

## EDUCATION FOR ECONOMIC DEVELOPMENT

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I. The Need to Educate for Innovation

I would like to address myself as an economist and not as a professional educator to the problem of the relationship of education to economic development and of the implications of this relationship for the role of the more developed countries in assisting the new nations attempting to make the transition from tradition into modernity. It is remarkable how recently the economics fraternity has begun to develop an awareness of the critical importance of education,--or, as it is coming to be called in the jargon of my trade, investment in the stock of human capital,--in the process of economic development. The logical structure of the theory of the development process elaborated by economists is perfectly capable of dealing with the central role of education, but the economists' customary categories of inputs into the productive process, namely land, labor, and capital, have been treated until recently in such a way as almost to exclude any serious examination of the problem of the expansion of the human resources of the society. Labor has been treated very largely as a currently available stock of undifferentiated human beings with only grudging footnotes recognizing that labor has varying qualitative characteristics, and capital formation has been regarded as a problem of expanding the stock of physical capital such as tools, machines, facilities, and stocks of goods in process.

This is the more extraordinary since education partakes of most of the classic features of capital formation. Inputs devoted to education, which produces its economic yield only over a long time in the future, must be withdrawn from the production of immediately consumable items. The period of production of human capital is longer than that of most physical plant and equipment, suggesting the need for even more careful long range planning of human investment than of physical assets. Once produced, human capital continues to yield services over a considerable number of years. However the stock of human capital does waste and require replenishment through time. Properly designed, education or investment in human capital produces a product much more flexible and adaptable than most physical capital, though as I shall stress later, the need for greater flexibility is not adequately recognized by many educators. On the other hand obsolete human capital cannot simply be scrapped when it is no longer productive. It can be retrained, but this too requires special educational attention. Finally human capital embodied in an individual cannot in free societies be owned and traded by other individuals or companies as physical capital can, a fact which

has profound implications for the social organization of investment in human capital. A few economists such as Theodore Schultz at Chicago, Richard Eckaus at M.I.T., and Frederick Harbison at Princeton have begun to spell out some of the economic implications for development of investment in human capital, but this work is in its infancy.

Those of us who have been forced by the difficulties of explaining development in terms of the conventionally analyzed economic forces to look upon it increasingly as a unitary economic, sociological, psychological, and political phenomenon, have come increasingly to believe that for many of the countries seeking development the key factor inhibiting economic growth is the absence of an effective educational system in the broadest sense of that term. No matter what the availability of physical resources or financing, neither economic nor political development is possible without an educational system which is efficient in a sense I shall presently describe. While the financial resources devoted to education by the governments of the underdeveloped countries in many cases constitute a large fraction of their total budgets, the imaginative attention paid to the design of an educational system to meet economic development needs has up to now been far short of what is required to make a significant dent on the problem.

From the standpoint of the developed nations, what is called for is something much more than the allocation of a larger fraction of development assistance budgets to educational assistance programs. Such a reallocation is called for, to be sure, and movements in this direction are fortunately already taking place. The new approach to development assistance being taken by President Kennedy's administration in the United States places great emphasis on the need for devoting increased funds and attention to the development of human resources. But there is still an inadequate recognition in my country of the extent to which helping the educational process in the transitional states is going to require the mobilization of forms of assistance much more difficult to come by than money. The problems are fully as much intellectual as financial, and what is needed is a massive effort to focus the best and most imaginative minds of both the developed and the underdeveloped world cooperatively on the problems of the redesign of education for development.

In these remarks I would like to stress one problem in particular which economists have neglected in their analysis of the forces at work in development and which has a special significance for education. This is the role of innovation in the development process. Economists in their theoretical models of economic growth have tended to take technology as a given and explain rising levels of output as a result of the accumulation of capital in the physical sense. Recent statistical studies of growth in the United States have suggested that not more than

half of our growth is attributable to physical capital formation. The balance reflects increases in the productivity of physical inputs which are to be explained partly by the expansion of human capital accomplished by education and partly by an acceleration of the process of invention and innovation. This acceleration has itself been enormously influenced by the educational process. It is my conviction that a similar level of innovative activity is a necessary condition for development in the underdeveloped world and that education should be more explicitly designed to promote this.

