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The Effect of Primary-School Quality on Academic Achievement across Twenty-nine High- and Low-Income Countries[1]

Stephen P. Heyneman and William A. Loxley
World Bank

Most previous research on effects of schooling has concluded that the effect of school or teacher quality on academic achievement is less than that of family background or other characteristics of students that predate entry into school. However, the evidence for that generalization is derived mainly from a few of the world's school systems (mostly in Europe, North America, and Japan). This paper explores diverse influences on pupil achievement in Africa, Asia, Latin America, and the Middle East. Children who attend primary school in countries with low per capita incomes have learned substantially less after similar amounts of time in school than have pupils in high-income countries. At the same time, the lower the income of the country, the weaker the influence of pupils' social status on achievement. Conversely, in low-income countries, the effect of school and teacher quality on academic achievement in primary school is comparatively greater. From these data, which are more representative of the world's population of schoolchildren than those used in previous studies, it is possible to conclude that the predominant influence on student learning is the quality of the schools and teachers to which children are exposed.

The past decade and a half has seen rapid expansion of academic achievement surveys followed by a burgeoning literature of interpretation. The

[1] This analysis has been undertaken as part of the World Bank's research projects "Textbook Availability and Education Quality" and "The Influence of School Resources." The International Association for the Evaluation of Educational Achievement data were acquired with the kind assistance of Edward Kifer at the University of Kentucky. The ECIEL data analysis was undertaken through the cooperation of the Programa de Estudos Conjuntos de Integração Ecônomica da America Latina headquarters in Rio de Janeiro. The El Salvador data were analyzed with kind permission from the Oficina de Planeamiento y Organización in the Ministry of Education in San Salvador, the U.S. Agency for International Development, and the U.S. Bureau of the Census. The Egyptian data were collected under the auspices of the National Center for Educational Research in Cairo and the Botswana data by the Research and Testing Centre in Gaborone and the Institute of International Education in Stockholm. The views and interpretations, however, are solely ours and do not necessarily reflect the views of any of the organizations mentioned above or of the World Bank. Requests for reprints should be sent to Dr. Stephen P. Heyneman, Education Department, World Bank 1818 H Street, N.W., Washington, D.C. 20433.

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general principle, drawing on production function models from the field of economics, has been to test whether the quality of schools and teachers is able to explain academic achievement variance to a greater extent than can the characteristics over which the school has presumably little or no control—the student's age, sex, and socioeconomic status.[2] The key assumption behind these studies was that governments, like banks, could identify the goods and services most likely to raise learning levels and then invest in them. This led to the attempt to quantify the characteristics of a school which are subject to physical investment—teacher educational levels and specializations, library resources, audiovisual equipment, and the like—or to managerial investment—stronger discipline, different contact hours, more homework, and so forth.

The basic tone of subsequent investigations has been set by a discovery stemming from *Equality of Educational Opportunity* (Coleman et al. 1966; hereafter referred to as the Coleman Report) and the Plowden Report (Peaker 1971), namely, that the amount of variance in academic achievement accounted for by student experiences prior to entering school—called "preschool influences"—has substantially exceeded the impact of all the elements of school quality taken together. This conclusion has been disturbing to professional educators and to the education industry at large, and it has, perhaps, added an element of determination to the search for "school effects." Some promising new lines of research have attempted to measure, in addition to the availability of high-quality goods and services, such characteristics as socialization patterns (Rosenbaum 1975) and classroom organizational patterns (Wiley 1976; Bidwell and Kasarda 1975; Harnischfeger and Wiley 1980). Other tangents have been taken by investigators using longitudinal panel information to see whether school effects accumulate over time (Hyman and Wright 1975; Hyman, Wright, and Reed 1975), or using information pertaining to the distribution of achievement scores instead of to mean levels (Brown and Saks 1975). As creative as they have been, these and other efforts in the same vein seem to have taken as their point of departure the conclusions from the earlier studies, namely, that as determinants of achievement, the goods and services over which the school has control, measured on a cross-sectional basis, were comparatively weak; and though these new lines of investigation have considerably expanded the concept of "school effects," none has been able to in-

[2] Two lines of reasoning are used in attempts to summarize the characteristics over which the school has little control. One is to use "preschool" measures, those characteristics that, it can be argued, the individual inherits (sex, socioeconomic status, date of birth, intelligence). Another is to use "out-of-school" measures, those characteristics that the individual may acquire at any time, including the years he or she is in school (urban residence, travel, exposure to public libraries, etc.). In this paper we will limit the discussion to preschool influences because of the lack of comparable data on pupil communities and their out-of-school experience.

validate the earlier conclusions (Jencks et al. 1972, 1979; Dougherty 1981).

The first question one needs to ask in the science of comparative education is whether a tendency is universal. But the major handicap to drawing any conclusion of this sort from the research on school effects is the predominance of evidence from the North American environment. With less than 5% of the world's school population, the United States accounts for the majority of the world's empirical research on education. This imbalance is particularly problematic with regard to school-effects research because the results, which have set in doubt the efficacy of investment in school physical resources, have spread from where the evidence is abundant to countries around the world—countries which often depend on foreign capital for the development of school quality—where the relative value of school effects has never been tested.

DATA FROM OUTSIDE THE UNITED STATES

We have drawn together as much survey information as we could on the school and teacher quality available to 13- and 14-year-olds around the world and on their achievement in science.[3] This information is derived from six sources: (1) the International Association for the Evaluation of Educational Achievement (IEA; 18 countries);[4] (2) the National Institute of Education, Makerere University (Uganda); (3) the Oficina de Planeamiento y Organización (ODEPOR) in the Ministry of Education (El Salvador); (4) the Programa de Estudos Conjuntos de Integração Econômica da América Latina (ECIEL; seven countries); (5) the National Center for Educational Research (Egypt); and (6) the Research and Testing Center (Botswana). A summary of each source appears in table 1 and is discussed below.

International Association for the Evaluation of Educational Achievement

The 18-country IEA Science Survey focused on representative national samples of 10- and 14-year-olds as well as secondary-school seniors in 1972. Schools were sampled first, and within schools students were sampled with a probability inversely proportional to school size. Technical details have

[3] Science scores were not available in Uganda, Egypt, or Botswana; in these cases we used math scores. In the 26 other countries the dependent variable is specifically limited to science.

[4] In the IEA surveys, 20 different "national tests" (two in Belgium) were utilized, 19 were used in the Science Achievement Survey, and 18 in the Population II Science Achievement Survey. Israel and France were the two countries not participating in the Population II sampling. Since we are making use only of the Population II Science Survey, we will refer to the number of participating IEA countries as 18.

TABLE 1

SUMMARY OF DATA SOURCES

	Year of Survey	Age/Grade Levels Available*	Sample Representation	Sample Size at Age 14, or Last Year in Primary School		
				Schools	Teachers	Pupils
India	1971	Ages 10, 14, LYS	4 out of 23 states, limited to Hindi medium schools	155	311	2,400
Uganda	1972	Grade 7	5 out of 12 districts, all major urban areas	61	598	1,900
Botswana	1976	Standard 7, Form III, Form V	National	37	186	870
Bolivia	1975	Grades 1, 4, 6, LYS	4 out of 9 regions	48	96	528
Thailand	1971	Ages 10, 14, LYS	Bangkok and environs	29	49	2,000
Egypt	1979/80	Grades 3, 4, 5, 6	National	60	753	1,250
Paraguay	1975	Grades 1, 4, 6, LYS	National	58	157	909
El Salvador	1975	Grades 2, 3, 5, 6, 8, 9	National	137	1,100	824
Colombia	1975	Grades 1, 3, 5, LYS	National random sample of urban education districts	52	207	900
Iran	1971	Ages 10, 14, LYS	Tehran	33	42	1,000
Brazil	1975	Grades 1, 4, 6, 8, LYS	Brasilia State	42	163	699
Peru	1975	Grades 1, 4, 6, LYS	Lima and Puno	61	102	648
Mexico	1975	Grades 1, 4, 6, LYS	Federal District	38	97	1,194
Chile	1971	Ages 10, 14, LYS	National	103	306	1,200
Hungary	1971	Ages 10, 14, LYS	National	210	917	4,200
Argentina	1975	Grades 1, 4, 6, LYS	Buenos Aires and surrounding regions	61	252	865
Italy	1971	Ages 10, 14, LYS	National	327	616	4,000
Japan	1971	Ages 10, 14	National	196	752	1,945
Scotland	1971	Ages 10, 14, LYS	National	70	399	1,980
England	1971	Ages 10, 14, LYS	National	144	706	3,000
New Zealand	1971	Age 14, LYS	National	74	520	1,960
Finland	1971	Ages 10, 14, LYS	National	77	280	2,240
Netherlands	1971	Ages 10, 14, LYS	National	49	141	1,200
Australia	1971	Age 14, LYS	National	221	1,638	5,300
French Belgium	1971	Ages 10, 14, LYS	National	21	60	545
Flemish Belgium	1971	Ages 10, 14, LYS	National	31	95	695
Germany	1971	Ages 10, 14, LYS	National	83	432	2,200
Sweden	1971	Ages 10, 14, LYS	National	95	620	2,300
United States	1971	Ages 10, 14, LYS	National	137	490	3,500

