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RESEARCH ON EDUCATION IN THE DEVELOPING COUNTRIES*

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Abstract — Developing countries are in a major educational crisis. Educational opportunity has expanded but quality has been sacrificed. In some instances the quality of education has become so low that one might do well to question whether the costs of expansion do not outweigh the benefits. Research on education has not prepared the developing countries to meet the crisis at hand. The article mentions three examples—in pedagogy, in curriculum and in 'deschooling' theory—where educational research has not been helpful. On the other hand, the article points to several areas where there has been useful work, and where new work might make a substantial contribution in the years ahead.

INTRODUCTION

I would like to focus upon the role of education research in developing countries and in particular, upon three categories: (1) past analytic directions which have turned out to be spurious; (2) recent advances; and (3) a promising new future direction which I will call 'the missing link'. Throughout I will refer to research generated by institutions other than universities as well as by universities, and I will take this opportunity to comment on the nature of the product emanating from the two sources.

Educational expansion

Between 1950 and 1980 the expansion of education systems has occurred in every country. In the poorer countries the average portion of the age cohort attending primary school in 1950 was 37%; in 1960 it was 48%; today it is over 70%. By the year 2000 virtually every child born will, at least temporarily, enter a school 'of some kind'. This growth has occurred, despite the fact that in poorer countries the relevant age cohort itself has increased by factor of 100–200%.

Education finance

Resources for teaching students have increased dramatically in OECD countries. The Netherlands is a good example. The Netherlands devoted 7.3% of its national budget to education in 1950. Ten years later it was up to 16%; 16 years later it was 22%; and 25 years later 28%: a rise from 7.3% of the national budget to 28% of the national budget over the 25-year period. Furthermore this rise was occurring along with a rise in the budget itself. Similar 'double increments' in educational expenditures can be found in Norway, Sweden, Belgium, and the Federal Republic of Germany, among other countries. Yet as more resources were being devoted to education in these countries, the number of students did not rise proportionally. There were 1.2 million elementary school students in the Netherlands in 1950; and 1.4 million in 1970, an increase of 14%. In Norway there were 343,000 in 1950 and 387,000 20 years later, an increase of 12%. In Germany there was actually an 8% *decline* in the number of (elementary) students over the 20-year time period.

This situation differs substantially from that of the developing world where expansion has taken place at the expense of quality. There, the number of students has skyrocketed. These countries devote as large portions of their national budgets to education as do the Netherlands—currently in Benin it is 36%; in Mali 33%; in Malaysia 26%—but over nine-

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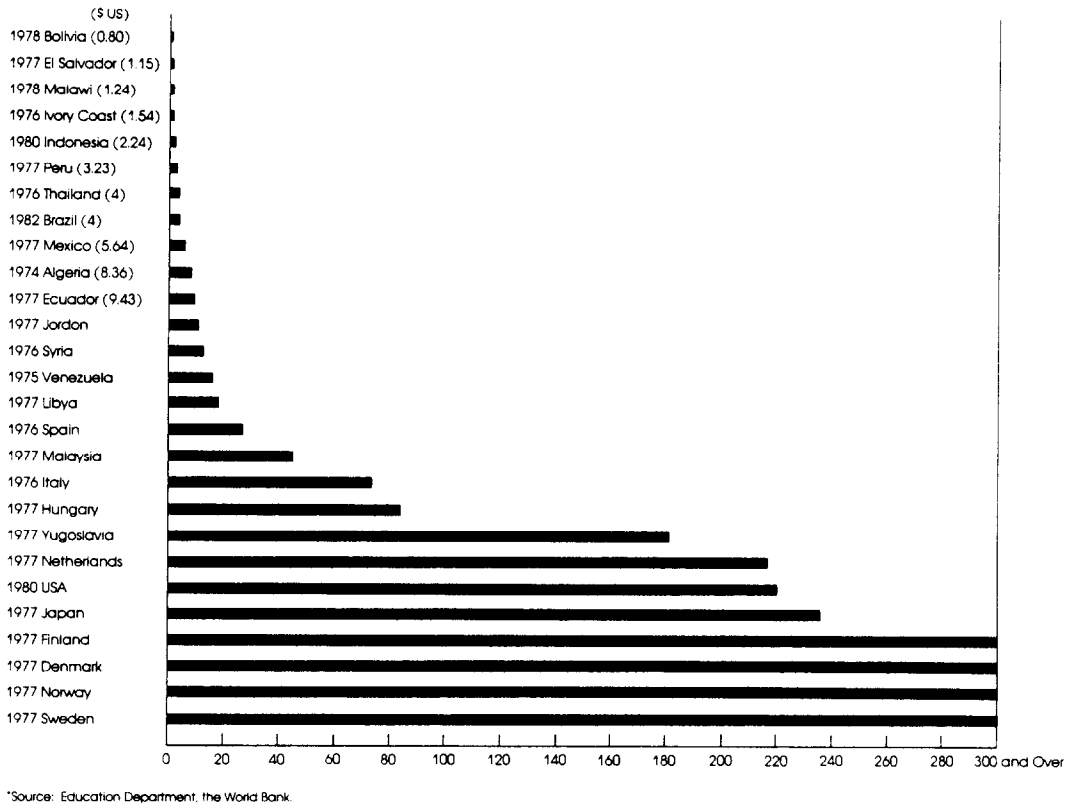

