School Policy: Implications of Recent Research for Human Capital Investments

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Improving schools is frequently high on the policy agenda of both developed and developing countries. The nature of the policy focus, however, differs across countries with some emphasizing increasing school attainment and others focusing on quality concerns.

Until recently little evidence was very useful in helping decision makers to formulate appropriate schooling policies. In the last decade, however, there has been a dramatic increase in useful information about the role of human capital in development and about the ways in which governments can promote human capital formation.

This paper reviews evidence on the economic impacts of human capital investment with an eye to where investment decisions might be made. While the evidence on actual impacts is quite clear, the evidence on how best to make the investments is less clear. Specifically, recent research underscores the prime importance of educational quality, as measured by cognitive achievement, and the much lower importance of pure school attainment. This research spans both developed and developing nations. On the other hand, on the key question is how cognitive achievement can be improved, the relevant evidence is less clear. There is substantial evidence that simple resource policies have not worked in either developed or developing countries. On the other hand, the leading candidate for high impact is teacher quality, but research on this is largely confined to the United States.
Is Human Capital Important?

Governments around the world place considerable emphasis on investments in human capital through the provision of schooling. And this focus carries through to international agencies such as the World Bank, which also emphasizes the provision of schooling.

The underlying message is that human capital is important for individuals and for nations. At the same time, human capital – identified as the stock of productive skills of an individual – is an abstract concept. Both researchers and policy makers must transform the concept into practical terms that can be studied and translated into policy.

The genius of early researchers, led by Mincer (1970, 1974), was to recognize that varying amounts of schooling signified different amounts of human capital and thus could be a clear measure of the abstract idea of human capital. From a research standpoint, various census and survey databases routinely provide school attainment information that can be linked to incomes and other individual outcomes. From a policy viewpoint, school attainment is also a concrete notion – leading virtually all countries of the world to devote attention to rates of school completion and the promotion of access to further schooling.

The worldwide quest to improve schooling is highlighted in the developing world by the establishment of the Education for All (EFA) movement (headed by UNESCO) and of the Millennium Development Goals (MDG) of the United Nations. The EFA initiative grew out of the world summit on education in 1990 and was given more specificity in the Dakar summit in 2000. The key elements of the EFA initiative (all to be accomplished by 2015) are: expand early childhood care and education; provide free and compulsory primary education for all; promote learning and life skills for young people
and adults; increase adult literacy by 50 per cent; achieve gender parity by 2005, gender equality by 2015; and improve the quality of education. While each of the goals has received attention in annual monitoring reports (e.g., UNESCO (2005)), it appears clear that schooling attainment largely drives the movement. The MDGs, developed in 2000, cover a range of broad issues including health, nutrition, and the environment, but the second goal is achieving universal primary education.\textsuperscript{1} Again the focus is getting school attainment up at least to the primary schooling level everywhere.

This discussion begins with a review of the evidence on the value of added years of schooling.\textsuperscript{2} Following that, however, the discussion turns to issues of educational quality. The perspective taken is that school attainment is just one possible proxy for human capital and that other plausible proxies may be superior, particularly in an international context. Specifically, using cognitive achievement tests in mathematics and science provides a superior measure of international differences in human capital. And, focusing on this changes the policy issues noticeably.

\textit{School Attainment}

The importance of increasing school attainment is generally treated as needing little or no discussion in policy debates. It is, after all, well known to all that further schooling has a large payoff. This fact was developed in the innovative analyses by Jacob Mincer (1970, (1974), who considered how investing in differing amounts of

\footnote{The Millennium Declaration has 8 objectives, initially set by UN resolution in 2000 and adopted by 189 world leaders during the world summit in 2005: eradicate extreme poverty and hunger; achieve universal primary education; promote gender equality and empower women; reduce child mortality; improve maternal health; combat HIV/AIDS, malaria, and other diseases; ensure environmental sustainability; and develop a global partnership for development.}

\footnote{Details of the underlying statistical analyses plus an extended set of references can be found in Hanushek and Wößmann (2006).}
Schooling affects individual earnings. Over the past thirty years, literally hundreds of such studies have been conducted around the world. In fact, these have been reviewed in a large of interpretative articles including Psacharopoulos (1994), Card (1999), Harmon, Oosterbeek, and Walker (2003), Psacharopoulos and Patrinos (2004), and Heckman, Lochner, and Todd (2006).

