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Author(s): Stephen P. Heyneman and Dean T. Jamison

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# Student Learning in Uganda: Textbook Availability and Other Factors

STEPHEN P. HEYNEMAN AND DEAN T. JAMISON

## Student Learning: The General Problem

Only recently has it been recognized that the average amount learned at the same age level in science, mathematics, and other universal subjects is substantially less in countries of low per capita incomes,<sup>1</sup> and that there has been a gradual but definitive shift in priorities in many low-income countries away from the need to place higher proportions of children in school and toward an investment in how much they learn after entry has been obtained. In Africa 14 out of 37 countries now enroll more than 70 percent of their children at the first level of schooling; in Asia and the Middle East it is 14 out of 22; in Central America it is 6 out of 10; in South America it is 9 out of 10.

Nevertheless, even though significant advances have been made in the availability of classrooms, gross differences remain between poor countries and rich countries, and within poor countries, in what pupils can expect to find in classrooms when they enter. The value of pedagogical equipment, furniture, and supplies at the fourth-grade level in Bolivia is 1 percent of what it is in Maryland.<sup>2</sup> The OECD countries in 1975 invested 33 times more per primary school student than did countries with per capita incomes of less than US\$265/year. Moreover, this gap has been widening. As a result of the demand that primary schools transfer more information more efficiently, per pupil investments are rising faster in rich countries than in poor countries.<sup>3</sup>

This shift in investment need is reflected to some degree in the lending program of international organizations such as the World Bank. As

These data were collected in 1972 under the sponsorship of the Ugandan government and the National Institute of Education, Makerere University. This analysis has been undertaken as part of the World Bank's research project on "Textbook Availability and Educational Quality," RP0671-60. However, the views and interpretations are those solely of the authors and, in particular, do not necessarily reflect those of the World Bank.

<sup>1</sup> Alex Inkeles, "The International Evaluation of Educational Achievement," *Proceedings of the National Academy of Education* 4 (1977): 139-200, particularly pp. 157-73.

<sup>2</sup> Stephen P. Heyneman, "Primary Education in Bolivia: What's Wrong?" mimeographed (Washington, D.C.: Education Department, World Bank, 1979).

<sup>3</sup> World Bank, *Education Sector Policy Paper* (Washington, D.C.: International Bank for Reconstruction and Development, 1979). If one were to attempt, however, to adjust for international variations in purchasing power that are not captured in computation of exchange rates, the ratio of spending in industrialized to nonindustrialized societies would decline. For example, at the official exchange rate, the 1975 per capita income of the United States was approximately 53 times that of India; after adjusting for differences in purchasing power, however, this ratio declines to 14 (see *World Development Report, 1979* [Washington, D.C.: World Bank, 1979], p. 177).

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far as we can predict, the bulk of the Bank Group's capital investment in education will continue to assist the expansion of specific educational institutions—96 percent of the resources dispersed between fiscal years 1970 and 1974, and 93 percent between fiscal years 1975 and 1978. But this proportion is expected to decrease. By fiscal year 1983 it is expected to decline to less than 85 percent. The remainder is accounted for by increases in lending not to specific institutions: for curriculum development, radio, TV, administration, and particularly for increases in the development, production, and distribution of learning materials. By fiscal year 1983 the Bank Group's Education Sector is expected to be investing US\$51 million/year in classroom "software" alone—up from US\$1.6 million/year a decade earlier. For example, 5 percent of the education projects contained a textbook component in fiscal year 1975; 10 percent in 1976; 25 percent in 1977.

Though the rationale for this shift in emphasis is strong, it could be undertaken more surely were there sufficient evidence on which quality-improving investments were the most effective; but that is hardly the case. There were 16 times more studies published on the cognitive impact of teacher training in the United States in 1 year than over the previous 2 decades in low-income countries.<sup>4</sup> Similar imbalances exist with respect to the evidence on textbooks, duplicating machines, radio, television, pupil health, maps, sound equipment, and educational magazines—in fact, with respect to all school resources. Since choices have to be made in an environment of scarcity, our evidence on factors contributing to the efficiency in learning will have to be more abundant and of higher quality. This paper reports on the findings of part of a broader World Bank research program that is designed to provide that evidence.