Fig. 1. Value of classroom materials and other non-salary recurrent investment per student enrolled in primary schools.

tenths of this investment has to be allocated to teacher salaries. Consequently, as more and more students enter school, there are fewer and fewer materials to teach them with.

There are two pieces of information which suggest that this is true—one on the total unit recurrent expenditures and another on non-salary recurrent expenditures. In terms of total unit recurrent expenditures for example: in 1960 the typical OECD country was able to invest 14 times more per student than did the average poor country; but five years later the gap had risen to 16: 1; ten years later it was up to 22: 1. Today, 20 years later, it is 50: 1. The average (elementary school) student in an OECD country is exposed to 50 times the level of recurrent cost investment as a student at the same grade level in a low-income country.

But an international comparison of cost figures which includes salaries is full of problems. Distortions occur even when comparing the change in cost ratios, such as those just mentioned. Nevertheless, the figures for recurrent non-salary (physical) costs per student mirror those for total recurrent costs. Non-salary costs include everything else necessary to make a classroom operational—books, maps, chalk, furniture, and the like. The current fiscal situation is displayed in Fig. 1. By contrast, Italy currently invests $75/pupil in classroom supplies; the Netherlands and the afford $1.24/pupil; Indonesia, despite recent substantial effort, can still only afford $2.24. By contrast, Italy currently invests $75/pupil in classroom supplies; the Netherland and the USA invest $220/pupil; some countries, such as Sweden, invest over $300/pupil. In practical terms this means that one out of three

elementary pupils in the USA now has access to a computer; 97% of the elementary schools in Japan have a tape recorder, 27% have a color TV camera, and virtually all schools in Japan have an overhead projector, a slide projector, and an 8 mm projector. In the USA there were 71,000 school libraries in 1978; each elementary school pupil had access to 14 titles, in addition to textbooks, reference books and visual aids. For every elementary school pupil in the USA in 1978, $34 was spent in library supplies.

The availability of classroom materials in the developing world is very different. In 1977, for instance, there were ten pupils for each available primary school textbook in the Philippines. Thus, pupils in the USA have in the range of 140 times the amount of reading material put at their disposal. In 1979 in Malawi only one pupil in eight even had a chair, and only one in 88 had a desk. Primary schools in Malawi—and many other countries are without safety standards. Walls frequently collapse after a rainfall; roofs have holes; wind and storms disrupt classroom activity as a matter of course. The normal classroom is dark and stuffy; students are forced to sit on a bare floor and balance an exercise book on their knees in order to write.

These national differences in school quality 'inputs' get translated into wide differences in learning achievements. The average score in reading comprehension and in science of a typical student from a developing country falls in the bottom fifth to tenth percentile of the scores across all countries. In one sample of primary school achievements in 25 high-, medium- and low-income countries, the correlation is strong and statistically significant ($r = 0.55$; $P < 0.001$), indicating that the wealthier the country in economic terms the greater the cognitive skills acquired at the end of the primary school cycle (Heyneman and Loxley, 1983).

The term has been overused, but we *are* in a 'world education crisis'. Ceilings on expenditures have been reached; the demand for schooling is high and is constant (Heyneman, 1983b); political authorities—on all sides of the political spectrum—are under extraordinary pressure to expand educational opportunity; and quality is being sacrificed (Heyneman, 1983a; 1983b). The problem I wish to raise is why this has taken us by surprise. There has been a substantial amount of research on education over the last several decades; why hasn't it prepared us for what we see in front of us?