By all accounts, the rate of return to additional years of schooling is large. In estimates of Mincer earnings functions for 98 countries, Psacharopoulos and Patrinos (2004) find that average returns for the world are above 17 percent and that they are systematically higher in developing countries (see Table 1).\(^3\)

These findings have been reinforced in analyses of the relationship between schooling and economic growth. Early studies used adult literacy rates (e.g., Azariadis and Drazen (1990); Romer (1990)) or school enrollment ratios (e.g., Barro (1991); Mankiw, Romer, and Weil (1992); Levine and Renelt (1992)) as proxies for the human capital of an economy. An important innovation by Barro and Lee (1993, 2001) was the development of internationally comparable data on average years of schooling for a large sample of countries and years, based on a combination of census or survey data on educational attainment wherever possible and using literacy and enrollment data to fill gaps in the census data.

The standard method to estimate the effect of education on economic growth is to estimate cross-country growth regressions where countries’ average annual growth in gross domestic product (GDP) per capita over several decades is expressed as a function

\(^3\) The Mincer earnings function relates the logarithm of earnings to years of schooling, potential labor market experience, and other factors specific to individual studies (Mincer (1974)). The coefficient on years of schooling in this regression can, under specific circumstances, be interpreted as the rate of return to schooling. (See, however, Heckman, Lochner, and Todd (2006) who offer a critique and interpretation of these analyses).
<table>
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*Non-OECD.

of measures of schooling and a set of other variables deemed to be important for economic growth. Following the seminal contributions by Barro (1991, 1997) and Mankiw, Romer, and Weil (1992), a vast early literature of cross-country growth regressions has tended to find a significant positive association between quantitative measures of schooling and economic growth. To give an idea of the robustness of this association, in the recent extensive robustness analysis by Sala-i-Martin, Doppelhofer, and Miller (2004) of 67 explanatory variables in growth regressions on a sample of 88 countries, primary schooling turns out to be the most robust influence factor (after an East Asian dummy) on growth in GDP per capita in 1960-1996.

The problem of course is that cross-country comparisons of average years of schooling implicitly assumes that a year of schooling delivers the same increase in knowledge and skills regardless of the education system. For example, a year of schooling in Peru is assumed to create the same increase in productive human capital as a year of schooling in Hong Kong. Additionally, this measure assumes that formal schooling is the primary (sole) source of education and, again, that variations in the quality of nonschool factors have a negligible effect on education outcomes. This neglect of cross-country differences in the quality of education is probably the major drawback of such a quantitative measure of schooling, and we come back to this issue in great detail below.

**Educational Quality**

The analysis of human capital typically treats, as noted, years of schooling as the conceptually appropriate measure of human capital and then concentrates on how to obtain the best possible estimate of the return to a year of schooling (see, for example,  

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4 For extensive reviews of the literature, see, e.g., Topel (1999); Temple (2001); Krueger and Lindahl (2001); Sianesi and Van Reenen (2003).
Card (1999)). An alternative position taken here is that school attainment is simply one proxy for the relevant human capital skills of an individual. Another measure with considerable appeal is the cognitive achievement of individuals.

A variety of researchers are now able to document that the earnings advantages to higher achievement on standardized tests are quite substantial. These results are derived from different specific approaches, but the basic underlying analysis involves estimating a standard “Mincer” earnings function and adding a measure of individual cognitive skills.\textsuperscript{5}

Three recent U.S. studies provide direct and quite consistent estimates of the impact of test performance on earnings (Mulligan (1999); Murnane, Willett, Duhaldeborde, and Tyler (2000); Lazear (2003)). These studies employ different nationally representative data sets from the United States that follow students after they leave school and enter the labor force. When scores are standardized, they suggest that one standard deviation increase in mathematics performance at the end of high schools translates into 12 percent higher annual earnings.\textsuperscript{6}

A limited number of additional studies are available for other developed countries. McIntosh and Vignoles (2001) study wages in the United Kingdom and find strong returns to both numeracy and literacy. Finnie and Meng (2002) and Green and Riddell (2003), investigating returns to cognitive skills in Canada, suggest that literacy

\textsuperscript{5} The clearest analyses are found in several references for the U.S. (analyzed in Hanushek (2002); see Bishop (1989, (1991); O'Neill (1990); Grogger and Eide (1993); Blackburn and Neumark (1993, (1995); Murnane, Willett, and Levy (1995); Neal and Johnson (1996); Mulligan (1999); Murnane, Willett, Duhaldeborde, and Tyler (2000); Altonji and Pierret (2001); Murnane, Willett, Braatz, and Duhaldeborde (2001); and Lazear (2003)).