* LYS = last year in secondary school.

been widely reported elsewhere, for example, in Purves (1973) and Thorndike (1973). Samples averaged some 1,000 students per age level in each country. Information was obtained from mail survey questionnaires querying students, teachers, and principals. From these responses, well over 500 pieces of information were obtained relating to each student's social background and to school resources and facilities, in addition to specific teacher characteristics averaged by school level. Test instruments measuring science achievement were developed in close conformity to each country's curriculum objectives. Each test item was translated into the national language and pretested prior to use.

Uganda Data

The data from Uganda, collected by Heyneman under the auspices of the National Institute of Education, Makerere University, in 1972, are derived from 61 primary schools in five districts (North and South Karamoja, West Buganda, Bugisu, and Toro) and in all three urban areas (Kampala/Entebbe, Mbale/Tororo, and Jinja). Within each locality, schools possessing a seventh grade were identified and a minimum of 10% selected randomly. The final sample contained 12% of the schools and teachers and 13% of the grade 7 pupils within the selected areas. Sample schools were situated in varied local settings—for example, in isolated but economically developed areas, isolated but economically poor areas, plantation and peasant agricultural areas, urban areas (some with manufacturing and commerce), and areas of relative isolation from all modern stimuli (Heyneman 1975*a*, 1976*a*, 1976*b*). The data are derived from four sources: separate questionnaires for pupils and staff, an inventory of school physical facilities, and the pupil performance on the Primary Leaving Examination taken eight months after the questionnaires were administered.

El Salvador Data

To explore whether the level of school quality in El Salvador was adequate, ODEPOR within the Ministry of Education, with assistance from the U.S. Agency for International Development (USAID) and the U.S. Bureau of the Census, conducted a nationwide survey of school pupils in 1973. The project included 20% of all schools. Working Document no. 5 (Oficina de Planeamiento y Organización [ODEPOR] 1975) presents the details of the formula by which the sample was drawn and the methods of analysis employed. The sample was stratified into two parts. First, 595 schools were selected, with a probability proportional to size, based on whether each school was located in rural or urban surroundings, housed few or many grades under one roof, and so on; and second, a 50% sample of the students in each of these schools—some 55,000 in all—was tested in science, Spanish reading comprehension, mathematics, and social studies. Data on number of desks and chairs, cost of books, repetition and matriculation rates, total hours taught per 100 students, and other school characteristics were gathered and averaged by school; every student in a given school was assigned the same value on any given school item (Loxley and Heyneman 1981).

In previous analyses, ODEPOR concentrated on mapping the distributional characteristics of school equipment, teacher attributes, student flow, school size, and the four achievement scores; and on plotting the mean distributions across various school categories (e.g., rural/urban, lower/higher grade levels, single/double shifts).[5] This previous work has led to conclusions on the degree of equity of school resource distribution. Prior investigations did not, however, make use of regression analyses to examine the impact of home and school on achievement.

ECIEL Data

Data from Brazil, Paraguay, Mexico, Peru, Colombia, Argentina, and Bolivia were collected under the auspices of ECIEL, an umbrella organization of member institutions in different countries. The educational achievement survey was conducted in 1975 in a fashion similar to that of the Coleman Report and IEA studies. Information was obtained directly from students, teachers, and principals on a variety of home background and attitudinal characteristics; achievement was measured by selecting an appropriate range of items from the original IEA-designed tests of reading comprehension and science (Castro et al. 1980*a*). The ECIEL survey instruments were designed principally by economists, however, and significant improvements were made in the specification of school physical facilities. Of the variables, 106 referred to school quality characteristics alone; data on these were collected in all seven countries for both primary and secondary schools (Castro and Sanguinetty 1977; Heyneman, Loxley, and Sanguinetty 1980, 1981). Following the collection of the survey information, each participating national institution issued a report. Some investigators analyzed the determinants of academic achievement; others concentrated on the costs of education or rate of student repetition and number of dropouts (Bianchi 1976, 1977; Morales and Siles 1977; Sanguinetty 1977; Rivarola, Graciela, and Zuñiga 1977; Veloso 1979). There have been two international

[5] Earlier work did utilize an Automatic Interaction Detection (AID) technique to determine the particular school characteristics closely associated with higher mean achievement scores, but the discussion was limited to an examination of differences in mean achievement.

comparisons of educational factors—one on access, performance, and equality (Castro et al. 1980*a*) and a second on costs and efficiency (Castro et al. 1980*b*).

Egyptian Data

Achievement and school quality data representing a national sample of Egyptian primary-school children were collected by the National Center for Educational Research in Cairo under the auspices of the World Bank in 1979 and 1980 as part of a longitudinal study on the retention of basic literacy and numerical skills. The subsample in this analysis includes 1,250 fifth and sixth graders who were attending 60 randomly selected Egyptian primary schools in 1980 (Loxley 1983). Socioeconomic background information and test scores in reading comprehension, writing, and mathematics were gathered for each student. Surveys of teachers and principals were also administered, resulting in information on the quality of some 744 teachers and a variety of school characteristics—availability of desks, health care, presence of after-school programs, active PTA support, use of audiovisual materials, presence of a school telephone, running water, electricity, and the like. All questions were similar to the types asked in the IEA, ECIEL, Botswana, and Uganda questionnaires.

Botswana Data

As part of a 1976 national assessment of its education system, the Botswana government sponsored (1) the testing of students in math and reading comprehension at the level of grade seven and during the third and fifth years in secondary school; and (2) an inventory of teachers, principals, and school physical facilities. All instruments were adapted from the IEA originals (Husen 1977; Leimu 1976; Kann and Lecoge 1980). From this national survey only the terminal level of primary school has been utilized in this analysis—870 pupils in 37 schools—and only the math test was used as a dependent variable.

METHODOLOGICAL CAVEATS

Because all the studies were similar in design, it is possible to examine the differences among societies at varying levels of economic development. Nevertheless, comparisons among these studies raise five methodological concerns. First is the intent of the achievement tests. Each IEA test was especially devised for cross-national use and had no function other than research. The Uganda test, however, was designed specifically for schoolchildren in Uganda and was intended as a selection examination for admission to secondary school.[6] The Salvadoran and Egyptian tests were designed specifically for Salvadoran and Egyptian children, but for purposes of research, not selection. The Botswana tests, like those of ECIEL, were used for research purposes only and were adapted from the IEA originals. A comparison of means and standard deviations, after appropriate adjustments for differences in the number of common items, is possible among the IEA and ECIEL samples, but not among the samples from El Salvador, Botswana, Uganda, or Egypt.