SPURIOUS ANALYTIC DIRECTIONS SINCE THE 1950s

One problem is that some research, stemming for the most part from universities, has led us into spurious directions, into lines of problem conception and investigation which have proven to be a waste of time, resources, and energy. Let me mention three examples:

Pedagogy

Observers in large numbers, usually curriculum specialists or teacher trainers from North America and Europe, began visiting Third World schools for the first time in the 1950s, and they returned with surprisingly uniform conclusions: that the problems they saw could be attributed essentially to poor pedagogy. As solutions they proposed to: (1) make teachers eliminate rote memorization techniques, and (2) make the curriculum more 'relevant', more practical. For example:

> There sat the children on their wooden benches. There stood the teacher in front of the room. Back came the young voices: 'These are my shoes.' Over and over. . . . Then the teacher asked, 'What are shoes? Who can tell me what shoes are?' No one answered . . . I felt completely defeated.[1]

Not a stimulating classroom by any account. But according to the foreign observer in this case, the solution was to reform the content of the training colleges so that teachers could be trained through the 'discovery method'. What the observer never mentioned was the fact that students in the primary school visited had nothing to read; they had no maps, no library books, no visual aids, no dictionary, no encyclopedia, no reference books of any kind. There was no mention of the absence of eye glasses, or the fact that many of the students were probably malnourished or incapacitated by fever. There was no mention of the fact that the teacher probably had undertaken only two or three years' more formal schooling beyond primary school. The point is this: in situations of school poverty, where, typically, the teacher

has access to only one book, it is hard to imagine that *any* pedagogy is feasible other than memorization.

This blindness to the poverty of classrooms has been so typical that development assistance agencies—in many cases the largest source of education development capital—have allocated a high proportion of their education resources to 'reforming' curriculum and teacher training techniques. The result has been new curricula and new techniques for teaching but classrooms left unchanged. Again and again technical assistance has been provided so that countries could redesign materials to make them 'more relevant' when the source of the problem was not the absence of relevant materials, but the absence of any materials. With hindsight it is hard to view these efforts as anything other than boondoggles. Where is the 'Entebbe Mathematics' now? The 'New Primary Science Curriculum?' The 'Community School?' They appear today as empty theories. They affected laboratory schools which had close linkages to the university training college, but little else. Today they are abandoned, even there. They emerged out of the anti-traditional enthusiasm of the open-classroom wave which swept the OECD countries in the 1960s. Now where is this enthusiasm? American and European educators have rediscovered the virtues of stimulus–response, of repetition, of short-term memory and exposure to time-on-task. They have come full circle in their own countries. They now stress the application of time-honored principles: limitations on curriculum choice when personal interests are immature, and meeting requirements in basic skills as a criterion for advancement to the next grade. This turn-around has left the pedagogical reforms in the Third World high and dry, like a dead whale on a California beach.

Curriculum

Research and policy advice emanating from the field of curriculum has been almost as problematic, for several reasons. Since the middle 1960s assistance has been reaching classrooms at least on the secondary school level, but this assistance has had a fixation on something called 'practical skills'—wood and metalshop subjects, domestic science, agriculture. My complaint about the effectiveness of curriculum research does not challenge the virtue of practical skills; my complaint has to do with the lack of attention to their managerial prerequisites—to the multitude of chemicals, hammers, wood, solder and other consumable supplies required, and their cost; the degree of training necessary for the teacher; and the availability of a constant source of affordable water, electricity, and the like. These prerequisites are rarely present. As a result, all over the world one can find graveyards made up of workshops and laboratories. Equipment sits rotting in the corners. Electric saws, lathes, and drill presses can be found rusted through and discarded within a year of arrival. In some cases this equipment for 'practical' subjects has been considered the first priority and has been sent to secondary schools which had no library, no textbooks, no geography maps—none of the essential materials for teaching the basic skill subjects of mathematics, science and language. Thus, not only is the strategy of curriculum diversification problematic in terms of implementation, but it is unbalanced. Assistance to raising basic and fundamental skills has been ignored in favor of assisting vocational skills.

The problem is that curriculum specialists have argued that students *always* have to have something called 'hands-on experience' before they can understand a theory;[2] that they always have to experience a metalshop in order to have a well-rounded, balanced education. And curriculum specialists continue to make this argument when everyone can see that these subjects cannot be managed. But no-one has had the courage to ask that they be cut out of the curriculum.

The very same problem of curriculum specialists being unable to say 'no' is true also for curricular objectives. The list of objectives is always getting longer. The amount of knowledge which students are expected to absorb and which teachers are expected to teach, in every country, is too great. Curriculum objectives are decided completely independently of the capability of the average school to deliver them. Specialists in curriculum always seem willing to consider new content; but they do not recommend that content be omitted in order to accommodate

the addition. There is no sense of curriculum economics in the Third World. And there is a virtual and embarrassing absence of curriculum economics in the curriculum literature.

The functions of schooling and the poor

Among coffee shop intellectuals there is a very popular line of argument which holds that the experience of schooling works against the poor; that it teaches them to accept their failures, become docile workers, willing peasants, in essence, to become obedient citizens who will not question authority. Proponents label themselves as Marxists, though the label's accuracy may be questionable. Debate over these theories has taken up considerable space in some of our best professional journals and has engaged some of the brightest minds in universities in North America, Europe, and in the Third World. One example of how popular this line of reasoning is, can be seen from a recent summary of trends in academic research on Latin American education. One of the most popular questions that this academic research has tried to address was whether schooling *retards* economic and social progress (Egginton, 1983).