We have in the past conceived of the problem of assisting development much too narrowly as the simple transfer from the developed to the underdeveloped countries of knowledge, technology, institutions, and practices in common use in the United States and Europe. Slowly and painfully out of the experience of ten years we are coming to learn in agriculture, in health, in industry, in political organization, that while the underdeveloped world has an enormous advantage, which it must exploit to the full, in being able to draw upon the experience of the developed world accumulated since the Renaissance, an adaptation of that experience to the problems of the underdeveloped countries requires a process as creative, innovative, and experimental as any we went through.

This need for creative innovation in the development process has a double implication for education. In the first place it suggests that one of the central goals of education should be a rapid expansion in the capacities of people at all levels in the underdeveloped societies for problem solving and for a rationally inventive approach to the issues confronting them. It is a great weakness of traditional education in the Western world that it is looked upon too largely as a process of transmitting a body of received knowledge, information, and conventional skills from one generation to the next and too little of creating a set of attitudes and talents conducive to finding new and more effective ways of doing things running all the way from designing simple hand tools to constructing workable administrative and political institutions for a whole society. This is not a new problem in educational philosophy, and some advances have been made on it in the West. In recent years, particularly in elementary instruction in science and mathematics, substantial strides have been made in pilot efforts to teach these subjects in ways which place more emphasis on the student's interest in and capacity for creativity and rational inquiry and less on the absorption of received doctrine. But we have a long way to go.

However weak our efforts to design a more constructive educational process in the United States and Europe have been, the extension of Western educational techniques into the underdeveloped countries has been even less adapted to the needs there. For a variety of reasons, our export educational product has during both the colonial and post-colonial eras placed even more emphasis on rote learning, preparation

for fixed subject-matter examinations, and the memorization of a body of knowledge of limited relevance to local needs than our domestic product. Since the utilization of knowledge requires understanding adaptation to local conditions and since the economic, physical, and social conditions in the various parts of the underdeveloped world differ widely from those in the United States and Western Europe, the educational process has been even less effective in fulfilling its function there than here.

This brings me to the second implication for education of the need for creative innovation in the development process. This is for much more imaginative innovation in educational techniques themselves to adapt them to the needs and resources of the underdeveloped countries. The fundamental laws of physics are universal. Their application to the design of a particular piece of equipment for a particular use in a particular society with unique resources, culture patterns, psychological attitudes, and physical environment requires an intellectual effort as challenging as the discovery of the fundamental laws themselves. Similarly some problems of educational philosophy are universal problems but the design of appropriate and efficient educational techniques for a particular environment requires a special act of invention to accommodate education to the limitations and exploit the opportunities of that environment.

## II. Some Critical Problems of Education in Underdeveloped Countries

With this in mind I would like to catalogue what seem to me to be some of the crucial differences between the underdeveloped and the more advanced societies which suggest major differences in the thrust and emphasis of educational policy.

1. More economical educational methods. The first of these is that the underdeveloped countries are exceedingly poor, and that therefore if they are to mount, as they must, massive educational programs they must find ways of doing this which are much less costly than the methods in use at all levels in the United States and Europe. This can be stated in financial terms. In the United States, for instance, we spend more than \$100 per capita per year on all forms of education. This is only about 4 per cent of our gross national product and about 20 per cent of our gross physical capital formation, but it is twice the entire per capita gross national product of a large part of the underdeveloped world. This comparison is of course misleading in a wide variety of ways, some of which make it an overstatement and some an understatement of the problem. Costs of teacher time of equivalent quality are several times as high in the United States as in underdeveloped countries. On the other hand the proportion of the population of most underdeveloped

countries consisting of those of school age is very much larger than in the United States. Nevertheless the orders of magnitude make it clear that an educational system of the scope and character of that of the United States (with which we Americans are not very happy) is wholly beyond the resources of the contemporary underdeveloped world supplemented by any conceivable levels of international economic aid.