### Student Learning in Uganda

Previous efforts to estimate the achievement impact of school resources in Uganda have utilized either zero-order correlations<sup>5</sup> or regressions of school effects blocked in the aggregate.<sup>6</sup> From this experience it is

<sup>4</sup> The ERIC system lists 388 titles published on this subject in the United States in 1977. A recent review of the evidence from low-income countries could locate 23 published between 1963 and 1977 (see Torsten Husen, Lawrence J. Saha, and Richard Noonon, "Teacher Training and Student Achievement in Less Developed Countries," World Bank Staff Working Paper no. 310, December 1978). A subsequent review, which made a specific effort to locate studies published in non-European languages, could locate a slightly higher number (see Beatrice Avalos and Wadi Haddad, "A Review of Teacher Effectiveness Research in Africa, India, Latin America, Middle East, Malaysia, Philippines and Thailand: Synthesis of Results," mimeographed [Ottawa: International Development Research Center, June 1979]).

<sup>5</sup> Stephen P. Heyneman, "Differences in Construction, Facilities, Equipment and Academic Achievement among Ugandan Primary Schools," *International Review of Education* 23, no. 1 (1977): 35–45.

<sup>6</sup> Stephen P. Heyneman, "Influences on Academic Achievement: A Comparison of Results from Uganda and More Industrial Societies," *Sociology of Education* 49 (July 1976): 200–211.

evident that school facilities strongly influence achievement, and that school facilities are statistically more able to predict achievement in Uganda than they are in industrial societies. Still no one has yet attempted to answer the question of which school resources account for the impact of schools on learning. This paper is in response to that question.

We will first discuss how the basic variables were measured and the methodological procedures we intend to utilize. Then we report on the impact of school resources on student learning, taking the school as the unit of analysis. Next we will take the pupil as the unit of analysis and attempt to estimate the impact both of pupil characteristics and of school characteristics on student learning. In assessing the impact of pupil characteristics we control for all school effects by using indicator variables, identifying which school a child is in, to capture aggregate school effects. Finally we summarize what we have learned.

## Data and Methods

### *Sample*

These data were collected by Heyneman in 1972 from 61 Ugandan primary schools from five districts (North and South Karamoja, West Buganda, Bugisu, and Toro), and from 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 percent selected randomly. The final sample contained 10.7 percent of the schools, 13.1 percent of the grade 7 pupils, and 12.9 percent of teachers within the selected areas. The sample schools were situated in varied local settings—for example, 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. Political and economic considerations prevented a truly national sample, but there is reason to believe that the major socioeconomic factors associated with Primary School Leaving Examination performance in Uganda are adequately represented. 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 8 months after the questionnaires were administered.

### *Socioeconomic Status*

In our analysis, a pupil's socioeconomic status is indicated by a summary measure of mother's education, father's education, father's occupation, and consumer possessions in the home. The four component measures have been explored elsewhere.<sup>7</sup> They are, of course, highly intercorrelated; none has an impact on achievement in a manner divergent

from the others. In previous explorations their relationships with achievement have been found to be weak. However, this is the first occasion in which their impact has been calculated after having controlled for pupil intelligence.

#### *Teacher Language Ability*

Each teacher was asked to respond to six multiple-choice questions of English usage.<sup>8</sup> Scores for all teachers in a school were then added together and averaged by school. Like Hanushek,<sup>9</sup> we have chosen to average teacher scores because grade 7 students, if affected at all, are affected by more than the teacher in grade 7; they are affected by all their teachers. Other teachers have taught them in previous years, or have guided students outside the classroom environment. The degree of contact is particularly high in isolated schools.<sup>10</sup>

#### *Textbook Availability*

Each book available in grade 1 and grade 7 classrooms was counted and the sum divided by the total number of pupils in those two grades. The resulting ratios of books/child in grade 1 and grade 7 were then combined to constitute total books/child. Total books/child is a measure of reading material of all kinds: textbooks, readers, pamphlets, workbooks, and library books. No distinction was made between old, inappropriate, or damaged books, or between books in a vernacular, in English, or whether in science, mathematics, social studies, or other subjects. Total books/child is a measure of any reading material available, at the lowest and highest grade levels, and is a reasonably accurate portrayal of reading material available for the school as a whole.