\textsuperscript{6} Because the units of measurement differ across tests, it is convenient to convert test scores into measures of the distribution of achievement across the population. A one-half standard deviation change would move somebody from the middle of the distribution (the 50\textsuperscript{th} percentile) to the 69\textsuperscript{th} percentile; a one standard deviation change would move this person to the 84\textsuperscript{th} percentile. Because tests tend to follow a normal distribution, the percentile movements are largest at the center of the distribution.
has a significant return (although Finnie and Meng (2002) find an insignificant return to numeracy).

Further, in the developed countries, a portion of the return to cognitive skills comes through increased school attainment. In general, higher skills are strongly associated with continuation in school.\(^7\)

Questions remain about whether the clear impacts of quality in the U.S. generalize to developing countries. The literature on returns to cognitive skills in developing countries is restricted to a relatively limited number of countries: Ghana, Kenya, Morocco, Pakistan, South Africa, and Tanzania.

The evidence for developing countries is a little difficult to summarize easily.\(^8\) Nonetheless, the available estimates permit a tentative conclusion that the returns to quality may be even larger in developing countries than in developed countries. This of course would be consistent with the range of estimates for returns to quantity of schooling (e.g., Psacharopoulos (1994) and Psacharopoulos and Patrinos (2004)), which are frequently interpreted as indicating diminishing marginal returns to schooling.

Evidence also suggests that educational quality is directly related to school attainment in developing countries. In Brazil, a country plagued by high rates of grade repetition and ultimate school dropouts, Harbison and Hanushek (1992) show that higher cognitive skills in primary school lead to lower repetition rates. Further, Hanushek, Lavy, Angrist and Lavy (1997), Alderman, Behrman, Ross, and Sabot (1996), Behrman, Ross, and Sabot (forthcoming), Moll (1998), Boissiere, Knight, and Sabot (1985); Knight and Sabot (1990).

\(^7\) See, for example, Dugan (1976) and Manski and Wise (1983) for early analyses. Murnane, Willett, Duphaldeborde, and Tyler (2000) separate the direct returns to measured skill from the indirect returns of more schooling and suggest that perhaps one-third to one-half of the full return to higher achievement comes from further schooling. Similarly, Rivkin (1995) finds that variations in test scores capture a considerable proportion of the systematic variation in high school completion and in college continuation, so that test score differences can fully explain black-white differences in schooling. See further discussion and references in Hanushek (2006).

and Hitomi (2006) find that lower quality schools, measured by lower value-added to cognitive achievement, lead to higher dropout rates in Egyptian primary schools. Thus, as found for developed countries, the full economic impact of higher educational quality comes in part through greater school attainment.

This complementarity of school quality and attainment also means that actions that actually improve quality of schools will yield a bonus in terms of meeting goals for attainment. Conversely, simply attempting to expand access and attainment, say through starting a large number of low quality schools, will be self-defeating to the extent that there is a direct reaction to the low quality that affects the actual attainment results.

Finally, one data set (the International Adult Literacy Survey, or IALS) with consistent information on basic skills of literacy and numeracy for a representative sample of the population aged 15-65 was collected for a sample of countries between 1994 and 1998. This data set spans countries with different incomes. These data permit direct comparisons of the relative importance of quantity and quality of schooling across countries, although the bias toward developed economies remains. Hanushek and Zhang (2006) estimate returns to school attainment and to literacy scores for the 13 countries where continuous measures of individual earnings are available. Their samples include full-time workers between 26 and 65 years of age. The dependent variable is the logarithm of annual earnings from employment, and control variables are gender, potential experience and its square, and an indicator for living in rural area.