How this strange line of reasoning is received outside the world of universities I will illustrate with an anecdote. I once had the opportunity of being present at a social occasion when a proponent of 'de-schooling' met with a high official responsible for the planning of primary education in a developing country. The official listened carefully to the arguments of how children of the poor drop out of school for 'legitimate' reasons, and how, if they continue in school, they accept their fate and therefore tend not to question the legitimacy of the (capitalist) State; in essence, of how schooling worked against the interests of the poor and therefore why schooling should be abolished in its present form. At the end of the explanation the official asked this eloquent and very sophisticated North American expert what he would do. Essentially the answer was to eliminate primary schools in the rural areas altogether and replace them with 'peasant learning centers' where they (the students) could have their 'consciousness raised'.

The public official thought deeply for a long time before responding. He asked the foreign expert if he had ever visited one of the local slaughterhouses. 'No' was the answer, he never had. 'Well', said the education official,

> there is a health inspector there who has a pistol on his belt at all times. The pistol is loaded. And every so often it has to be used. When peasants bring in a cow for slaughter it's a major event, they may only have one cow. Income from that cow is critical for the survival of their family. But only after a slaughter can the health inspector check the liver, and once in a while the animal is found to be so diseased that the meat cannot be sold. When this occurs the farmer cannot be paid, and in grief some farmers have been known to attack the health inspector. Now there are schoolmasters who also need protection from peasants and for similar reasons. Not enough places in schools exist for everybody; repetition is illegal; there are standards of examination performance before entry to secondary schools can be obtained. We often have headmasters who are beaten when they tell a man there is no place for his child in school, and once in a while, a headmaster is killed because he had to turn someone away.

The foreign expert looked slightly confused in response to this story. The official explained:

> Peasants want their children to go to school very badly. To suggest that their children are injured by schooling is therefore to suggest that peasants are fools. Now it's all very nice to sit up in Berkeley and argue, in effect, that peasants don't know where their 'true interests' lie, but try closing a primary school door on their children and watch what happens.

His point in telling this story, and mine, is that this line of research has not been at all helpful. It has been an expensive intellectual diversion by those who have never had to face the challenge of providing what peasants generally want for themselves and for their children: more schools and schools of a quality equivalent to that which is obtained by children in more privileged circumstances.

RECENT ADVANCES

Thus far the discussion has been very critical. But there are areas of research where there has been an accumulation of useful findings, and, more importantly, where there may be potential breakthroughs. There are essentially two separate research traditions, one on external efficiency and another on internal efficiency. In my view it is the potential for their merger which holds out the hope for some major discoveries, and in

particular, for some major discoveries with respect to the productivity in agriculture.

External efficiency

The study of human capital began and for many years was taken to be identical with what is now called 'external efficiency'. Schultz (1964; 1981) first drew attention to the apparent correlation between advances in national economic growth and national investment in schooling. Since then measures and arguments have been refined, and have passed through two stages. *First* there has been an accumulation of research on the results of investing in education in the developing countries (Hicks, 1980; Wheeler, 1980; King, 1980; Meyer and Hannan, 1979; Colclough, 1980; World Bank, 1980; 1981). Perhaps this research has been best summarized through the work of Psacharopoulos (1981, 1982) on monetary costs and lifetime earnings; Psacharopoulos translated these into rates of return. Estimates are now available from 44 countries, and there are four patterns worthy of mention:

(1) Among all educational levels the highest economic returns come from investment in primary education.

(2) The private returns are in excess of social returns, especially at the university level.

(3) The returns on education in developing countries are higher relative to the corresponding returns in more advanced countries.

(4) The returns on education are as high as, or higher than, the returns to investments in physical infrastructure.

This line of investigation has not been without controversy. Some feel that earnings are not sufficiently accurate to be used as measures of productivity; others feel that 'credentials' skew the results from different earning streams significantly, and therefore regard the exercise as untrustworthy. There are responses to these objections, but as a technique the rate of return approach has been useful. Results provide rough estimates of the returns on educational investments, estimates which, in general, hold the potential for comparison across alternative sectors. But perhaps even more important is the clarity which the rate of return approach brings to the calculation of educational costs. There is no area where governmental agencies need to increase their understanding more than in the calculation of costs—of maintenance, salaries, alternative construction techniques, curriculum specializations, etc. The procedure for calculating a rate of return, as a side benefit, has had a marked pedagogical effect on clarifying alternatives for providing education.