#### *Pupil Health*

This was calculated by having pupils respond to five questions: (i) whether they had suffered from malnutrition when they were young, (ii) whether they had ever seen blood with their stool, (iii) how often they suffered from chills and fever, (iv) how often they had been in a clinic or

<sup>7</sup> Ibid. Stephen P. Heyneman, "A Brief Note on the Relationship between Socio-economic Status and Test Performance among Ugandan Primary School Children," *Comparative Education Review* 20 (February 1976): 42–47; "Why Impoverished Children Do Well in Ugandan Schools," *Comparative Education* 15 (June 1979): 175–85; and "Differences between Developed and Developing Countries: A Comment on Simmons and Alexander's 'Determinants of School Achievement,'" *Economic Development and Cultural Change* 28 (January 1980): 403–6.

<sup>8</sup> Though vernaculars were permitted or sometimes encouraged in grades 1–3, all grades were supposed to have English lessons, and grades 4–6 were supposed to be taught exclusively in English.

<sup>9</sup> Eric A. Hanushek, *Education and Race: An Analysis of the Educational Production Process* (Lexington, Mass.: Lexington, 1972).

<sup>10</sup> Forty percent of the teachers had taught for more than 10 years; 30 percent had taught for more than 5 years in the same school (see Stephen P. Heyneman, "Relationships between Teachers' Characteristics and Differences in Academic Achievement among Ugandan Primary Schools," *Education in Eastern Africa* 6, no. 1 [1976]: 41–51).

hospital overnight, and (v) how many diseases they had suffered from, that they knew about.<sup>11</sup> Each problem was explained to them in English and in one or more of six other languages. Personal assistance was given to each pupil who was unsure. If after receiving assistance a pupil was still uncertain, he was asked to check "No." Thirty-seven percent reported that they had been confined to a hospital at least once for "more than a few days." Seventy-five percent claimed to have had malaria; 12 percent had seen blood with their stool. Ten percent had had trachoma; 8 percent had had hookworm; 5 percent claimed to have been treated for malnutrition when they were toddlers.<sup>12</sup> Those within this 5 percent "malnourished when young" performed 25 percent of a standard deviation below the mean in academic achievement. Those reporting that they had hookworm also performed significantly worse.

*Raven's Progressive Matrices (RPM)*

Intelligence was measured by having each pupil respond to the 36 problems posed in the Raven's Progressive Matrices (RPM) test of perceptual and spatial abilities, colored version. The test is entirely nonverbal. It contains 36 pictures with differing shapes, colors, and patterns. At the bottom of the page, six alternative pieces are given. The task is to choose which of the six alternative pieces best fits the missing space in the shape at the top of the page. Because it is easily administered and entirely nonverbal, the RPM is a commonly used instrument in nonindustrialized societies.<sup>13</sup>

*Percentage of Children in School*

In communities where educational opportunities are limited, children who enter and who remain in school are distinct in one way or another by

<sup>11</sup> On the list were malaria, hookworm, trachoma, tuberculosis, and other diseases that were commonly recognized and had specific vernacular words to describe them.

<sup>12</sup> In a separate question children were asked what they ate before coming to school on the day of the visit to the school; 19 percent had had nothing to eat or to drink.

<sup>13</sup> Edgar A. F. Bowden, "Perceptual Abilities of African and European Children Educated Together," *Journal of Social Psychology* 72, no. 2 (1969): 149–54; Ernest L. Klingelhofer, "Performance of Tanzanian Secondary School Pupils in the Raven's Standard Matrices Test," *Journal of Social Psychology* 72 (August 1967): 204–15; Mallory Wober, "The Meaning and Stability of Raven's Progressive Matrices Test among Africans," *International Journal of Psychology* 4 (1969): 229–35; Philip E. Vernon, "Administration of Group Intelligence Tests to East African Pupils," *British Journal of Educational Psychology* 31 (1967): 282–91, and "Abilities and Educational Attainment in an East African Environment," *Journal of Special Education* 1 (Winter 1976): 335–45; Uma Sinha, "The Use of the Raven's Progressive Matrices in India," *Indian Educational Research* 3 (1968): 75–88; A. Ombredane, "Principes pour une etude psychologique des noires due Congo Belge," *Annee Psychologie* 50 (1951): 521–47; L. Berlioz, "Etudes des 'progressive matrices' faites sur les Africains de Douala," *Bulletin Centre de Recherches Psychotechnique* 4 (1955): 33–44; S. Biesheuvel, "Psychological Tests and Their Application to Non-European Peoples," in *Cross-cultural Studies*, ed. Douglas R. Price-Williams (Baltimore: Penguin, 1970); Michael A. Durojaiye, "Is the Concept of African Intelligence Meaningful," *East Africa* 7 (1971): 4–13; and Sydney H. Irvine, "Figural Tests of Reasoning in Africa: Studies in the Use of the Raven's Progressive Matrices across Cultures," *International Journal of Psychology* 4 (1969): 217–28.