The second caveat pertains to the content of the test questions. In each case an attempt was made to limit test content to science. The IEA and ECIEL tests contain comparable science items; however, the items used in El Salvador, Uganda, Botswana, and Egypt differ from those used elsewhere. Moreover, in Uganda, Botswana, and Egypt it was not possible to limit test scores to science.[7]

The third caveat concerns the sample populations. For each national sample, our effort has been to compare students at the top grade in primary education. The IEA (Population II) was limited to age 14. In Uganda and Botswana, the samples include grade-seven students whose ages happened to cluster primarily around 14 but in fact ranged from 10 to 18. The ECIEL, Egyptian, and Salvadoran sixth grades also contained ranges in age. In Botswana, Egypt, Uganda, and the ECIEL countries, we introduced age restrictions and removed students we thought too old to make the samples comparable with others. In the case of Uganda the total sample was reduced by 11%, in Egypt by 10%, in Botswana by 12%, in the ECIEL countries by 10% or less.

The fourth caveat has to do with the way the studies were administered. Data from the 18 IEA countries were collected by mail. This could have influenced the results in that questionnaires were not administered on site and therefore researchers had no direct contact with respondents. In the Ugandan, ECIEL, Salvadoran, and Egyptian studies, each questionnaire was personally administered on site by trained researchers.

The fifth caveat pertains to the representation of the samples, which varies substantially from country to country. The Argentina, Brazil, Thailand, and Iran samples were limited, basically, to the areas surrounding the capital city.[8] The Colombia sample was drawn from five major urban

[6] It is possible that some students try harder and therefore do better on selection tests. It is also possible that school quality has more effect on "school-curriculum based" tests than on standardized achievement tests (Madaus et al. 1979).

[7] Math scores were used because, unlike reading comprehension, math items are more closely based on school curricula. The pros and cons of utilizing different achievement data in different countries to test questions of school and home influence have been discussed elsewhere (Heyneman 1976*b*).

[8] Although it represents only one state (Brasilia), the Brazilian sample does include both the "Plano Piloto" and the satellite regions of the capital city.

areas.[9] The Peru sample was drawn from two urban areas (Puno and Lima), but these areas were significantly different from one another. The Uganda, India, and Bolivia samples were not national but represented such diverse areas that it is hard to imagine that major socioeconomic differences in those countries were not reflected. In Paraguay, El Salvador, Egypt, Chile, and the 14 industrialized countries, the samples were national.

METHODOLOGICAL PROCEDURES

The IEA country samples contain, at a minimum, 500 independent educational measures. These data represent the work of 300 experts using 14 languages in 18 countries in 10,000 schools having 50,000 teachers and 260,000 students. Of the questionnaire items, 45 referred solely to either the opportunity to read or the amount of reading material available. Theoretically the influence of any simple variable could be analyzed at the school or the pupil level of aggregation, by age, by subject matter, and in many other ways. The ECIEL, Botswana, Salvadoran, and Egyptian data contain a similar range of independent variables. Clearly some strategy had to be designed by which the number and variety of coefficients could be narrowed down to manageable proportions. Thus the first task was how to choose what to analyze.[10]

Data Organization

First the information on schools, principals, and teachers was merged with that on pupils. With respect to the Uganda, IEA, and Botswana data sets, this had been accomplished prior to the present analysis. With the ECIEL, Salvadoran, and Egyptian data, the process of merging was conducted for the first time specifically for this study. Each pupil from a school was assigned that school's level of textbook availability, for example, and that

[9] Bogota, Cali, Papayan, Bucaramanga, and Armenia.

[10] Given the disparate nature of the sources, it is surprising how similar these surveys were in organization (e.g., separate teacher, pupil, principal, and school questionnaires) and in content (e.g., books in library, school and class size, cost of books, teacher salaries, teacher education, time spent preparing lessons, membership in professional organizations). The surveys drew heavily on one another for information: the Uganda survey drew on the Coleman Report; the ECIEL and Egyptian surveys borrowed freely from the original IEA instruments. However, all added their own characteristics. The ECIEL surveys contained by far the most complete information on school costs. They also contained a measure of student eyesight and family socioeconomic background across two generations. The El Salvador survey contained exact information on household educational expenditures. The Uganda survey contained information on school and teacher quality—duplicating machines, an exact count of textbooks, teacher verbal ability—and on students—intelligence and physical health—which was not included elsewhere.

school's number of classrooms. When school characteristics—such as teacher education—contained more than one value, these values were averaged by school, and that average was then assigned to each pupil. In this way the ability to specify a particular teacher who might have affected a particular pupil has been lost, but experience has shown that students are rarely affected by only one teacher. Instead, by the time they have reached the upper levels of primary schools, students are a "product" of many teachers with whom they have had contact (Heyneman 1975*b*).

Data C aning, Recoding, and Reduction

Variables were removed from consideration in any country if they contained little or no variance or if the level of missing cases exceeded 25%.[11] School variables were selected in the following way: after preschool variables (sex, age, and SES) were controlled for, it was determined separately in each country whether each school variable had a significant impact on achievement of (a standardized β) .05 or higher.[12] The smaller list of variables which met this statistical criterion was then used in the final country-specific regressions in which the effects of preschool and school program/track were compared with those of school quality.[13] It is true that the analysis was handling close to 30 school variables at a time in each country's regression and that the nearly 450 correlations involved might seem to risk yielding matrix singularity. It is also true, however, that the large sample sizes (in the thousands) militated against matrix singularity. The ratio of degrees of freedom, a comparison of variables entering the equation with sample size, always exceeded 1:10. The 1:10 ratio is generally considered the absolute minimum limit below which regressions should not be performed.

Data Analysis: Individual or Aggregate?

Opinions differ on how to analyze academic achievement data—whether to use the pupil, the classroom, or the school as the unit of analysis (Meyer

[11] This is slightly more conservative than the original IEA analysis, which used a limit of 20% (Comber and Keeves 1973).

[12] The original IEA analyses averaged the standardized β coefficients across countries and allowed variables to enter the final regressions only if the average coefficient was greater than .05. This severely constrained the influence of school and teacher quality because it eliminated from consideration those characteristics which had important effects in one country but not across an average of all 18 countries (Heyneman and Loxley 1982).

[13] School program/track applies to those schools where 14-year-old students have been assigned to specialized vocational or technical programs. For the most part this pertains to Western Europe.

1980; Heyneman and Jamison 1980). There are advantages and drawbacks to each. If pupils are chosen, it is normal to assign levels of school or classroom quality to each individual pupil. This raises the statistical significance of school resources because of the change in the units of observation. In contrast, if the classroom or the school is chosen as the unit of analysis, it is normal to average the characteristics of individual pupil achievement, intelligence, health, socioeconomic status, and attitudes—variables for which there is more variance within classrooms, or schools, than among them. If averaged, some pupil characteristics, such as health status, lose statistical significance because of the drop in the units of observation. Moreover, aggregating individual pupil data may obscure important differences in the way school resources are utilized within schools or classrooms on the basis of sex, ethnic, or socioeconomic groups (Griffin and Alexander 1978; Alexander, Cook, and McDill 1978). For the purposes of this analysis, we have chosen to measure the impact of school and preschool variables on achievement on the basis of a between-pupil analysis. In this particular exercise we are not concerned with discovering which school characteristic has the most effect, and therefore the problem of having an "artificial" level of statistical significance for school characteristics assigned to individual pupils does not pertain. On the other hand, we can be certain that the variance of individual pupil characteristics, such as socioeconomic status, has not been attenuated. For us a central question centers on the impact of family background across societies, and we wanted to allow the measures of those particular variables to be given their full statistical opportunity (Burstein, Fischer, and Miller 1980).

RESULTS

Table 2 displays the sample size, test score mean, standard deviation, and the impact on achievement of preschool, program track, and school quality in each of the 29 nations. The sample nations themselves are arranged according to their gross national product per capita (hereafter referred to as GNP or national per capita income) in 1971.[14] Although this table illustrates numerous interesting tendencies, we will limit discussion to the following three: the level of academic skills acquired at the end of the primary-school cycle, the proportion of academic achievement accounted for by differences in socioeconomic status and other preschool characteristics, and the proportion due to the quality of schools and teachers.

[14] Although per capita product did change between 1971 and 1975—the time period for all except the Egyptian data collected in these studies—no nation in the survey, with the possible exception of Iran, significantly altered its position in relation to the others.