Where achieving an objective with presently available methods turns out to be too costly, there are two things one can do. One can restrict oneself to a more limited objective, or one can seek innovations in method which will achieve the same objective with a more manageable input of resources. In this case the first procedure, that of limiting educational objectives, poses a series of unacceptable choices. Shall we provide primary education for only a fraction of the children of school age, shall we abandon or sharply limit vocational training, shall we give up the attempt to have one or more significant institutions of higher learning and research, or shall we accept low standards throughout the educational system. Any of these choices has a good prospect of creating limitations on economic growth which will prevent the gross national product from ever rising to the point where resources would permit a decent educational system. Faced with this dilemma, it is surely worth making serious efforts to see whether new methods, new principles and even new gadgetry cannot be found which will make it possible to achieve the educational objectives essential to growth with inputs of resources which the underdeveloped countries can afford. This calls for radical and imaginative innovation.

The kinds of innovations that are needed to meet this economic difference between the developed and the underdeveloped countries will become clearer if we take a look not at the financial requirements of education but at the real resources which an educational system requires. The most important of these, and the scarcest in the underdeveloped countries, is teachers. These of course must themselves be products of the educational system. In economic terms education is an industry which requires as one of its major inputs, a substantial fraction of its own output. This circular relationship poses limits on the feasible rate of growth of education by conventional methods. Where the number of people turned out by the educational process is very small, the number available to be teachers is likewise very small and the rate of expansion of education is thus inhibited. This is particularly true in an economy just starting to develop in which the demands for educated persons for jobs outside education itself are very rapidly growing.

Can the rate of expansion of the educational system required by economic development be achieved in the face of the shortage of indigenous teachers who must themselves be the product of an educational system? In part it can and in the short-run I am convinced must be met

by the import of teachers from the educationally richer countries and the export of students from the educationally poorer ones. But for a host of reasons this can deal with only a tiny part of the problem.

Anything which significantly shortens the time it takes to bring a student to a given educational level will be very helpful. In the first place this reduces the input of teacher hours per pupil and in the second place it shortens the period of production of teachers themselves and thus speeds up the cycle of expansion. There is some evidence from experiments recently under way that the learning process in certain fields could be enormously accelerated. We have not been under great pressure to do this in the United States, but it is a matter of enormous economic significance for the underdeveloped countries.

Secondly, anything which increases the number of students with whom a teacher can effectively deal reduces the cost of education in teacher hours per student. There has been much talk about the possibilities of more imaginative use of some of the modern media of communication like radio and television to achieve this goal. The trouble is that the effectiveness of these devices is still uncertain, and in most cases these things too are expensive. Once effectiveness has been established, it is still necessary to make a very careful computation of the trade-off in economy between teacher hours and expensive equipment before concluding that this is a promising avenue. A perhaps more hopeful direction to explore is the development of inexpensive teaching aids which greatly increase the teaching effectiveness and productivity of a relatively inexperienced and poorly educated teacher. The conventional teaching aid of this sort is of course the text book, but for a variety of reasons this is a difficult aid to employ widely especially at the primary level. It is too expensive, it requires fluent literacy on the part of the student, and in many instances it can be made available only in a language other than the native tongue. Some interesting experiments are under way in the development of extraordinarily cheap projectors to project pictorial material on a classroom screen with the aid only of sunlight. The development of the instrument itself is not the critical part of the innovation here which is rather the development of substantive material to be presented through such a device for a teacher with very little background education.

Other major and costly inputs in education are buildings, laboratory and other equipment, and books. Much more effective innovation is needed in the design of inexpensive items of this kind than has yet taken place if the educational problems of the underdeveloped countries are to be made economically soluble.

2. New methods of language instruction. Another critical respect in which the educational problems of most of the underdeveloped countries differ from those of Europe and the United States is the absolute requirement

for training in a second language at a very early stage in the educational process. This need arises from a number of factors. First in some underdeveloped countries substantial parts of the population have a native tongue in which there is no significant body of literature. In many cases, whatever the policy of the local government, it will be simply unfeasible economically to create such a body of literature for a very long time to come. In the second place, in a good many underdeveloped countries there exists within the boundaries of a single state a considerable number of mutually incomprehensible languages. In such cases a national language, which for a good part of the population must be a second language, is an absolute necessity for the internal communication necessary to the building of an economically and politically cohesive national state.