comparison to the general age cohort in the community.<sup>14</sup> Put another way, in communities with less educational opportunity, seventh-grade students are less representative of the general age cohort than are those pupils who are in grade 7 in areas where school attendance is universal. The percentage of the 5–14-year-old age cohort in primary school has been calculated for each sample school.<sup>15</sup> These ranged between 6 and 76 percent. There is a marked tendency for average academic performance to be lower in areas with higher percentages of the age cohort attending school ( $r = -.251$ ,  $P < .05$ ). The question posed on this occasion is whether the influence of this preselectivity is as pronounced as the influence of characteristics internal to classrooms.

#### *School Facilities*

In addition to the availability of reading materials, the school inventory tallied the presence of a duplicating machine, farm, staff room, electricity, boarding facilities, football or hockey field, and whether or not window frames (present in all schools) were filled with glass. Common to each of these elements is the fact that, for better or worse, they were determined by authorities particular to the school, that is to say, by the teachers, the headmaster, and the parent's committee.<sup>16</sup> Elsewhere it has been argued that the presence of these physical facilities was an indication of initiative, specific to the school.<sup>17</sup> The fact that the presence of one item was, without exception, intercorrelated with the presence of each of the others, and with achievement, gives us further reason to consider these items together as an indicator of general facilities rather than separate variables. Each is therefore included in a summary scale, which has a range of 0–7.

#### *Pupil School Affiliation*

Among our interests is whether pupils, independent of ability and social background, are advantaged by being able to attend specific schools. One way to estimate the degree of this possible advantage is to estimate the statistical impact on achievement of students being affiliated with a particular school. Thus whether or not a student is in school number 12, or number 13, etc., is added to the regression equation as an

<sup>14</sup> Stephen P. Heyneman, "Relationships between the Primary School Community and Academic Achievement in Uganda," *Journal of Developing Areas* 11 (January 1977): 245–59.

<sup>15</sup> In West Buganda, Toro, and Karamoja the data reflect the proportion of the age group of the local county in school; in Bugisu, Kampala, Jinja, and Mbale the figures reflect district-level proportions.

<sup>16</sup> This stands in contrast to textbooks and high-quality teachers, which were distributed through central authorities (see Stephen P. Heyneman, "Changes in Efficiency and Equity Accruing from Government Involvement in Ugandan Primary Education," *African Studies Review* [April 1975], pp. 51–60).

<sup>17</sup> Stephen P. Heyneman, "Differences in Construction, Facilities, Equipment and Academic Achievement among Ugandan Primary Schools."

indicator variable for each school. (If a child attends school 12 the indicator variable for school 12 takes on the value 1 for that child; it takes on the value 0 otherwise.)

*Unit of Analysis: Individual or Aggregate?*

Divergent opinion exists on how to analyze academic achievement data—whether to use the pupil, the classroom, or the school as the unit of analysis. There are advantages and drawbacks to each. If pupils are chosen, then 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 increment in the units of observation. By 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, pupil characteristics lose significance because of the artificial attenuation of variance. Moreover, aggregating individual pupil data may overlook important differences in the way school resources are utilized within schools on the basis of sex, ethnic, or SES groups.<sup>18</sup>

We have chosen to discuss the determinants of achievement at both the pupil and the school levels of aggregation. Achievement aggregated to the school level is indeed appropriate for Uganda, perhaps even more so than for industrial societies. Pedagogical treatment of individual pupils does not differ dramatically within Ugandan classrooms, or between classrooms in the same school. There are no curriculum tracks, specialist personnel, or remedial reading teachers; there is no special equipment which can be assigned to specific individuals. These are options (and problems) of wealthier school systems. In Uganda the curriculum is universal for all children, and the assignment of teachers, equipment, and materials is based on national standards and effected by national authorities. Differences do exist, but they are differences between schools, not within them. Thus for our purposes we have chosen to analyze the achievement of primary school classrooms as well as the achievement of individual primary school pupils.