National Levels of Achievement

Whether among pupils, classrooms, schools, regions, or nations, achievement comparisons must be approached judiciously.[15] Nevertheless, it is increasingly evident that school systems are charged with cognitive functions characterized more by similarities than by differences. Objectives for teaching the basic skill subjects—the principles of mathematics, science, and reading comprehension—are fundamental; what diverges from school to school, or from nation to nation, is the degree of content overlap within these subjects. The purpose of applying any test in more than one school, or in more than one region or country, is to assess the attainment of objectives held in common. For mathematics and science the degree of content overlap is very high; for history it is less. These particular tests make possible a comparison of science performance among the samples from the 25 IEA and ECIEL countries.[16] It is clear that school children in low- and middle-income countries have learned less science after the same or approximately the same length of time in school as children in wealthy countries. In the United States the average mean is 32.8; in Japan, 40.9; and in Germany, 34.6. However, in India it is 20.6; in Colombia, 24.0; and in Thailand, 28.2. Primary-school children in the five countries with the lowest national per capita incomes from which achievement data are comparable (India, Bolivia, Colombia, Thailand, and Paraguay) performed .9 of a standard deviation below the primary-school children in the 14 industrialized countries. Primary-school children in the six middle-income countries (Brazil, Peru, Mexico, Chile, Iran, and Argentina) performed .8 of a standard deviation lower. The correlation between national per capita income and national achievement means in science reflects this pattern ($r = .55$, $P < .001$), indicating that students in wealthier

[15] For previous comparisons using IEA data, see Inkeles (1977) and World Bank (1980).

[16] The science test items utilized in the ECIEL data sets were the same items used in all IEA countries but with two differences: only half as many items were used, and the items chosen were among the easiest to answer. For purposes of comparison we have doubled the means and standard deviations of the ECIEL respondents. The results (for grade 6 science) indicate that the ECIEL respondents perform at approximately two-thirds of a standard deviation below the performance of the IEA respondents from industrialized societies in North America, Japan and Europe, and approximately one-third of a standard deviation above the mean for respondents in the four IEA less industrialized societies (Thailand, Iran, Chile, and India). From this it would be safe to conclude that students in the ECIEL countries (Bolivia, Paraguay, Peru, Mexico, Argentina, Colombia, and Brazil) performed at significantly lower levels than students in industrialized societies. However, because the ECIEL items were easier, it would not be safe to conclude that the ECIEL respondent means were higher than the means from the four IEA less industrialized societies.

TABLE 2

MEANS, STANDARD DEVIATIONS, AND INFLUENCES ON ACADEMIC ACHIEVEMENT IN 29 COUNTRIES

Country (1)	Gross Primary-School Enrollment Ratio 1971* (2)	National GNP per Capita (US$ 1971) (3)	Test Score Mean† (4)	Test Score Standard Deviation† (5)	Variance Explained by Preschool Influences‡ (%) (6)	Variance Explained by Program Track§ (%) (7)	Variance Explained by School and Teacher Quality‖ (%) (8)	Total (R^2) Variance Explained# (%) (9)	Proportion of Col. 9 Explained by Col. 8** (%) (10)
India	68	110	20.6	8.0	2.7	.3	27.0	30.0	90
Uganda	49	130	45.4	16.5	5.8		5.4	11.2	46
Botswana	48	160	10.6	4.2	6.3		13.9	20.2	69
Bolivia	71	190	24.8	9.4	11.4	0	24.0	35.4	67
Thailand	82	210	28.2	6.6	6.0	0	25.0	31.0	81
Egypt	70	220	19.7	6.5	6.3		13.6	19.9	68
Paraguay	107	280	24.8	10.4	23.4	0	16.4	39.8	42
El Salvador	71	320	20.8	7.3	4.2	0	11.9	16.1	72
Colombia	110	370	24.0	8.0	1.8	0	17.3	19.1	88

* Source: *Unesco Statistical Yearbook*, 1974, table 3.2. The gross enrollment ratio is the total enrollment of all ages divided by the population which corresponds to the age group of primary schooling. Over- or underaged students can frequently inflate the figures. A more accurate measure is the net enrollment ratio which uses only that part of the in-school population which corresponds to the relevant primary-school age cohort. However, this requires that accurate records of student ages be accessible, and in 1971 only eight of the 29 countries in this sample reported net enrollment ratios.

† Achievement means and standard deviations for Egypt, Uganda, Botswana, and El Salvador are not comparable with those for the other countries in the sample. Test scores for Uganda, Egypt, and Botswana refer to mathematics; all other scores refer to science. Means and standard deviations have been doubled in the case of Bolivia, Argentina, Paraguay, Brazil, Peru, Mexico, and Colombia.

‡ Age (in months), sex, and socioeconomic status.

§ School program (vocational, general, academic) and/or curriculum specialization (social studies, natural sciences, classics, etc.).

‖ No effort has been made to separate the common variance shared among the regression blocks. By virtue of preschool variables always being entered first into the individual country regressions, all common variance is subsumed by preschool variables; this amounts to a conservative bias directed against school effects.

\# Preschool variables were entered as a block into the regressions first, program and/or track variables second, and school and teacher quality third.

** The purpose of col. 10 is to allow a comparison of school effects across studies with wide ranges of R^2s and residuals.

TABLE 2 (*Continued*)

Country (1)	Gross Primary-School Enrollment Ratio 1971* (2)	National GNP per Capita (US$ 1971) (3)	Test Score Mean† (4)	Test Score Standard Deviation† (5)	Variance Explained by Preschool Influences‡ (%) (6)	Variance Explained by Program Track§ (%) (7)	Variance Explained by School and Teacher Quality‖ (%) (8)	Total (R^2) Variance Explained# (%) (9)	Proportion of Col. 9 Explained by Col. 8** (%) (10)
Iran	76	450	19.8	5.5	8.0	0	9.0	17.0	53
Brazil	71	460	33.0	11.4	4.6	0	20.0	24.6	81
Peru	127	480	24.8	9.6	15.4	0	16.6	32.0	52
Mexico	107	700	26.4	10.0	11.7	0	14.5	26.2	55
Chile	109	760	20.8	7.9	8.0	6.0	20.0	34.0	59
Hungary	99	1,200	38.9	10.3	14.6	0	11.5	26.1	44
Argentina	105	1,230	28.8	9.6	8.0	.4	13.5	21.9	62
Italy	106	1,860	28.1	8.4	7.8	2.2	12.6	22.6	55
Japan	100	2,130	40.9	11.8	21.0		9.0	30.0	30
Scotland	112	2,430	32.9	11.8	29.0	10.0	14.0	53.0	26
England	112	2,430	31.7	11.5	20.0	4.0	15.0	39.0	38
New Zealand	104	2,470	34.8	11.3	15.0	10.0	9.0	34.0	26
Finland	120	2,550	31.0	8.8	20.0	5.0	9.0	34.0	27
Netherlands	102	2,620	28.9	9.3	22.0	9.0	11.0	42.0	26
Australia	105	2,870	35.6	11.4	17.0	8.0	7.0	32.0	22
French Belgium	100	2,960	26.7	8.3	14.3	3.7	16.3	34.3	47
Flemish Belgium	100	2,960	31.9	7.8	12.0	2.0	16.0	30.0	53
Germany	127	3,210	34.6	10.4	17.0	5.0	14.0	36.0	39
Sweden	98	4,240	32.7	9.5	18.3	0	6.7	25.0	27
United States	110	5,160	32.8	9.5	21.0	1.5	12.5	35.0	36
Correlations with col. 3	...	...	.55	...	.66	...	−.40	.45	−.72

countries emerge from school with significantly more factual knowledge about science.[17]

Preschool Influences on Achievement

For whatever reason, the learning advantages or disadvantages of the home, established prior to entering school, are significantly more powerful determinants of achievement in high-income countries. The correlation between national per capita income and the proportion of variance explained by preschool influences is .66 ($P < .001$) (see table 2, col. 6). Within this, the principal discrimination among countries is neither the influence of sex nor student age—the correlations of their impact on achievement with per capita income are rather moderate ($r = .26$, $P =$ N.S.); ($r = .12$, $P =$ N.S.).[18] Instead, the principal distinction lies in the differences among countries in the power of socioeconomic status variables, which account for 18% of the R^2 in low-income countries (GNP < US$320), 23% of the R^2 in middle-income countries (GNP = US$370–$2,000), and 35% of the R^2 in high-income countries (GNP > US$2,000).[19] The correlation between the proportion of academic achievement variance accounted for by socioeconomic status and national income per capita is sizable ($r = .41$, $P < .001$). The question is, Why are these symbols of privileged family status—parental education, for example—such powerful and consistent influences on academic achievement in high-income but not in low-income countries? To our knowledge, there are three different explanations: (1) a lack of variance in pupil socioeconomic status in low-income countries, (2) preselectivity of low-socioeconomic-status pupils due to high dropout and repetition rates in low-income countries, and (3) higher levels of multicollinearity between socioeconomic status and school quality in low-income countries.