Second, there has been the specification of external effects in even more precise terms. Instead of earnings the new effort has been to calculate net agricultural yields associated with education and statistically isolated from other contributing factors—extension services, physical inputs, soil, weather conditions (Lockheed *et al.*, 1980). As with the rate of return approach, statistical caveats abound. But results from 8 countries have been generally consistent across the two methodologies. Four years of primary schooling, for example, is associated with an average increase of 13% in a farmer's net productivity when complementary agricultural inputs are present, and about 6% when they are not present (Jamison and Lau, 1982). Two observations might be worth mentioning: (1) that the percentage increase in net yields due to education is *double* when farmers are utilizing new seeds, irrigation or fertilizers (i.e. complementary inputs), suggests that education is more efficient when the level of occupational complexity increases; (2) that there was *any effect* at all given the measure of education being used is a curiosity in itself—four years vs nothing—and the four years being measured in this research consists of four years of primary schooling in Nepal, in Thailand, in Kenya, in schools which are not, what one might politely call, 'well-endowed'.

This is the problem with both styles of research on external efficiency: the measure of schooling has been extremely weak. Previous studies have had to rely upon 'number of years of schooling completed'. Only a few studies have been able to estimate the knowledge gained as a result of school. And—to my knowledge—only one study has been able to specify the economic effects for investing in a

specific school quality input (Schiefelbein *et al.*, 1983; Schiefelbein and Farrell, 1984).

Internal efficiency

Quite separately, some significant advances have been made in studying the efficiency internal to schooling in developing countries. Student learning, for example, can be broken down into two separate 'families' of determinants or influences. One is the influence outside the school's control—a pupil's gender, social status, neighbourhood, etc., the most powerful being social status. Another is the influence within the school's control—the curriculum, the quality of teachers, classroom facilities, etc.

Two points, essentially opposite sides of the same coin, are worth mentioning. First of all, in the developing countries the potency of a pupil's home background or social status is significantly less than it is in the industrialized countries (Heyneman, 1976a). Of the variation in student learning explained by all the influences taken together, education and occupation of the pupil's parents account for 75% in Australia, 65% in the USA, and 50% in Belgium; but it is less in the lower income countries. Parental education and occupation account for 45% of the explained variation in student learning in Mexico, 33% in Egypt, 20% in Brazil and only 12% in India (Heyneman and Loxley, 1983).

Findings of this kind have generated considerable argument and discussion (Niles, 1981; Lanzas and Kingston, 1981; Cooksey, 1981; Theisen, Achola and Boakari, 1983). Some have suggested that the lesser influence in the developing countries is due to idiosyncrasies of the data—a lack of sufficient variation in social status in the developing countries, or a self-selection process among students, etc. Others have argued that there are genuine differences from one country to the next in the degree to which social status represents a genuine social class, or the degree to which a difference in social status can characterize a difference in the psycho-linguistic manner of raising children (Saha, 1983; Johnson and Jinyono, 1983; Ramirez and Meyer, 1980; Heyneman, 1980). The basic issue under discussion, however, does not seem to be whether or not it is true that the influence of a pupil's social status is less in the less industrialized countries. Rather the issue appears to be the reasons why, under what conditions, by what processes these common indicators of family background can be powerful and important determinants of school achievement in one environment and not in another.

A second point, on the other side of the coin, is the relevance which this line of investigation has to the internal efficiency of schools. Because the power of social status, outside the school's control, differs from one country to the next, other factors, within the school's control, might differ as well; and this is the case. The variation in academic achievement attributable to factors internal to school classrooms, such as the quality of the teacher and physical facilities, differs substantially across countries, but it is significantly higher in the developing countries—88% of the explained variance in India, 80% in Brazil; 68% in Egypt; as opposed to 25% in Australia, 35% in the United States, and 27% in Sweden. Though significant effort has gone into the study of this, we are just beginning to understand the causes of these differences (Heyneman, 1976b; Heyneman and Loxley, 1982; 1983). What we do know is that the explanatory power of school and teacher quality is between two and three times greater in the developing countries than it is in the OECD countries (Fig. 2). This would suggest that a dollar invested in a school in India would have significantly more impact on learning than it would if invested, say, in Delaware. The question is whether one can draw this kind of a conclusion from cross-sectional research. Ordinarily one cannot, but there have been several recent national school quality investments—in the Philippines, for example—where a modest alteration in the accessibility of students to textbooks (of high quality) has been able to significantly raise the *national* level of science, mathematics and language skills (Heyneman *et al.*, 1978; and Heyneman *et al.*, 1984). Measured in units of standard deviations these learning gains in the Philippines are about double what would be achieved in the USA if the average class size could have been reduced from 40 to 10.