*Student Achievement*

Learning, in this instance, is defined as the achievement performance on the academic selection examination which every seventh-grade pupil must take. The test is rigorous. Because there are secondary school

<sup>18</sup> Larry J. Griffin and Karl L. Alexander, "Schooling and Socio-economic Attainments: High School and College Influences," *American Journal of Sociology* 84 (September 1978): 319–48; and Karl Alexander, Martha Cook, and Edward McDill, "Curriculum Tracking and Educational Stratification: Some Further Evidence," *American Sociological Review* 43 (February 1978): 47–67.



places for only one child in 10, tension and motivation run high. The test is administered simultaneously over a 3-day period in 2,500 locations. Grading is by computer. Children are identified by numbers; security is tight, and accusations of fraud are surprisingly few. Separate content is administered each day of the test: English language (reading comprehension and grammatical usage) may come on the first day, mathematics on the second, the general paper (science, geography, and social studies) on the third, etc. We will attempt to predict performance on each section separately and also together as a total.

*Learning Net of Ability to Learn*

More than anything else, current levels of achievement can be expected to follow from past levels of achievement, or from the level of natural capacity. It is not always specified whether survey research is accounting for the variance in the amount learned, in the amount of change in learning, or in the capacity to learn. Four techniques exist for disentangling these various elements, as follows: (a) subtracting a pretest achievement score from a posttest achievement score; (b) entering a pretest achievement score as an independent variable in a regression predicting the posttest score; (c) using a measure of natural capacity in place of a pretest and subtracting it from the posttest achievement score; or (d) entering the measure of natural capacity as an independent variable. We will not discuss type *a* or type *b* because we could acquire academic achievement data at one point in time only. However, we did acquire each pupil's performance on the Raven's Progressive Matrices (RPM) test, and we use their score on the RPM to control for natural ability in a fashion identical to controls which are placed on other independent variables in a regression equation (type *d*). In rejecting type *c* we are mindful of the work done by Cronbach and Furby.<sup>19</sup> They have argued that differences in initial and final scores regress toward the mean; that is, there will be a negative correlation between initial score and achievement change.<sup>20</sup> By contrast, entering RPM scores as an independent variable is relatively "problem free."<sup>21</sup>

<sup>19</sup> Lee J. Cronbach and Lita Furby, "How Should We Measure 'Change'—or Should We?" *Psychological Bulletin* 74, no. 1 (1970): 68–80.

<sup>20</sup> Cited by Peter R. Moock and David Rhodes, "Achievement in the Philadelphia Public School System," *IRCD Bulletin* (Teachers College), vol. 13 (Summer 1978).

<sup>21</sup> *Ibid.* This has been the preferred procedure of our previous work and of others. See Hanushek (n. 9 above); Dean T. Jamison, "Radio Education and Student Repetition in Nicaragua," in *The Nicaragua Radio Mathematics Project, 1976–1977*, ed. Patrick Suppes, Barbara Searle, and Jamesine Friend (Stanford, Calif.: Institute for Mathematical Studies in the Social Sciences, 1979); Richard J. Murnane, *The Impact of School Resources on the Learning of Inner City Children* (Cambridge, Mass.: Ballinger, 1975); and Donald R. Winkler, "Educational Attainment and School Peer Group Composition," *Journal of Human Resources* 10 (1975): 189–204.

## Determinants of Student Learning in Uganda

### *Analysis Using School-Average Data*

We have taken the school averages of seven potential influences on academic achievement: pupil SES, pupil RPM, pupil health, teacher language ability, school physical facilities, textbook availability, and the local enrollment ratio of each school in the sample. These we have regressed against average school performance on math, English, general paper, and total achievement tests, and also on RPM.<sup>22</sup> Means, standard deviations, and regression results can be found in table 1.

In table 1 we have aggregated all potential influences to the level of the school since our data on school variables (e.g., textbook availability) already are school-level aggregates. We do not view this level of data aggregation necessarily as a drawback. Because of financial constraints, policy changes have to be made at the level of the school; that is, teacher English quality and other school facilities, if altered up or down, would have to be altered for all children in a given school together. We are therefore interested in what effect these alterations might have.

Several observations seem appropriate for table 1. The first is that all three school variables (teachers' English, textbooks, and physical facilities) have positive and consistent (though rarely statistically significant) effects on all cognitive tests. Raising the average English-language ability of school teachers by 1 point, for example, would raise average school English-language scores by 1.3 points, general paper scores by 1.5 points, and total achievement points by 4.1 points. Similar gains to be expected from improving the availability of textbooks and school physical facilities can be estimated from the appropriate regression coefficients in table 1.