Lack of socioeconomic variance?—Is there sufficient variance in socioeconomic status in low-income countries to justify the comparison of cor-

[17] That students in low-income countries have lower cross-sectional achievement test scores does not necessarily imply that their schools are less effective. In fact it may quite easily be the reverse. Within the IEA sample the typical gain in knowledge, expressed as a percentage of what was known the year before on a test common to all, is basically the same for comparable sets of children. This suggests that schools in low-income countries, since they have fewer physical facilities with which to work, are actually more effective in making use of what they have (Inkeles 1979, p. 403).

[18] One question, outside the purview of this particular paper, deserves more attention than it has previously received: Why is the influence of sex highest in high-income countries? Sex accounts for 8% of the R^2 in both low- and middle-income countries and 18% of the R^2 in high-income countries.

[19] In all 29 countries the following variables were used as a measure of student socioeconomic status: mother's education, father's education, father's occupation, number of books available in the home, presence of a dictionary or some other measure of consumption such as a record player or dishwasher.

relation coefficients with those from high-income countries? To be sure, there are marked differences between high- and low-income countries in the distribution of socioeconomic status characteristics. The proportion of students in the sample whose mothers had attained university level education is .04% in Uganda, 3.0% in India, and 14.0% in the United States. Is it possible that the difference in distribution of these characteristics determines the difference in robustness in the measures of central tendency? If this were so, even though many fewer mothers in low-income countries had attained high levels of education, their children would still tend to perform better than others. Figure 1 displays a breakdown of science achievement by level of maternal education in six countries: Australia, Hungary, England, Thailand, India, and Colombia. In the first three the pattern is typical of high-income countries. There achievement rises as maternal education rises. The slope is not uniform from one category of maternal education to the next, but it is consistent in direction. In the latter three the pattern is typical of low-income countries. There the achievement/maternal education relationship is more idiosyncratic. The slopes are flatter on the whole, and there are inconsistencies. There are occasions when children of mothers with higher average levels of educational attainment perform slightly less well than other children. One explanation for this may be the selectivity of the low-status children who are in school (see below); but whatever the reason, these break-

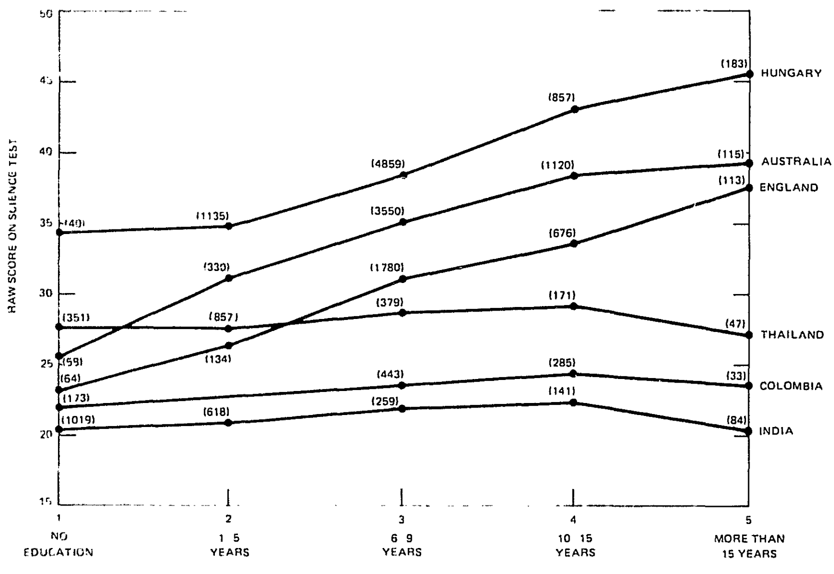

FIG. 1.—Student primary-school achievement by level of maternal education in six countries. Numbers of cases are in parentheses.

downs illustrate that the academic performance patterns of school children from different socioeconomic-status levels are not consistent across countries at different levels of national economic development. This leads us to suspect that the lower achievement impact of pupil socioeconomic status is not due to the differences from country to country in the distribution of socioeconomic variance.

Selectivity of children from lower socioeconomic backgrounds?—Where primary schooling is not universal, the children who do attend and later progress in school may be systematically different from their general age cohort in the population (Heyneman 1977). Is it possible that in low-income countries children from lower socioeconomic backgrounds tend to perform as well as children from high socioeconomic backgrounds because they are "more tightly selected"? There are three possible ways to test this possibility. First, if this were the case, in such countries statistical linkages between socioeconomic status and achievement would emerge in the geographical areas with high rates of school attendance. Within Uganda this was tested by comparing the SES/achievement tendencies in the capital—with 90% school attendance—and within the district of Karamoja—with 8% school attendance. Yet despite the different rates of school attendance, no significant correlations emerged in either district between socioeconomic status and achievement (Heyneman 1979).

Very little school attendance information exists on the catchment areas of these national samples, and the interdistrict correlation comparisons, available for Uganda, cannot be systematically employed elsewhere. However, a second possible test whether selectivity has an influence on the SES/achievement linkage is to examine the change in the correlation coefficients at the primary- and secondary-school levels in different countries. In countries where the proportion of the age cohort in secondary school is dramatically different from the proportion in primary school, the selectivity of children from lower socioeconomic backgrounds is more intense, and in those countries one might anticipate a substantial decline in the size of the SES/achievement correlation coefficients between primary- and secondary-school students. In theory, the decline in the SES/achievement coefficients should be largest in those countries where the secondary-school continuation rate is the smallest. Data from 25 of the 29 countries lend themselves to these comparisons. In high-income countries (GNP > US$2,000), the average mother's education / achievement correlation does decline from .19 to .07; and in middle-income countries (GNP US$370–US$2,000) from .19 to .14. But in low-income countries, where movement between primary and secondary school is the most selective, the coefficients do not decline at all; in fact, they increase from an average of .11 to .15. Similar results were obtained for father's education and father's occupation.

A third way to test for selectivity, albeit still imperfect, is to see whether the relationship between national GNP per capita and the influence of preschool variables holds after controls are placed on the proportion of the relevant age cohort in primary school. This was accomplished by recorrelating the figures in columns 6 and 3 after controlling for the figures in column 2 (table 2). The controls do affect the strength of the relationship but not enough to nullify it; it is .66 beforehand and .48 ($P < .01$) afterward.[20] This suggests that the modest achievement effect of socioeconomic status characteristics in primary school in low-income countries is due to factors other than the selectivity of students found in primary-school samples.

Multicollinearity between school quality and socioeconomic status?— Is it possible that school quality in low-income countries is distributed so inequitably that its influence on achievement cannot be statistically separated from that of socioeconomic status? To test this, we first constructed a scale of school quality by (1) taking the variables with the highest achievement regression coefficients in each country, (2) standardizing their value to make them comparable, and (3) creating a summary value of school quality for each school in each sample.[21] Next we correlated each student's access to school quality with each student's socioeconomic status.[22] Finally, we calculated the average (school quality/SES) correlation coefficient for each national sample, the result being a measure of the inequality of access to school quality by students of varying socioeconomic backgrounds in each of 29 countries. In Finland, a high-income country, the correlation between school quality and student social background is rather high ($r = .31$), as it is in Japan ($r = .23$). Yet it is also high in several medium-income countries: Colombia ($r = .30$), Peru ($r = .25$), and Chile ($r = .48$). However, it is rather low in several high-income countries: Sweden ($r = .05$), Italy ($r = .08$), and the Netherlands ($r = .08$); as it is in some low-income countries: India ($r = .06$) and Thailand ($r = .07$).[23] A negative but statistically insignif-

[20] These correlations are between the percentage of variance explained and national GNP per capita. Similar correlation figures emerge from the percentage of R^2 explained by preschool variables and national GNP per capita: $r = .60$ without enrollment ratio controlled, and $r = .51$ ($P. < .01$) with the enrollment ratio controlled.