Universal mastery of the national language is essential among other things to ensure widespread equality of opportunity and economic and social mobility within the society. There are enormous educational advantages in the selection as the national language of one of the languages commonly used in international discourse. Where considerations of national pride or prestige or residues of anticolonial resentment prevent this from being done, it is necessary for the educational system to include provision for extensive training in still a third language. The economic, cultural, and political interdependence of the various parts of the world is growing by leaps and bounds and a nation whose educated classes do not have mastery of at least one of the four or five principal languages customarily used in international discourse is at a grave disadvantage. The effectiveness of the educational process itself is seriously limited if extensive use cannot be made of the available literature without translation and if utilization of imported human capital in the form of teachers, researchers, advisors, and technicians is inhibited by a language barrier.

Huge strides are being made in techniques of language instruction and recent experiments both with classroom methods and with the use of a variety of mechanical aids, some of them quite inexpensive, deserve careful study by the educational authorities of the underdeveloped countries. Widespread use of the best techniques currently known could enormously improve the efficiency and reduce the cost of this key aspect of the educational process, but there is a crying need for further research and continued innovation in language instruction.

3. Education to change the view of nature. A third difference between the United States and Europe on the one hand and many of the underdeveloped countries on the other which is of profound importance to the educational process is the attitude toward nature and the physical world which is instilled at very early ages by the cultural environment in which a child grows up. In most traditional societies the ordinary

processes of life are dominated by the notion that most of what we would call natural phenomena are beyond the control of man, are unpredictable, mystical, and subject to the whims of personalized but unseen forces. There are, fortunately, and always will be elements of mystery and unpredictability about the natural world in all societies. But in the more developed countries the child grows up in an environment of repairable machines, mechanical toys manipulable according to understandable principles, medical practice based at least partly on a theory of rational inquiry into the nature of the biological world and the like. The environment of the child and especially of the rural child in the underdeveloped world is quite different.

The teaching of science and of what Pareto called the logico-experimental approach in ways which will not destroy the unique non-scientific values of each culture is a challenge to educational imagination in all countries of the world. We have just recently begun to tackle this problem in a seriously innovative way in the United States with some very promising preliminary results. But the importance for economic and social development of founding new ways of instilling a widespread capability for bringing the right combination of reason and observation to bear on everyday problems of man's relation with the physical world is incomparably greater in the underdeveloped countries than with us. Finding ways of doing this which are effective, which can be utilized by teachers of limited background, which are within the resource capabilities of poor countries with some assistance from the richer nations, and which have relevance to the everyday problems of the common man is an urgent task deserving the attention of the very best minds of the technologically more advanced as well as the technologically less advanced societies. Innovation in the elementary teaching of science, mathematics, and technology with transparent relevance to local conditions for both children and adults is one of the crying needs of education in the underdeveloped world.

4. Education for problem-solving. Another characteristic of the contemporary world which has relevance for education everywhere but needs perhaps to be especially emphasized in designing education for underdeveloped countries is the extraordinary rapidity and unpredictability of the changes through which these societies are going. The generation now entering school is going to have to cope constructively with a world not only totally different from the one their fathers were brought into but also totally different from the one in which we now live. Thus the educational problem is not to train them to substitute our present answers for their fathers' answers but rather to give them tools and an attitude of mind with which to work out answers of their own.

From the economists point of view, when change is slow, it is possible to predict with some confidence what for ten or twenty years ahead



will be the particular knowledge and talents required by various elements of the labor force. A good deal of training can then concentrate on producing a supply of people with sufficient mastery of particular technologies to operate them satisfactorily according to prescribed rules. When change is fast, such special purpose human capital obsolesces in much less than a working lifetime and a much more flexible and adaptable labor force is required. This in turn calls for a much more fundamental kind of education which equips a man, through understanding what he doing, to adapt it to rapidly changing circumstances. Every society has always required a few such people. But as economic development proceeds and change accelerates, the numbers needed with the kind of fundamental education which gives flexibility are enormously expanded.