Among the three school characteristics it is difficult to isolate one or another as being predominant. The most noticeable categories of influence might be textbook availability on the English-language test and total achievement scores, and school physical facilities on RPM performances.<sup>23</sup> However, if one averages the size of the significance measures (*t*-values) across cognitive tests, as we have done in the right-hand col-

<sup>22</sup> We have entered RPM both as dependent and independent variables because we are aware that no test of natural ability is uninfluenced by environment, particularly school environment. Results here, particularly with regard to school physical facilities, bear us out.

<sup>23</sup> In addition to examining the impact of textbook availability on student achievement in general, we also used the school-level data to examine whether book availability was differentially effective for high- or low-SES students and high- or low-ability students. We approached this question both by adding textbook by SES or RPM interactions into the regressions and by stratifying the sample into various SES and RPM groups. Our sample sizes were small and regression coefficients often unstable and of low significance. Our results do suggest, somewhat unfortunately, that the effect of textbook availability is more pronounced for higher-SES and higher-ability schools. However, this is not the case for teacher English, which has the most pronounced impact on low-SES schools, whether or not they averaged high on the RPM measure of intelligence.

TABLE 1  
INFLUENCES ON LEARNING: THE SCHOOL-LEVEL UNSTANDARDIZED REGRESSION COEFFICIENTS (N = 61)

Variable	Mean	SD	RPM	English	General Paper	Mathematics	Total Achievement	Average <i>t</i> -Value
Constant	...	...	19.047	29.326	39.779	27.800	96.905	...
SES	9.664	2.791	.084 (.484)	-.235 (.906)	-.807** (2.042)	-.093 (.265)	-1.135 (1.253)	...
RPM	23.113	3.237	...	.539** (2.648)	.546 (1.760)	.473 (1.709)	1.558** (2.190)	(.99)
Local enrollment ratio	41.951	17.468	.011 (.446)	-.033 (.914)	-.044 (.789)	-.065 (1.312)	-.142 (1.116)	(2.11)
Pupil health	3.005	.500	-.121 (.152)	1.681 (1.416)	.305 (.167)	1.186 (.736)	3.172 (.765)	(.92)
Teacher's English quality	4.087	.895	.149 (.329)	1.327* (1.958)	1.479 (1.434)	1.273 (1.383)	4.080* (1.724)	(.65)
Textbook availability	6.530	6.318	.081 (1.075)	.194* (1.707)	.072 (.417)	.020 (.126)	.286 (.720)	(1.4)
School physical facilities	3.219	1.669	.681** (2.556)	.536 (1.268)	.887 (1.379)	.352 (.613)	1.775 (1.203)	(.81)
R <sup>2</sup> (adjusted for df)	...	...	.146	.327	.137	.070	.191	...

NOTE. —*t*-values are in parentheses. English mean = 51.467 (SD = 5.458); general paper mean = 52.843 (SD = 7.340); math mean = 95.056 (SD = 6.306); total achievement mean = 149.366 (SD = 17.393).

\*  $P < .1$ .

\*\*  $P < .05$ .

umn, school physical facilities and teacher English appear to be the more significant: 1.4 as opposed to 0.81.

It is surprising here that the influence of SES on all (academic) achievement tests is negative. From previous analyses we would have expected it to be low and/or insignificant; but in these analyses the influence of SES was not explored after having controlled for ability. That it is negative is of interest, though any interpretation must be made with caution because, when analysis is undertaken at the pupil-specific level, the apparent impact of SES can alter.

*Analysis Using Pupil-specific Data*

To calculate the learning influences on individual pupils we ran the same regression,<sup>24</sup> displayed in table 1, on individual pupils; this time we assigned characteristics of school and teacher quality identically to each pupil in the same school. The results are displayed in table 2. Alterations do occur in the size of the regression coefficients, but they are not major. The influence of textbook availability on the RPM is .081 at the classroom level and .047 at the pupil level; on English-language achievement the difference is .194 versus .223; on general paper .072 versus -.034; on mathematics achievement .020 versus .104; and on total achievement .286 versus .311.<sup>25</sup>

The most important difference between table 1 and table 2 can be found in the degree of statistical significance, measured in *t*-values. For each variable, the degree of statistical significance increases markedly in table 2. The average *t*-value (for the five dependent variables) is increased from 0.81 to 2.4 in the case of textbook availability; from 1.4 to 3.3 for school physical facilities; from 1.4 to 4.5 for teacher's English.