[21] It is important to remember that school quality consists of elements that are both monetary (school budget per pupil, books per pupil, etc.) and nonmonetary (hours of homework, frequency of parent-teacher conferences, etc.). The equity of the distribution of school quality among students, therefore, is not necessarily amenable to the same solutions as would be the redistribution of land or personal income (Heyneman and Loxley 1983).

[22] We also noted the distribution of school quality per pupil by calculating a gini coefficient for each of the 29 countries and then correlating the gini coefficient with national GNP. The relationship is small ($r = .10$, $P =$ N.S.).

[23] These between-pupil correlations, having degrees of freedom in the thousands, commonly emerged with high levels of statistical significance.

icant relationship does emerge between the school quality/SES distributional inequality and national GNP per capita ($r = -.29$, $P =$ N.S.). This indicates that the degree of distributional inequality is not entirely random but instead slightly higher in lower-income countries. However, the small size of the coefficient and its lack of significance suggest, at least to us, that higher degrees of multicollinearity are not the principal explanation behind the lack of power of socioeconomic status variables to predict primary-school achievement in low-income countries. For this, an explanation must be sought elsewhere.

Influence of School and Teacher Quality on Achievement

Educational variables used in each country's regressions can be found in Appendixes A, B, and C. However ambiguous the efficacy of school physical facilities and teachers may seem as a result of some surveys conducted in high-income countries, no such ambiguity exists in low-income countries. The proportion of the explained achievement variance due to schools and teachers (table 2, col. 10) is 90% in India, 88% in Colombia, and 81% in both Thailand and Brazil. This compares with 22% in Australia, 26% in Scotland, and 27% in Sweden (see fig. 2). Italy is the only industrialized country for which data are available where the major proportion of explained achievement variance is due to school and teacher quality (55%). The tendency is rather evident when the effect on academic achievement of school and teacher quality is correlated with national per capita income ($r = -.72$, $P < .001$).[24] Thus the available data suggest that the poorer the country, the greater the impact of school and teacher quality on science achievement.

DISCUSSION

The question remains, Why does the influence of socioeconomic status vary significantly with national economic development? If a satisfactory explanation cannot be found in a statistical artifact—multicollinearity between school quality and social background, tighter selectivity of stu-

[24] The correlation of cols. 10 and 3 in table 2. As with preschool variables, we have tried running the school-effects results in a variety of ways to test their resilience. Controlling for national primary-school enrollment reduces the strength of the relationship, but not dramatically (from —.72 to —.61). In addition, the transformation of all variables to logs was undertaken, and several combinations of log and nonlog values were tested. Log transformations were tried because countries were unevenly spaced in GNP per capita, and this generated a potential need to remove nonlinear tendencies. The log of the GNP per capita variable increases the overall correlation from —.72 to —.75, but we believe the increase is insufficient to warrant alterations of interpretation beyond noting the obvious fact that the log relationship is slightly more powerful.

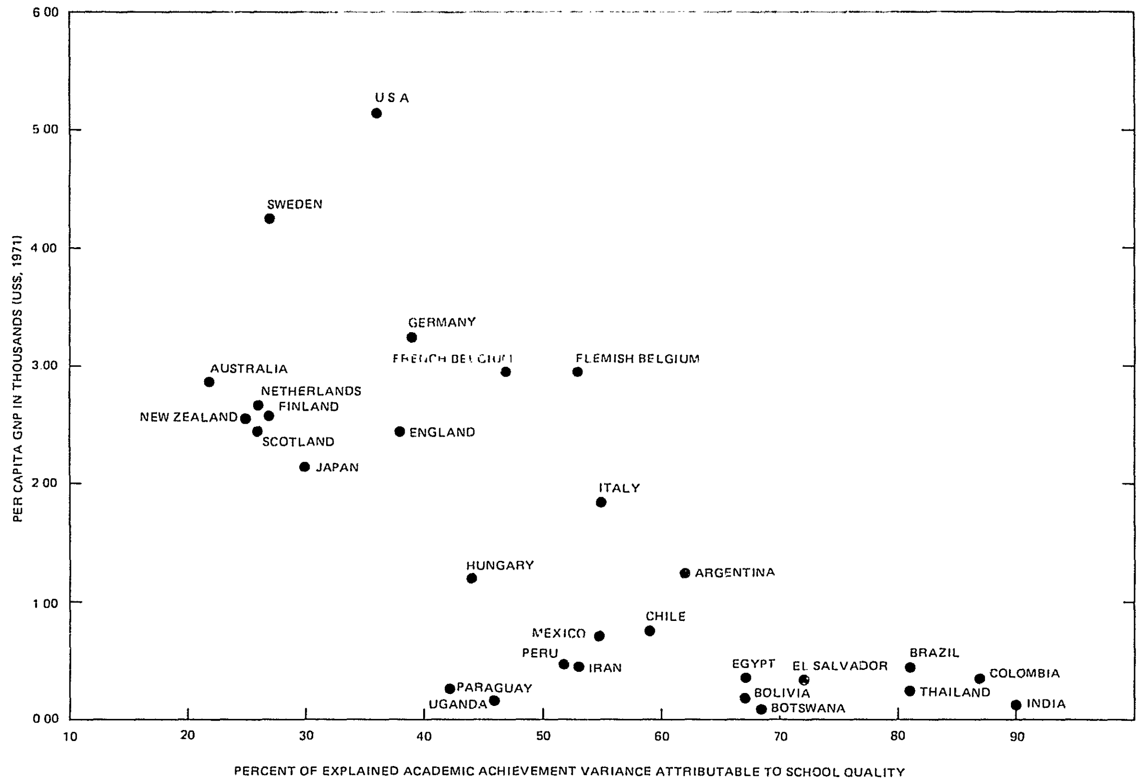

FIG. 2.—Relationship between per capita income and the effects of primary-school quality on academic achievement in 29 countries ($r = -.72$, $P < .001$, $N = 29$). Academic performance was measured by mathematics tests in Botswana, Uganda, and Egypt and by science tests in all other countries.

11/81

dents from lower social backgrounds because of high rates of noncontinuation, or lack of socioeconomic variance—then perhaps there are determining characteristics to be found outside schools. Economic returns to education tend to be highest in low-income countries (World Bank 1980). This reflects the fact that, as a commodity, education is both scarce and in high demand.[25] In low-income countries there is no plethora of educational avenues—no entry into university for senior citizens, no educational leaves from employment, no university degrees by television. These opportunities are available only in societies characterized by educational abundance. Education in low-income countries is lockstep in nature: lack of ability to complete primary or secondary school as a youth precludes the opportunity to proceed in education later in life. Scarcity creates competition for school places from the onset of grade 1, and at a level of intensity unknown in wealthy countries until college or, in the case of the United States, until graduate school.[26] This scarcity is well understood within both rich and poor families.

Furthermore, in low-income countries education is not a dubious instrument for upward social mobility. Larger portions of the labor market are employed in the public sector. The public sector, in turn, tends to be more definitive about the educational qualifications required for job entry. To be sure, the aggregate level of upward mobility in low-income countries is small. The key, however, is not the aggregate amount of upward mobility but the role of the school in permitting what personal mobility may be available. In low-income countries the power of educational attainment and, in particular, school achievement to determine occupational success may be substantially higher than the power of socioeconomic status or sex (Schiefelbein and Farrell 1981; Currie 1977; Fry 1980; Heyneman 1980*b*). Examples of occupational mobility due to education—particularly in countries receiving their independence after World War II—have been dramatic, with many current leaders in commerce and administration having their origins in the most impoverished social milieus. Certainly, structural handicaps exist. Education is not free of private cost; there is incomplete primary-education geographical cover-

[25] For example, when asked "whether it is important to do well in school," (secondary-school) students in India almost uniformly answer yes, whereas in France three students in 10 say no. When asked whether they would like to "leave school as soon as possible," 10% in India, 30% in England, 45% in the United States and Sweden, and 65% in France answered yes. Among secondary-school students, 90% in India "find school challenging," but only 80% in Sweden, 70% in Hungary, 65% in the United States, 60% in England, and 50% in France. On almost every attitudinal indicator, students in India value school more and are more likely to consider it important and are more likely to want the opportunity to continue (Fagerlind and Munck 1981).