Figure 1 provides the relevant summary information on the returns to cognitive skills, estimated in a model that jointly includes school attainment and literacy scores. As in the prior analyses, both school attainment and cognitive skills enter into the
Figure 1: Returns to Cognitive Skills, International Adult Literacy Survey

determination of individual incomes. With the exception of Poland, literacy scores have a consistent positive impact on earnings. The (unweighted) average of the impact of literacy scores is 0.093, only slightly less than found previously for the U.S. studies. (These estimates reflect the increase in log earnings associated with a one standard deviation increase in measured tests; for small changes in test scores, this estimate is approximately the proportionate increase in earnings.) The U.S. is noticeably higher than other countries and the previous U.S. studies, perhaps reflecting that these earnings are obtained across the entire work life. The average excluding the U.S. is still 0.08.

The estimates of the individual earnings functions shows relative earnings within each country associated with both school attainment and with achievement. It does not, however, permit direct comparisons across countries in the value of skills. For this it is appropriate to return to differences in aggregate growth rates across countries – except here the focus is cognitive skills of individuals in different countries.

From the mid-1960s to today, international agencies have conducted many international tests of students’ performance in cognitive skills such as mathematics and science. The different tests contain both “academic” questions related to the school curricula as well as “life skill” questions requiring practical applications to real-world phenomena. There have been twelve testing occasions that present results from a total of 36 separate test observations at different age levels and in different subjects. As discussed below, there are some difficult issues in putting these results on a common scale. Nevertheless, it becomes obvious that the developing countries that ever participated in one of the tests perform dramatically lower than any country in the group of OECD countries. The variation in the quality of education that exists among OECD
countries is already substantial, but the magnitude of the difference to developing
countries in the average amount of learning that has taken place after a given number of
years of schooling dwarfs any within-OECD difference.

Over the past ten years, empirical growth research demonstrates that consideration of the
quality of education, measured by the cognitive skills learned, alters the assessment of the
role of education in the process of economic development dramatically. When using the
data from the international student achievement tests through 1991 to build a measure of
educational quality, Hanushek and Kimko (2000) find a statistically and economically
significant positive effect of the quality of education on economic growth in 1960-1990
that dwarfs the association between quantity of education and growth. Thus, even more
than in the case of education and individual earnings, ignoring quality differences very
significantly misses the true importance of education for economic growth. Their
estimates suggest that one country-level standard deviation higher test performance
would yield around one percentage point higher annual growth rates.

This analysis has been extended to a larger group of countries and to economic
performance through 2000 in Jamison, Jamison, and Hanushek (forthcoming). The
growth estimation relies upon the development of a consistent set of achievement
estimates that rescale the various international tests to be comparable that is developed in
Hanushek and Wößmann (in process).\(^9\) Hanushek and Wößmann (2006) also use these
data to extend the analysis of growth in a variety of ways.

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\(^{9}\) The rescaling uses performance of U.S. students over time (as measured by the National Assessment of
Educational Quality, or NAEP) to calibrate the U.S. scores on different international tests. Then, by setting
the variance of each test according to an OECD standardization group, each country and test can be
equated.
The Hanushek and Wößmann (2006) measure of the quality of education is a simple average of the mathematics and science scores over all the international tests between 1964 and 2003. They interpret this as a proxy for the average educational performance of the whole labor force. This measure encompasses overall cognitive skills, not just those developed in schools. Thus, whether skills are developed at home, in schools, or elsewhere, they are included in the growth analyses.

The basic result is depicted graphically in Figure 2. After controlling for the initial level of GDP per capita and for years of schooling, the test-score measure features a statistically significant effect on the growth in real GDP per capita in 1960-2000. According to this basic specification, test scores that are larger by one standard deviation (measured at the student level across all OECD countries in PISA) are associated with an average annual growth rate in GDP per capita that is two percentage points higher over the whole 40-year period.

Moreover, once educational quality is included in the cross-country growth regressions, school attainment appears to have little or no role in growth. This finding is extraordinarily important and the subject of the policy discussion below.