There is one exception to the rule that in countries with severe financial constraints, like Uganda, educational interventions cannot be administered to pupils individually. The exception is with health and nutrition. As a variable, pupil health appears to have about the same average degree of statistical significance as textbook availability, though with less variation in significance by subject. However, unlike school facilities (or the quality of a teacher's English, or textbook availability), vitamin supplements, parasitic treatments, and antibiotics can be administered by teachers to those pupils whose ailments are more obvious.<sup>26</sup> What this implies is that an intervention in health and nutrition, because it could be

<sup>24</sup> Sex has been added as an individual characteristic.

<sup>25</sup> From the evidence to date, textbook availability is the most consistently positive predictor of school achievement in less industrialized societies, substantially more consistent, e.g., than length of teacher training (see Stephen P. Heyneman, Joseph P. Farrell, and Manuel A. Sepulveda-Stuardo, "Textbooks and Achievement: What We Know," World Bank Staff Working Paper no. 298, October, 1978).

<sup>26</sup> School lunch programs, an equally important device, would have to be administered on a school-by-school rather than a pupil-by-pupil basis.

TABLE 2  
 INFLUENCES ON LEARNING: THE INDIVIDUAL PUPIL-LEVEL UNSTANDARDIZED REGRESSION COEFFICIENTS ( $N = 1,907$ )

Variable	Mean	SD	RPM	English	General Paper	Mathematics	Total Achievement	Average $t$ -Value
Constant	...	...	18.473	33.922	37.556	25.089	97.061	...
Sex	.359	.480	-2.989**	-2.208**	-7.669**	-5.483**	-15.420**	(8.4)
SES	9.916	4.340	.277**	.098	-.123	.031	-.020	(1.6)
RPM	24.072	8.468	...	(1.544)	(1.615)	(.335)	(.100)	(13.3)
Local enrollment ratio	41.951	17.468	.002	(16.203)	(14.370)	(17.248)	(18.519)	(4.0)
Pupil health	3.022	1.760	(.197)	(4.757)	(4.621)	(4.739)	(5.622)	(2.4)
Teacher's english	...	...	.165	.300*	.450**	.437*	1.207**	(4.5)
Textbook availability	...	...	(1.551)	(2.284)	(2.853)	(2.284)	(2.918)	(2.4)
School physical facilities	...	...	.388	1.471**	1.928**	1.620**	5.101**	(2.4)
$R^2$ (adjusted for df)	...	...	(1.726)	(5.307)	(5.794)	(4.016)	(5.848)	(3.3)
	...	...	.047	.233**	-.034	.104**	.311*	...
	...	...	(1.375)	(5.290)	(.677)	(2.426)	(2.342)	...
	...	...	.606**	.537**	.749**	.283	1.501**	...
	...	...	(4.755)	(3.398)	(3.950)	(1.230)	(3.018)	...
	...	...	.068	.229	.231	.209	.267	...

NOTE. — $t$ -values are in parentheses. English mean = 52.473 (SD = 11.480); general paper mean = 53.495 (SD = 13.800); mathematics mean = 46.014 (SD = 16.495); total achievement mean = 152.024 (SD = 37.05).

\*  $P < .05$ .

\*\*  $P < .01$ .

administered to specific children who were not already healthy, holds out the possibility of a more targeted gain in learning than, for example, increasing the availability of textbooks.

*The Influence of Pupil Affiliation with Particular Schools*

Counting the availability of educational equipment and the abilities of teachers is an imperfect way to estimate the sum total of school effects. However necessary for calculating which variable might make the best educational investment, inevitably something is not counted and therefore its effect may be overlooked.

We have attempted to get around this problem by noting simply the affiliation of a student with a particular school and its achievement impact, separate from those characteristics about a student which are determined by influences outside the school: sex, health, SES, intelligence, and the like. Thus, for table 3, we have calculated 65 coefficients: four for student-specific characteristics and 61 corresponding to the indicator variables denoting school affiliation.

To be frank, we have had some difficulty deciding how to display the list of 65 regression coefficients in a concise fashion. To have such a long list is hardly customary, and the importance of particular affiliations cannot be apparent to a reader unfamiliar with the name of each school.