[26] The United States has a higher percentage of its population in graduate schools than many developing countries have in secondary schools.

age; school quality varies between urban and rural, rich and poor communities, and so on. In all countries, particularistic influences—friends, family, and ethnic fraternity—are given frequent favor in the labor market. There is no society of which it can be said that occupational mobility is determined solely by merit.

The issue is not just the degree to which a society is meritocratic, for no available evidence suggests that low-income countries are any less meritocratic than high-income ones. Instead, the issue is the difference which may exist in child-rearing patterns of high- and low-status families in different parts of the world (Bulcock, Clifton, and Beebe 1977). In the Western industrialized countries (Japan being the exception), substantial differences between high- and low-status families have been documented, particularly with respect to their attitudes toward schooling. It is not clear how strong this general pattern is within low-income countries. There may be more consensus among the general public that educational achievement is a fair criterion for occupational mobility. In low-income countries there may be a higher degree of acceptance of education's rituals and a more uniform aspiration among high- and low-status families to utilize education for social mobility. In reality, few peasants see schools as instruments of an established elite bent on the social subjugation of peasant offspring. Political demands on the part of peasants the world over reflect a desire to attract more and better schools to their areas rather than a challenge to schools themselves. This consensus may explain why the educational "push" which children feel from their homes is not as tightly determined by the education or occupation of the parent. In low-income countries the push is certainly not equally strong among all homes, but the desire for a place in school and the pressure on students to do well on examinations does not appear to vary as markedly on the basis of parental socioeconomic status. Consequently socioeconomic status may affect school performance less in low-income countries than in high-income ones.

CONCLUSIONS

A danger inherent in paradigms pioneered in one part of the world is that results might be assumed to be universal without undergoing the requisite testing. This is the case in the prediction of academic achievement. It is unfortunate that not all countries are self-sufficient in terms of development capital, including the capital necessary to improve learning and to conduct research on the improvement of learning.[27] The areas of

[27] Each of the research efforts reported on here had to adapt the indicators of school and teacher quality, and it should not be overlooked that the level of R^2 varies with national GNP per capita ($r = .45$, $P < .001$)—the wealthier the country, the tighter the

the world with comparatively large amounts of research and development capital tend also to be the areas where educational paradigms are invented, and where results tend to determine the availability of development capital internationally as well as domestically. If bilingual education appears "to work" in Texas, it must therefore be appropriate for Bolivia; if new math, PSSC physics, and open classrooms are recommended for "the poor" in Massachusetts, they must also be appropriate for the poor in developing countries. And quite conversely but no less adhered to, if schools "make no difference" in the United States, perhaps school quality–improving investments should take lower priority elsewhere. School-effect studies from the United States and other industrialized countries have added a tone of skepticism to international efforts to improve school and teacher quality in areas of the world where no related achievement studies have been conducted.

This skepticism about the efficacy of educational investments is premature. Paradigms developed in conjunction with the Coleman Report and other surveys in industrialized societies appear to have very different results when applied internationally. The fact is, even when quantified and entered into regression models in a fashion equivalent to the production-function paradigms of the 1960s, school and teacher quality appear to be the predominant influence on student learning around the world; and the poorer the national setting in economic terms, the more powerful this school effect appears to be.

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fit of the research paradigm. This suggests that future studies of school quality in less industrialized countries will have to be designed using measures which are far more sensitive to the characteristics of school systems in those countries.

APPENDIX A

SCHOOL AND TEACHER VARIABLES QUALIFYING FOR THE FINAL REGRESSIONS IN EACH ECIEL COUNTRY

Variable	Countries in Which Used
Map in classroom	Bolivia, Brazil
Teacher cabinet	Colombia, Mexico
Number of library books on loan	Argentina, Mexico, Brazil
Times library used per week	Paraguay
Times library used per month	Colombia, Argentina, Mexico
How many students attend library per month	Peru
Hours lab used per week	Argentina
Hours per work week	Argentina, Bolivia, Mexico
Total payroll (US$) teaching staff	Mexico
Age of school buildings	Bolivia, Peru, Paraguay
Land area of school	Mexico
Estimated value of building	Argentina
Students pay into school fund	Argentina
School gives free materials	Paraguay
Annual cost of materials given to students	Paraguay
Total number of primary-school classes	Paraguay
Highest monthly absence rate	Argentina, Mexico
Absence rate last month	Peru
Expenditure per student	Argentina
Principal qualification level	Paraguay
Years as school principal	Paraguay
Years principal of this school	Peru
School coed	Colombia
Hours per day school is open	Bolivia
Number of school shifts	Peru
Number of hours per day	Peru, Mexico
School has telephone	Colombia, Argentina, Brazil
School has auditorium	Bolivia
School has sports yard	Mexico
School has choir	Argentina
School has book club	Colombia, Brazil
School has alumni association	Mexico, Peru
Percentage of students with minimum reading and writing materials	Mexico
School provides free meals	Mexico
Size of school library holdings	Argentina, Peru, Bolivia, Brazil
Can books be borrowed	Paraguay, Mexico, Bolivia
School has PTA	Colombia, Argentina
Admit students by residence	Colombia, Bolivia
Admit students by entrance exam	Colombia, Brazil
Group students by ability	Peru
Degree of principal emphasis on attendance	Mexico
Remedial programs	Mexico
Elective courses	Argentina
School requires students wear shoes	Peru, Bolivia
Afternoon teaching shift	Peru
Is teacher married	Argentina, Peru
Number of children teacher has	Colombia, Argentina
Number of persons living with teacher	Paraguay, Peru
Number of rooms in teacher's house	Colombia
Teacher has car	Mexico
Teacher's educational level	Bolivia, Brazil
Teacher specialized in education courses	Argentina, Bolivia, Peru
Attended teacher training courses	Mexico
Currently attending courses	Paraguay

NOTE.—The following seven preschool variables were inserted in each country-specific regression prior to the block of school and teacher variables: father's education, mother's education, father's occupation, number of books in home, presence of phonograph, sex of student, and age of student.

APPENDIX A (*Continued*)

Variable	Countries in Which Used
Educational level of teacher's father	Peru, Bolivia, Paraguay, Argentina, Brazil
Occupational level of teacher's father	Colombia
Number of schools ever taught in	Bolivia, Argentina, Colombia, Brazil
Working only at one school at a time	Paraguay
Permanent versus contract	Mexico
Spend time grading tests at school	Argentina, Colombia
Spend time at meetings	Mexico
Meet with parents	Paraguay
Gross monthly salary	Peru
Salary per hour of class	Bolivia
Satisfied with teaching profession	Peru, Mexico
Went into teaching for professional satisfaction	Mexico, Paraguay, Brazil
Believe opinion carries weight	Bolivia
Teacher has projector	Colombia, Paraguay
% of time explaining lesson	Peru, Brazil
% of time spent discussing exercises	Paraguay
% of time spent assigning homework	Argentina
% of time correcting exercises	Argentina
Books in teacher's home	Bolivia
How often teacher reads periodicals	Mexico, Paraguay
How often studies subjects related to education	Paraguay
Annual cost of materials teacher asks student to buy	Bolivia
Teacher unwilling to label individual students as troublesome	Colombia
School requires uniform	Brazil
Number of class days per year	Brazil
Frequency teacher goes to library	Brazil
Teacher owns television	Brazil
Presence of science laboratory	Brazil

NOTE.—The following seven preschool variables were inserted in each country-specific regression prior to the block of school and teacher variables: father's education, mother's education, father's occupation, number of books in home, presence of phonograph, sex of student, and age of student.

