

In other words, the appropriate technology movement is a strategy of development much wider than the mere transfer which of course forms part of it. It extends to other aspects of process technology while centering around the development of endogenous capacity.

In this brief account of ideas and experiences we have seen the challenge that faces the countries in transition or disadvantaged areas of developed nations to adopt educational technology without running the risk of endangering their cultural identity. The incorporation or the transfer of technology can be, however, a two-edged sword; it may be a real contribution to solving problems in education through the qualitative structuring of the content and philosophy of education, or it might boost the use of resources to maintain, strengthen and multiply the very practices that should be eliminated.

This point is quite clear if we refer to the media. A bad class or lecture in a classroom would not have the same consequences as if it were broadcast for example by television. Or in another aspect, even with revolutionary media and systems one can find the most stick-in-the-mud teachers.

And so to conclude, we may mention the need of any country to have a policy of comprehensive transfer with the following criteria among others:

1. Interrelation between educational policy and the general policy of transfer, and the latter with scientific and technological policy in the aspects of process and of product, to take up and to divulge selected and appropriate innovations within a system designed to create software and even industrial products and educational materials.
2. Support for the infrastructure of this industry and application of the processes of separation of technologies.
3. Promotion and intensification of fundamental and applied research on the definition and invention of different types of software and hardware for educational purposes.
4. Continuous study of alternatives in technological transfers to avoid a possible exclusiveness which would lead to a state of dependence and of distortion.
5. Selection of strategies and techniques which could be easily mastered by the user. Only in this way can the system be controlled.
6. Permanent evaluation of the effects at short-, medium- and long-term to establish courses of promotion, restriction or application.
7. Consultations with other organizations involved in importation of technologies which could have a bearing on the educational sector.

These criteria must not be seen as obstacles but as a guide among the many risks involved, including that of the much discussed resistance to innovation in education. Certainly there are teaching and university circles in which the incorporation of cybernetics and computers and the supremacy of technology in the developed countries is being ignored. Teachers from developed and developing countries are still being trained for a type of education that is doomed to extinction and is an obstacle to social progress and development. It is an urgent need to change the school culture toward an integration between cognitive and affective domains of teaching, between technology and human interaction, between information and formation. (Escotet, 1992b)

Also, universities, except for a few notable exceptions, are still Napoleonic. In the space age they are still bound to the blackboard, chalk, textbook and notebook, a plight made worse by the constant overcrowding and a professional supply of fifty years back. This not only refers to countries in transition but also to a major number of those of the developed countries, and it is a serious obstacle to the technological reconversion so necessary in the educational system. (Escotet, 1996)

The world, however, is being swept by a predominantly technological current. If we are not to be left on the margin we have to master it. Otherwise our generations will be responsible for the new illiterates, ignorant of the technological language that came in with this century, and responsible also for the gulf that separates the countries that have technology from those that have to import it. We are in the process of moving from the inner city to the global village. We have high inequality of access worldwide. Inequity of access to technology resources, mirrors the unequal distribution of every other human and material resource in public

education, like the United States, where educational funding is tied to local property taxes. The inequities of access to technology are even bigger between developed and developing countries (Cummins and Sayers, 1995).

The educational technology challenge means a real effort for the developing countries. For each country going it alone, the effort might be excessive. What is needed for the development of educational technology is a concerted action by all of them or by groups of countries and/or cultures to organize expenditure and shorten the technological gap.

This adoption of new techniques in education cannot be postponed. The lack of transfer could cause irreparable damage to society, and international responsibility should demand that efforts be made by the producers and by the receivers of technology to make a sensible decision for the benefit of man who is, after all, the focus point of development. Birds need two wings to fly, but let us not transfer an eagle's wings to a sparrow.