What we have done in table 3 is to average the absolute value of the coefficients of the indicator variables denoting school affiliation. The effect is pronounced. On an average, being in a good or bad school can affect the student's total achievement score by 15 points. Approximately half of the school-affiliation coefficients are significant at the  $P < .05$  level (on total achievement score) and ultimately can explain 39 percent of the explained variance.<sup>27</sup>

Perhaps most interesting is the ability of Ugandan schools to affect performance on an intelligence test. Though less than half of the variance is explained at all, 73 percent of what is explained can be attributed to school affiliation.<sup>28</sup> This lends further evidence to the theory that performance on culture-free tests such as the RPM is hardly free of environmental effects, even though we are able to explain much less variance in RPM than in the achievement-test scores.

<sup>27</sup> For purposes of comparability with the IEA (science) results, previous estimates attributable to school effects did not control for intelligence.

<sup>28</sup> In the United States, James Coleman and others find that school characteristics explain more variance in intellectual aptitude than academic achievement. They explain it as follows: "Achievement scores cover material that is nearly the same in all school curriculums toward which all schools teach alike, while the ability tests cover material that the school teaches more incidentally and thus with more differential success. Consequently, student bodies that differ at the beginning of school become slightly more alike with respect to skills most directly related to a standard curriculum, but do not with the skills in which the curriculum is less standard" (see James S. Coleman, Ernest Q. Campbell, Carol J. Hobsen, James McPartland, Alexander M. Mood, Frederic Weinfeld, and Robert L. York, *The Equality of Educational Opportunity* [Washington, D.C.: Department of Health, Education, and Welfare, 1966]).

TABLE 3  
THE INFLUENCE OF SCHOOL AFFILIATION ON LEARNING NET OF INDIVIDUAL PUPIL CHARACTERISTICS (N = 2,009)

Variable	RPM (N = 2,019)	English	General	Mathematics	Total Achievement
Constant	21.41	41.40	44.00	28.45	114.17
Student characteristics:					
1. Sex	-2.35** (5.94)	-1.92** (4.01)	-7.20** (13.22)	-5.06** (7.10)	-14.30** (4.62)
2. Raven's Progressive Matrices (RPM)	—	.46** (16.77)	.52** (16.90)	.73** (18.03)	1.70** (20.14)
3. Health	.13 (1.29)	.23 (1.84)	.40** (2.86)	.37* (2.01)	1.04** (2.73)
4. Socioeconomic status (SES)	.18** (3.04)	.27** (3.91)	.21** (2.59)	.02 (.19)	.48** (2.20)
5. School affiliation:					
Mean absolute value of coefficient	2.94	4.92	7.05	4.95	15.17
% of coefficients significant at $P > .05$	22.00	41.00	56.00	19.00	48.00
% of coefficients significant at $P > .01$	11.00	27.00	41.00	10.00	27.00
$R^2$ (adjusted for df)	.15	.34	.41	.28	.38
% of $R^2$ attributable to school affiliation <sup>a</sup>	73	50	53	32	39

<sup>a</sup> This is defined to equal 100 times the ratio of the  $R^2$  of the regression containing both the student and school-affiliation variables, less the  $R^2$  of the regression containing only student variables to the  $R^2$  of the regression containing both.

\*  $P < .05$ .

\*\*  $P < .01$ .

How much additional impact emerges from this affiliation method of estimating school effects? To answer this we turned school affiliation into a dependent variable and predicted it on the basis of textbook availability, teacher's English quality, and school physical facilities. These characteristics can predict a maximum of only 40 percent of the school-affiliation influence. Thus the impact of schools on pupil achievement is at least 60 percent over and above the combined explanatory power of our three strongest school variables. This difference between the school effects which we can specify through our measurements of classroom quality and the school effects which we can quantify but cannot disaggregate is pronounced; and it is important enough to warrant further research.

### **Summary**

We have learned that differences among schools are extremely powerful determinants of school achievement in Uganda. Yet there is much about school impact that we have left uncounted, and therefore much we have yet to learn about how to measure school quality. However much we have left to learn though, the search for methodological improvement should not delay intelligent investments in environments where the needs are genuine. And in Uganda, improving the quality of a teacher's language ability, the availability of textbooks, school physical facilities, and the pupil level of health and nutrition would be intelligent investments.