Three issues are particularly important for understanding the role of human capital on economic performance in developing countries, and the analysis is extended to address them. First, educational quality is surely not the only thing that is important in determining growth, and many have emphasized the role of economic institutions. Second, the cross-country analysis is dominated by developed countries, and the impacts

10 Details of the data and analysis are found in Hanushek and Wößmann (2006). The source of the income data is version 6.1 of the Penn World Tables (cf. Heston, Summers, and Aten (2002)), and the data on years of schooling is an extended version of the Cohen and Soto (2001) data described in Jamison, Jamison, and Hanushek (forthcoming).
Figure 2: Added-variable Plots of Growth and Educational Quality

Notes: Added-variable plots of a regression of the average annual rate of growth (in percent) of real GDP per capita in 1960-2000 on the initial level of real GDP per capita in 1960, average test scores on international student achievement tests, and average years of schooling in 1960.

Source: Hanushek and Wößmann (2006)
of educational quality may not be the same across all countries. Third, concentrating on just the average cognitive skills of a population may mask significant variations in quality within countries, particularly within developing countries.

While the evidence confirms an independent effect of educational quality on economic growth, this effect may differ depending on the economic institutions of a country. North (1990), for example, emphasizes that the institutional framework plays an important role in shaping the relative profitability of piracy versus productive activity. If the available knowledge and skills are used in the former rather than the latter activity, one may certainly expect the effect on economic growth to be substantially different, and maybe even to turn negative. Similarly, Murphy, Shleifer, and Vishny (1991) show that the allocation of talent between rent-seeking and entrepreneurship matters for economic growth: countries with relatively more engineering college majors grow faster and countries with relatively more law concentrators grow more slowly. Easterly (2002) argues that education may not have much impact in less developed countries that lack other facilitating factors such as functioning institutions for markets and legal systems. In a similar way, Pritchett (2001, 2006) suggests that deficiencies in the institutional environment might render the average effect of education on growth across all countries negligible.

To address these issues, both Jamison, Jamison, and Hanushek (forthcoming) and Hanushek and Wößmann (2006) incorporate measures of economic institutions in their analyses. These measures include the openness of a country’s economy over the latter half of the 20th century and the strength of property rights in the country. Two findings emerge from these extensions. First, economic institutions are indeed important. But,
second, the role of educational quality remains even in the face of different economic institutions. If anything, economic institutions and educational quality are complementary: better economic institutions leads to stronger impacts of educational quality.

An important issue is whether the role of educational quality holds for developing countries. If the analysis is separated for the sample into OECD countries and non-OECD countries, the results are remarkably similar (see Hanushek and Wößmann (2006)). The effect of educational quality on economic growth does not differ significantly between the two groups of countries. The results remain qualitatively the same when openness and quality of institutions are again added as control variables. Alternatively, it is possible to divide the sample into countries above and below the sample median of initial GDP per capita. Educational quality remains significant in both subsamples, but the effect of quality is considerably larger in the low-income countries. Thus, if anything, the effect of educational quality is larger in developing countries than in developed countries.

Finally, Hanushek and Wößmann (2006) further consider the roles of basic literacy and numeracy and of top-end performance. Both turn out to be separately significantly related to economic growth. That is, both education for all and the share of absolutely top performers seem to exert separately identifiable effects on economic growth. For a variety of reasons, however, these initial results should be viewed as suggestive rather than definitive.

The analyses of variations in economic growth across countries make it clear that educational quality is very important to a nation’s economic health. Before discussing
The policy implications of this, however, it is important to understand the magnitude of these effects.

**The Implications of Improved Quality**

The previous estimation provides information about the long run economic implications of improvements in educational quality. These analyses provide a means for linking policy reforms directly to the pattern of economic outcomes.

Two aspects of any educational reform plan are important. First, what is the magnitude of the reform that is accomplished? Second, how fast does any reform achieve its results?

Consider a schooling reform that yields a 0.5 standard deviation improvement in average achievement of school completers. In terms of representative countries, moving average achievement in Brazil, Indonesia, Mexico, and Thailand to close half the gap with the average OECD student would be about a half standard deviation improvement.

The timing of the reform is also important. Two aspects of timing enter. First, such movement of student performance cannot be achieved instantaneously but requires changes in schools that will be accomplished over some time (say, through systematic replacement of teachers through retirements and subsequent hiring). The time path of any reform is difficult to specify, but achieving the change of 0.5 standard deviations described above for an entire nation may realistically take 20 to 30 years. Second, if the reforms succeed, their impact on the economy will not be felt until the new graduates become a noticeable portion of the labor force.