This flexibility is needed not only at the top of the educational pyramid amongst the university trained intellectuals. In agriculture the problem is not today to train the cultivator in the use of what is now considered the best practice but rather to instill in him a new attitude towards continual change and a capacity to shift his methods from year to year in response to new knowledge. It is not enough to teach the mechanic to repair today's automobile or radio set. He must be equipped to grasp new technology as it comes along. Thus the key role for education at all levels is not only the transmission of a body of knowledge, though that is necessary, but also the inculcation of a spirit of inquiry, a capacity for analysis of new problems and a willingness to set out into the unknown.

There is nothing new in this exhortation to education for problem solving. In principle I suspect everyone would recognize it as a desirable goal. But it carries with it heavy costs. Confronted with a choice between relatively quick training in specific subject matter and particular skills and the longer run inherently more difficult process of creating fundamental understanding and changing attitudes toward innovation, the emphasis is too often on the former. The educational economies of narrowly focussed applied training are particularly attractive to the poorer countries, but in the world of rapid change in which we live these economies will turn out before long to be false ones. We must achieve our economies not by limiting our goals in this fashion but by seeking greatly to increase the efficiency of a more fundamental type of education.

The rapid rate of change has another implication for educational priorities in the underdeveloped countries. For economic development to proceed rapidly, the underdeveloped countries must as a matter of national policy devote much more attention to adult education than is necessary in the United States and Western Europe. In the underdeveloped countries an exceedingly small fraction of the labor force possesses

the education necessary to operate a modern economy. Professor Richard Eckaus of M.I.T. has estimated that in 1950 some 94 per cent of the U. S. labor force required seven years of primary education to be effective in their jobs and some 77 per cent required the equivalent of ten years of schooling. While the figure is much lower for most underdeveloped countries, it is rising rapidly as they grow. If we were to rely exclusively on the education of school age children to change our capital stock of educated human beings, an underdeveloped country with little education in the past which adopted today universal primary education and extensive secondary education, would require thirty or forty years to bring its entire labor force up to the educational levels needed to operate a modern economy. This is too long to wait. Clearly special measures are needed to raise the educational level of the existing labor force. We simply do not have the time to wait for its replacement by a wholly new product. But the fundamental education of adults requires techniques in some ways quite different from those required for the education of school children. If economic development is not to be inhibited much more resources and much more imaginative attention must be paid to new techniques of adult education.

5. Education as a search and selection device. One final problem confronting the underdeveloped world which can be solved only through a massive educational effort is the double problem of ensuring equality of opportunity to all elements in the population and selecting from the entire population those best qualified to fill professional technical, administrative, and political roles. The first of these issues is essentially political, the second primarily economic.

There is by now an impressively growing body of empirical evidence that political stability in the new states cannot be maintained under free institutions if both the opportunities and the fruits of economic development are concentrated in narrow segments of the population. There is a tendency under the impact of modern communications for aspirations to participate in the modern sector of the society,--politically, economically, and socially, to spread much more rapidly than opportunities to do so. Most new states are in principle committed to the concept of equality of opportunity for all their citizens. But whether this is accepted as a value by the leadership or not, a movement in this direction by the leadership is probably a condition for their remaining in power over the long pull. The pressures of large frustrated and underprivileged classes can be held in check for a time by authoritarian measures, but ultimately the forces of change will break through constraint imposed by force. The most essential condition for equality of opportunity is universal primary and extensive secondary education. Without this, evolutionary change under democratic institutions is likely to be impossible and political conflict disrupting economic development is probable.

But beyond this the purely economic need for universal education as a selection device is great. Economic growth under whatever form of political control requires for quite technical reasons an enormous broadening of the function of decision making through all sectors of the society. The demand for competent decision makers cannot be effectively met by relying on a small hereditary elite. Devices must be found for searching for talent through whole populations and for selecting the most promising human materials for intensive investment in training and skills. The most efficient such device we have yet discovered for surveying the inherent qualities of entire populations and drawing the best qualified into responsible positions is a proper system of universal education.