What we have, in sum, is an opportunity for

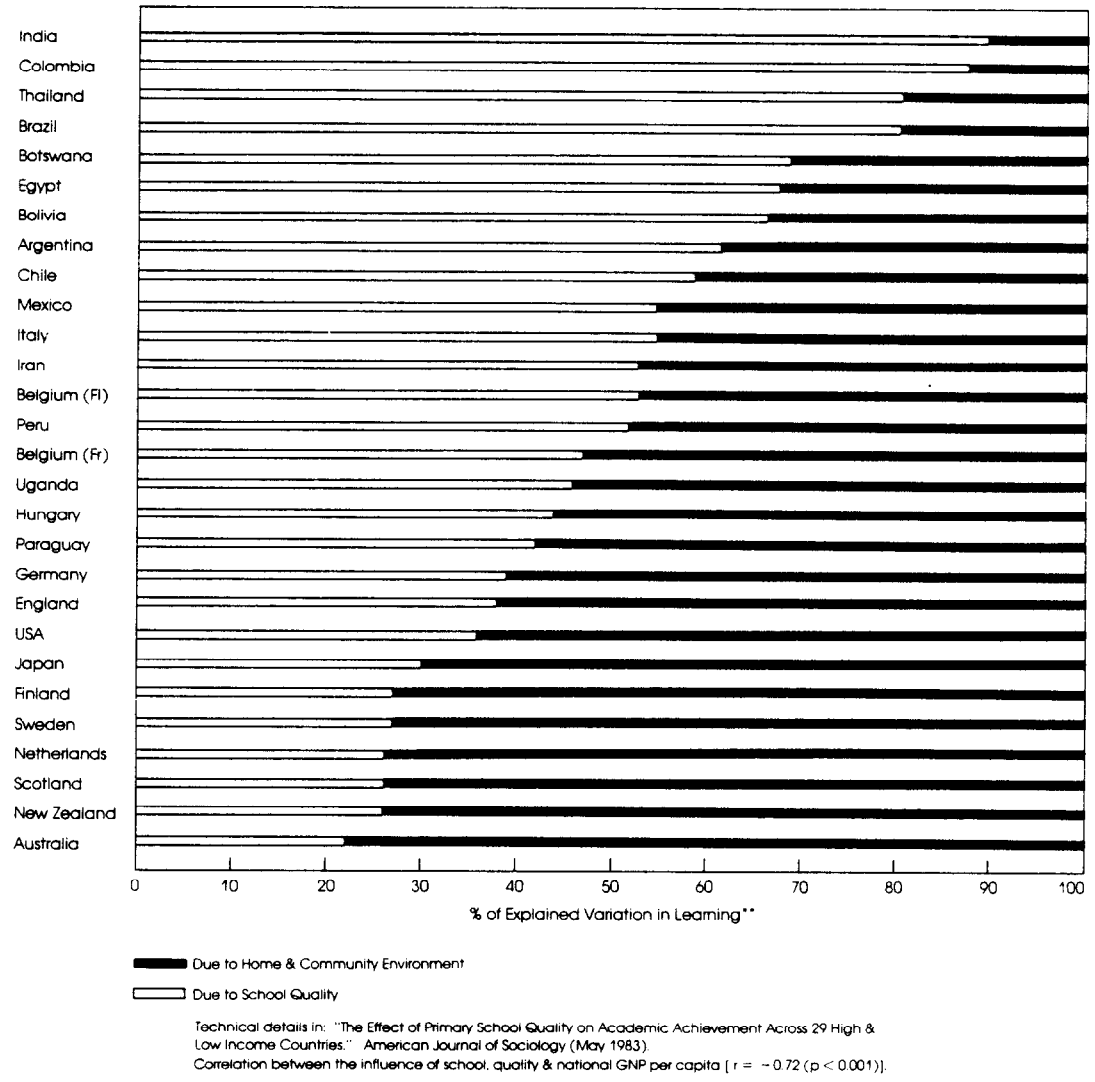

Fig. 2. Influences on primary school science achievement.

making a very sizeable alteration in student learning in the developing countries. There are fiscal and managerial caveats, but current school environments are so devoid of learning materials and stimulae that significant gains can result from very simple interventions.

FUTURE DIRECTIONS IN HUMAN CAPITAL RESEARCH

Few people need to be convinced of the importance of agricultural productivity. As the *1981 World Development Report* makes clear, the level of a nation's productivity in agriculture can make the difference between economic survival and economic collapse. Certain countries, India and the Philippines for example, have been able to turn themselves around from a food-importing country to a food-self-sufficient country in the last decade; while most countries in Africa, for many reasons, have seen the level of their agricultural productivity slip precipitously. Now the question is: why should agriculture—frequently with the same crops—be making gains in some parts of the world and not in others?