Figure 3 simulates the impact on the economy of reform policies taking 10, 20, or 30 years for a 0.5 standard deviation improvement in student outcomes at the end of
Figure 3: Improved GDP with Moderately Strong Knowledge Improvement (0.5 s.d.)
upper secondary schooling – what we label as a “moderately strong knowledge improvement.” For the calibration, policies are assumed to begin in 2005 – so that a 20-year reform would be complete in 2025.¹¹

The figure indicates how much larger the level of GDP is at any point after the reform policy is begun as compared to that with no reform. In other words, the estimates suggest the increase in GDP expected over and above any growth resulting from other factors.

Obviously, for any magnitude of achievement improvement, a faster reform will have larger impacts on the economy. But, the figure shows that even a 20- or 30-year reform plan has a powerful impact on GDP. For example, a 20-year plan would yield a GDP that was five percent greater in 2037 (compared with where the economy would be with no increase in educational quality). The figure also plots 3.5 percent of GDP, an aggressive spending level for education in many countries of the world. Five percent of GDP is significantly greater than the typical country’s spending on all primary and secondary schooling, so that it is truly a significant change that would permit the growth dividend to more than cover all of primary and secondary school spending. But even a 30-year reform program (that would not be fully accomplished until 2035) would yield more than five percent higher real GDP by 2041. Over a 75 year horizon, a 20-year reform yields a real GDP that is 36 percent higher than would be with no change in educational quality.

¹¹ The actual reform policy is presumed to operate linearly such that, for example, a 20-year reform that ultimately yielded ½ standard deviation higher achievement would see the performance of graduates increasing by 0.025 standard deviations each year over the period. It also assumes that the impact is proportional to the average achievement levels of prime age workers, based on workers in the first 35 years of their work life.
Policy Objectives

Governments generally have multiple objectives when they develop schooling policies. They generally are concerned about the economic wellbeing of citizens and the nation as a whole. But they are also concerned about the distribution of economic outcomes.

The previous analysis has suggested educational quality should be the primary focus of attention – because quality is the dominant factor affecting economic outcomes. However, the push to expand access clearly has deep roots in the distributional objective of governments by making sure that all citizens can obtain schooling. Clearly at a basic level the absence of schools means that government policy toward promoting human capital cannot be effective.

Two aspects of the distributional side of governmental schooling policy are important. First, the strong message of the existing empirical work reviewed above is that time in school has little payoff if it is not accompanied by learning. The student who attends eight years of school but comes away unable to read adequately is unlikely to reap many rewards from the schooling.

Second, the distribution of cognitive skills appears to be closely related to the distribution of earnings. Nickell (2004), employing the IALS data on international differences in literacy, finds a close association between skill variation and earnings variation. As seen in figure 4, the spread of earnings mirrors the spread of cognitive skills. Clearly this does not establish causation, but it is highly suggestive of the role of educational quality.

All of this suggests that merely erecting schools without concern for quality is unlikely to meet the human capital objectives of governments. Indeed, as suggested
Figure 4: Inequality of Educational Quality and Earnings

Earnings inequality

Test score inequality

Note: Measure of inequality is the ratio of ninth decile to first decile in both cases; test performance refers to prose literacy in the International Adult Literacy Survey.

previously, low quality schools may also make it even more difficult to increase attainment, because students respond to lack of quality.

**How Should It Be Achieved?**

The difficulty with this policy prescription is that increasing student achievement has often proved to be a difficult challenge. Policy makers around the world have taken up the pursuit of improved school quality. Sometimes it is based on concerns about the observed performance on assessments – ones like PISA that provide direct information on relative performance. Sometimes it is based simply on their instincts or on the political popularity of discussing school quality issues.

One important feature, however, pervades much of the existing reform discussion. Historic reform policies have generally been expensive, but they have not led to widespread improvements in student performance. The existing evidence suggests that common improvement strategies center on such things as increasing teacher qualifications or reducing class size do not have a powerful effect on student outcomes (see discussion in Hanushek (2003)). Although clearly controversial, the past analyses of resource policies do not indicate that continuation of these as a very hopeful way to achieve student performance increases.