APPENDIX B

SCHOOL AND TEACHER VARIABLES QUALIFYING FOR THE FINAL REGRESSIONS IN EACH IEA COUNTRY[a]

Variable	Countries in Which Used
Number of Students in laboratory classes	1, 2, 4, 9, 11, 12, 13, 15, 16, 17
Time reading science text in class	1, 2, 3, 4, 5, 6, 7, 9, 13, 17, 18
Percent of teachers in school teaching science	1, 2, 8, 10, 11, 15, 16, 18
Number of science teachers in school	2, 4, 5, 7, 9, 10, 12, 14, 15, 16
Class size - science	2, 5, 10, 14, 15, 16, 18
Homework in science, requires textbook	2, 3, 8, 13, 14, 16, 17, 18
Total enrollment - boys	4, 5, 6, 7, 9, 10, 16, 18
Use of textbooks in science class	1, 6, 8, 9, 10, 13, 18
Hours science preparation (teacher)	2, 3, 4, 10, 12, 16, 18
Years of general science study (student)	6, 10, 12, 15, 16, 18
Hours preparing reading lessons (teacher)	1, 4, 6, 8, 9, 10, 11, 18
Budget for science equipment	3, 5, 6, 8, 12, 16
Number of teachers in school	2, 3, 4, 7, 9, 14, 16
Science teacher's age	1, 3, 6, 9, 10, 11, 16
Hours per week - prepare lessons in science	1, 3, 7, 10, 16, 18
Hours per week marking papers in science	1, 9, 13, 14, 15, 18
Years of biology study (students)	3, 5, 8, 9, 11, 16
Hours of instruction in general science (students)	1, 2, 3, 6, 9, 16, 18
Time spent on laboratory work in general science	1, 2, 3, 6, 8, 9
Average age of reading teachers in school	1, 4, 9, 10, 14, 18
Use of individual reading materials (teachers)	1, 8, 10, 12, 17, 18

a The following seven preschool variables were inserted in each country-specific regression prior to the block of school and teacher variables: Father's Education, Mother's Education, Father's Occupation, Number of Books in Home, Use of Dictionary in Home, Sex of Student, and Age of Student. Track and type of program were only included in those countries where such variables were relevant.
Countries are identified, by number, as follows: 1. India, 2. Thailand, 3. Iran, 4. Chile, 5. Hungary, 6. Italy, 7. Japan, 8. England, 9. Scotland, 10. New Zealand, 11. Netherlands, 12. Finland, 13. Australia, 14. Fl. Belgium, 15. Fr. Belgium, 16. Germany, 17. Sweden, 18. United States.

Use of individual reading instruction	5, 6, 10, 12, 18
Annual budget for teaching materials	6, 8, 9, 11, 17
Average hours school per week	1, 5, 14, 16, 18
Frequent use of audio visual materials	3, 4, 14, 15
In-service training (chemistry)	4, 9, 10, 16, 17
In-service training (biology)	2, 4, 8, 9, 16
Hours science preparation outside school time (science teacher)	1, 4, 13, 16
Years of study by student (chemistry)	3, 12, 16, 17
Hours homework per week general science	1, 7, 10, 11, 13, 14, 16
Number reading teachers from school in sample	5, 6, 9, 10, 12, 17
Years of primary & secondary education (reading teachers)	1, 9, 10, 14, 18
Years of post secondary education (reading teachers)	1, 4, 5, 8, 10
Budget for salaries of classroom teachers	4, 5, 7, 11, 18
Number of laboratory assistants	6, 9, 10, 13
Number of years of secondary education (science teachers)	8, 17
Years of post secondary education (science teachers)	1, 2, 3, 4, 7, 14, 18
Read subject matter journals (science teachers)	6, 9, 10, 18
Semesters training in chemistry	4, 7, 15, 16
Semesters training in biology	1, 4, 9, 12, 13, 16
In-service training in physics	1, 4, 11, 14, 15
Years of physics study by students	6, 15
Class size (biology)	9, 11, 14, 15
Class size (chemistry)	5, 8, 9, 16
Hours instruction per week in chemistry	2, 4, 5, 12
Student time on laboratory work in chemistry	2, 3, 9, 15
Years teaching in current school (reading teacher)	5, 18
Frequency of audio-visual usage in reading class	1, 5, 9, 18
Bookcorner in classroom	6, 9, 11, 12
Hours of instruction in teaching reading	1, 4, 5, 9, 18
Hours of homework per week in reading class	3, 4, 15, 17
Budget for school maintenance	1, 7, 11, 16
Annual budget for books	1, 4, 5, 16
Remedial teaching in reading	4, 7, 9, 10, 18
Use of printed drill in science class	3, 4, 14
Use of individualized material in science	6, 9, 16, 18
Semesters training in physics	4, 7, 9, 14
Hours instruction per week in biology	2, 6, 9, 15, 17
Time on laboratory work in biology	1, 3, 5
Time on laboratory work in physics	5, 9, 15
Laboratory workbook used in science	3, 8, 15

Years teaching experience for reading teacher	5, 10, 12
Use of printed drill in reading class	9, 10, 18
Number of books in bookcorner	3, 10
Number of new books placed in bookcorner this year	8, 9, 18
Teacher uses standardized reading test for student evaluation	8, 10, 18
Class size in language class	8, 9, 17
Hours instruction per week in language	1, 14, 17
Percent of male teachers	2, 18
Number of librarians	1, 18
Admission criteria - prior achievement	2, 6
Admission criteria - entrance exam	2, 11
Remedial teaching in science	8
Number of weeks in school year	1, 6, 10
Years teaching experience (science teacher)	12, 13
Read teaching journals (science teachers)	15, 16
Teaching criteria - textbooks	14
Semesters training in other sciences	1, 18
Class size - physics	2, 11
Hours homework (biology)	4
Hours homework (chemistry)	14, 16
Hours instruction (physics)	2, 5
Hours per week marking papers (reading teachers)	5, 9
Dictionary for each student	6, 9
Teacher reads aloud in class	3
Total enrollment (girls)	4
Annual budget (non-teaching salary)	11
Number of language assistants	9
Remedial teaching in school language	4
Science teaching is specialized	11
University degree in science	4, 5
Teacher support for extracurricular science	13
In-service training (geology)	18
Hours homework in physics	17
Reading teacher's gender	5
University degree in mother tongue (reading teacher)	5
Proportion of time employed by reading teacher	12
Use of textbooks by reading teacher	15
Student buys textbook in mother tongue	11
Highest grade science is compulsory	15

APPENDIX C

School and Teacher Variables
Qualifying for the Final Regressions
in El Salvador, Egypt, Botswana, and Uganda

El Salvador

Total number of teaching hours per 100 students
Number of repeaters per class
Number of school buildings per school
Unit cost of desks
Number of chairs in good condition
Presence of a library
Annual rent per school
Number of 7–15-year-olds in school
Cost of supplies per year
Years of service of teachers
Piped water on school premises
Cost of books per school
Average age of teachers
Area per 100 students
Age of school building

Egypt

Number of times family visits school
Years principal taught
Number of training courses taken by principal
Presence of a playground
Teacher assessment of adequate desks
Teacher assessment of adequate books
Active parent association
Principal assessment of teaching staff
Health personnel visits school regularly
School follows up dropouts
Teacher comes from area near school
Number of teacher training courses
Teacher feels outside text is needed
Teacher has outside income
Teacher changed schools more than once
Work enthusiasm of teacher
Frequency homework assigned
Teacher welcome staff meeting

Botswana

Amount of formal teacher training
Weeks of in-service training
Adequacy of math books available
Number of volumes added to school library last year
Remedial instruction in math available
Student ability basis for guiding students
Students encouraged to take notes
Hours marking papers by teacher per week
Frequency of assigned homework
Number of students per classroom
Years teaching experience
Frequent use of in-class discussion
School has library
Frequent use of English in classroom

Uganda

Duplicating machine
Staff room
Glass in windows (unbroken)
Library
School farm
Proportion of local age cohort in primary school
Pupil self-concept
Athletic field
Religious affiliation of school
Books per grade 1 child
Books per grade 7 child
Parental education of teachers
Level of teachers' English ability
Level of teachers' education

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