Educational quality and agricultural productivity

To predict productivity in agriculture is complex. One has to account for numerous characteristics, some particular to the nation, some particular to a region, to the farm, or to the farmer—pricing policies, accessibility to markets, storage facilities, avoidance of drought, pestilence and the like, but some characteristics are new. There are fewer and fewer farmers today who are cropping just as their ancestors did, without alteration in technique. It is almost universal to find a new input in the production process. New varieties of seeds are now widely available. What is not recognized is that these new seeds require new skills, for they are often quite delicate. Some seeds require a new depth or different contour. The type of contour will depend upon the water supply. The water supply will change when new irrigation schemes are operating. The choice of seed will also depend on the kinds of soil conditions. But soil conditions can now be altered artificially, by the amount of water, and by the use of certain fertilizers during certain seasons. New seeds alter the chance of pest damage. The change in seeds may require new pesticides, but new pesticides require a careful understanding of how they work. Pesticides have to be used differently with different seed crops, different climates, different drainage conditions. As soon as agriculture is altered from the traditional, the potential gains are sizeable; but proportional to the increase in benefits is an equal increment in the level of complexity.

For some time it has been clear that this complexity might be better mastered if farmers were to have more education. The appropriate question is not whether this is true, but why? Under what circumstances? The most interesting question today has to do with the antecedents to the relationship between education and agriculture.

One of the universal products of schooling is the development of the cognitive skills—in language, science and mathematics, for example. Though still crude, some researchers in both developed and developing countries have begun to model the different levels of cognitive skills which farmers must attain, perhaps over several generations, in order for agriculture to change from its base in father-to-son knowhow to its ultimate—in the highly technical, capital instensive operation that one observes in OECD countries and occasionally now in developing countries. Within this process of agricultural development lie cognitive pre-requisites, the essential cognitive tools to efficiently manipulate agricultural inputs (Heyneman, 1982; 1983a).

For example, irrigation-based agriculture involves four different levels of development. The most elementary is where knowledge and skills are passed from father to son (level A); little schooling is required here. The second (level B) includes a single modern input, such as fertilizer, whose utilization is substantially improved if the farmer has rudimentary literacy and a pencil and paper, ability to add, subtract, and divide. Without this ability a farmer will have to follow by rote the one-to-one advice of an extension agent. This is an expensive and inefficient method of learning food production. The third level (C) includes several modern inputs simultaneously, such as high-yielding varieties of seed and careful allocations of pest control and fertilizer. Here, having to follow the advice of an extension agent by rote is even more expensive. But, in these conditions, for the farmer to take initiative on his own requires an understanding of long division, multiplication, and other mathematical procedures; an ability to read and write; rudimentary knowledge of some chemical and biological principles. The fourth level of technology (D) is the most modern. It includes all the above inputs plus tubewell access during the off-season. For a farmer to operate efficiently at this level he needs to be able to communicate in writing, to research familiar words and concepts himself, to understand basic concepts drawn from chemistry, biology, physics, and to have dependable access to new information from print as well as electronic sources. This is the ideal: that every farmer be able to calculate his own 'production-function' anew every year and with each change in crop.

The missing link

Perhaps the most interesting questions of human capital research will be concentrated