There are some dangers in this process. If the educational system is universal but is designed too exclusively to select and train a top elite, the rejects from this process can, as some underdeveloped countries have already learned, form a growing pool of frustrated educated unemployables which can seriously threaten the stability of the society. There are ways of meeting this danger, which again requires innovative imagination in the design of the educational system.

In summary, then, the focus of innovative thinking to adapt education in underdeveloped countries to the needs of economic development should be on attempts to solve such critical problems as: 1) how to provide effective education at much lower cost in money and in such scarce resources as teachers than prevails in the U.S. and Europe, 2) how to deal with the special language problems of the underdeveloped countries, 3) how to design an educational system which will from its beginnings tend to replace a fatalistic and mystical view of the universe with a logico-experimental view, 4) how to train in the techniques of problem solving necessary to the mastery of a rapidly changing environment rather than in the acquisition of a fixed body of knowledge, 5) how to provide equal opportunity and a system of selection according to ability without creating a class of educated unemployables.

### III. Implications for Assistance from the Developed World

The implications for development assistance of what has been said above about the nature of the educational problem facing the underdeveloped countries are fairly clear. Increased allocation of funds are called for, especially to meet the foreign exchange costs of greatly expanded educational programs. Such funds are needed for the expansion of school plant, for the stocking of libraries, for textbooks, for other teaching aids, and perhaps especially for the hiring of people from the developed countries who can help in the reform and extension of educational systems. The provision of qualified people is a particularly critical aspect of educational assistance which will not be solved

simply by the provision of funds to pay them. The fact that the most important inputs into the educational process at all levels are the products of that process, namely educated people, suggests the problem confronted by nations attempting rapidly to expand their educational systems. Many of them will require not merely technical assistance but teachers, researchers, and even administrators from abroad in considerable numbers while they are building up their stock of qualified indigenous educators.

But there is a third requirement if the two needs on which I have laid stress in this paper are valid, namely the need for education for innovation and the need for innovation in education. This is a requirement for serious attention to the redesign of educational methods by a large number of the quality minds of both developed and underdeveloped countries.

Let me emphasize again that the problem is not one of transferring techniques which have become conventional with us to the underdeveloped world. Just as we cannot solve the problems of agriculture, health, transport, or industry by exporting our present technology, our second hand machines, and our second-rate people to the underdeveloped countries, so we cannot give serious help to education there by exporting our standard educational methods or our routinely trained teachers.

We need to give more serious and more experimental intellectual attention to the design of new techniques for education in the underdeveloped world than we are giving in our own countries. The kind of thing I have in mind is illustrated by an exercise I have just been through. A group of top flight American natural and social scientists have been involved for the past several years in a basic re-examination of the teaching of science in American high schools under the auspices of the Physical Science Study Committee. Many of these people recently assembled for six weeks with a group of leading African educators to re-examine in a fundamental way the whole problem of education in Africa. From this exploration a number of results emerged. The group produced proposals for curriculum change in the primary and secondary levels. They had some very imaginative ideas about teaching aids, teacher training, demonstration equipment, and the like. But their major conclusion was that much more extensive research, experimentation, and fresh thinking needed to go into educational design for Africa. More important, some of the Americans who had had no previous contact with or interest in African educational problems were so challenged by the intellectual issues raised that they indicated their intention of continuing to make this their major preoccupation for the near future. They proposed the establishment of a number of new institutes where this kind of research and experiment could be carried forward

cooperatively by Americans, Europeans, and Africans on a scale sufficient to promise significant results.

If we are to help the underdeveloped countries with their mammoth educational problems in ways which will contribute to economic, social, and political development we must allocate to this problem a substantial share of our scarcest resource, creative brainpower. In the process there is a good prospect that we will learn a good deal that will be very useful to us in dealing with our own still unsolved educational problems.