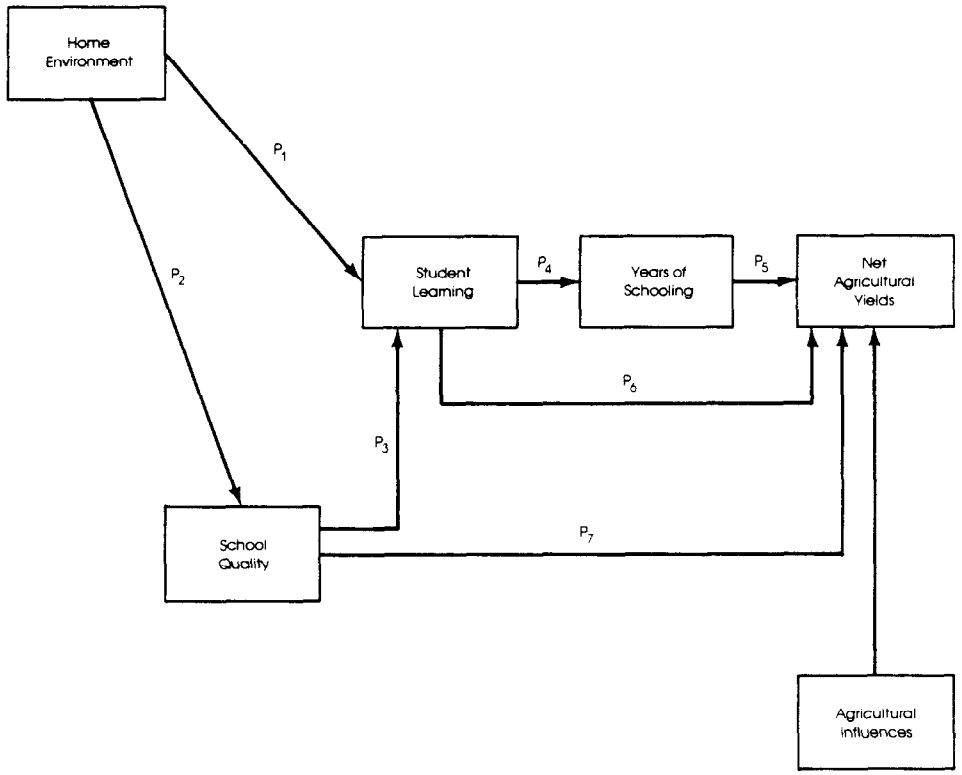

Fig. 3. Educational influences on agricultural yields.

over the next decade upon what might be termed 'the missing link'. There is already a substantial body of information on external and internal efficiency. The next step is to clarify how the internal processes of schooling affect an individual's later ability to adapt to the technological requirements in agriculture. A model of this missing link can be found in Fig. 3. Here influences are expressed in terms of hypothesized (or actual) path coefficients. P_1, P_2, P_3, P_4, and P_5 are already within technical grasp. What is missing are estimates for P_6 and P_7—the degree to which net agricultural yields are determined by school achievement; and lastly, the degree to which agricultural yields are determined by prior investments in school quality.

Implications of this line of investigation go beyond the realm of academic curiosity. Learning achievement can be raised substantially by making school-quality improvements. Poor quality and brief schooling has been found to have an identifiable and solid impact on agricultural yields independent of other factors. Now the question is 'Why?' Under what circumstances? Are mathematical skills more influential? Is it reading ability? Is it an understanding of specific scientific principles? Is it an attitude generated by schooling? The answers to these questions we do not know. What we do know is that schooling itself, under many circumstances, can be a determinant even more powerful than the presence of agricultural extension. It is my belief that substantially-improved schooling could become an important criterion of whether a nation is able to reach a point of agricultural self-sufficiency. Though difficult to imagine at the moment, it may be the case that an investment in classroom reading materials—through its impact on cognitive skills—may someday be identified as an 'agricultural input' equal in impact to the presence of a fertilizer or a pesticide.

THE ROLE OF UNIVERSITIES

I indicated earlier that I would discuss both university and non-university research and would take the opportunity to comment on their characteristics. The balance in terms of quality is uncertain. There has been a substantial amount of spurious research emanating from universities over the last several decades; and there is a growing amount of first class, original research emanating from government agencies, foundations, consultant firms and international banks. This might be worth some speculation. One particular problem about university-based research is that it is often specific to a single discipline. Disciplines are subject to fad and to insularity. Sometimes this generates a research product able to focus only on a small part of the problem, as in the case of pedagogy, or in the case of curriculum. On the other hand, public agencies are forced to start not with a discipline but with a problem. From the problem they then proceed to package ideas together which help explain or solve it. Those ideas can come from anywhere, from any discipline, from any tradition. Research on agricultural productivity has had to adapt techniques not only from the applied sciences, but from public administration, sociology, anthropology, and economics. This new research—on school quality—will have to add administration, anthropology, psychology, human development, linguistics and, of course, pedagogy to its repertoire. Without access to the full gamut of these various traditions and skills, the research will almost inevitably fall short.

Shils (1978) once pointed out that it was not until after World War I that universities began to generate a large magnitude of scientific research. Until that time the lion's share of original science had emerged from the world of business, from independent inventors and the like. There was a shift between the wars as the state became more heavily involved. But the direction is not irreversible. The importance of universities in certain fields ebbs and flows. I believe the human capital research described here will be conducted over the next decade in any case, because it is the next logical step in the understanding of *how* cognitive skills determine productivity. But the contributors have yet to be identified. Where they come from will depend upon how clearly groups of people see the problem—the research problem and the economic development problem—for what it is; and how clearly a plan can be presented to attack it. I believe that universities will play a leading role in this research, but I also believe that role is not a foregone conclusion.

NOTES

1. Lessons relearned in Africa. *Michigan Education Journal* **45** (February 1968) 17–19.

2. This may have originated from a misunderstanding of John Dewey. Dewey never argued that 'hands-on experience' was necessary for education. He argued that inductive experimentation—as an experience—was necessary for education. Inductive experimentation should never have been identified with laboratories, school farms or 'work experience'. An educative experience is often entirely intellectual. In fact, a genuine educative experience is that which is able to *overcome* one's hands-on experience' (Buchman and Schwille, 1983). The simplistic interpretation of an 'educative experience' in the developing countries has led to disastrous assumptions as to the meaning of an 'appropriate curriculum' and 'appropriate pedagogy'. These in turn, have led schools and school systems into completely unnecessary and wasteful allocations of time and resources.

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