One possible explanation for past failure, supported by research into the determination of achievement, is that insufficient attention has been given to teacher quality. By many accounts, the quality of teachers is the key to student performance. But the research evidence suggests that many of the policies that have been pursued have not been very productive. Specifically, while the policies may have led to changes in
measured aspects of teachers, they have not improved the quality of teachers when identified by student performance.\textsuperscript{12}

The strong conclusion from current research is that evaluations of teacher quality must be based on student outcomes. Output based measures of teacher quality are rather new, and they are nonexistent for research outside of the United States. Thus, this part of the analysis is based entirely on the U.S. teacher market and the quality distribution found there.

Rivkin, Hanushek, and Kain (2005), in a study of students across the state of Texas, describe estimates of differences in teacher quality on an output basis. Specifically, the concern is identifying good and bad teachers on the basis of their performance in obtaining gains in student achievement.\textsuperscript{13} The analysis provides direct estimates of the distribution of teacher quality: One standard deviation in teacher quality is at least 0.11 standard deviations of annual growth in student achievement.\textsuperscript{14} A second study of schools (Hanushek, Kain, O'Brien, and Rivkin (2005)) obtains even larger estimates: between 0.15 and 0.18 standard deviations of student achievement growth.

\textsuperscript{12} For a review of existing literature, albeit largely for developed countries, see Hanushek and Rivkin (2004). This paper describes various attempts to estimate the impact of teacher quality on student achievement.

\textsuperscript{13} An important element of that work is distinguishing the effects of teachers from the selection of schools by teachers and students and the matching of teachers and students in the classroom. In particular, highly motivated parents search out schools that they think are good, and they attempt to place their children in classrooms where they think the teacher is particularly able. Teachers follow a similar selection process (Hanushek, Kain, and Rivkin (2004)). Thus, from an analytical viewpoint, it is difficult to sort out the quality of the teacher from the quality of the students that she has in her classroom. The analysis of teacher performance goes to great lengths to avoid contamination from any such selection and matching of kids and teachers.

\textsuperscript{14} The analysis uses annual test score data on all public school students in the State of Texas. Several entire cohorts of students (over 200,000 per cohort) are tracked across time. To deal with selection, it concentrates on differences among teachers within a given school in order to avoid the potential impact of parental choices of schools. As such, it is very much a lower bound estimate on differences in teacher quality.
By the low estimate, having a “good” teacher (one standard deviation of quality above the mean) as compared to the average teacher quality would lead the average student to move up over four percentile points in the year. If a student had a good teacher as opposed to an average teacher for five years in a row, the increased learning would be sufficient to close entirely the average gap between a typical low income student and a higher income student in Texas.

These estimates of the importance of teacher quality permit calculations of what would be required to yield the reform results discussed earlier. Specifically, consider what kinds of teacher policies might yield a 0.5 standard deviation improvement in student performance. The specific policy considered is the replacement of current teachers with higher quality teachers.

The implications for policy depend crucially on two factors: how fast is reform accomplished? and how much change can be introduce into the schools in any year? In order to improve student achievement, teacher quality would have to improve on average from the current level. This is necessarily a time consuming plan, because it involves replacing typical teachers of today with teachers that are higher quality.\(^{15}\)

To be concrete, consider two different scenarios. In the first, only 5 percent of existing teachers are replaced each year; in the second, 15 percent are replaced. Then, linking to the planning horizons in Figure 3 (i.e., reforms accomplished in 10, 20, or 30 years), it is possible to be very explicit about the quality of teachers that must be hired.

To obtain an improvement of student outcomes of \(\frac{1}{2}\) standard deviation within 10 years with the lower teacher turnover rate would require hiring at the 65\(^{th}\) percentile of

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\(^{15}\) The discussion presumes that quality improvements require changing the stock of teachers. It is possible that this could be done through professional development and training of existing teachers, but currently available evidence does not suggest that such an approach would be very effective.
the quality distribution. This drops to the 55\textsuperscript{th} percentile if it is possible to turnover 15 percent of the teachers each year. Both of these seem terribly ambitious.

If the planning horizon moves to 20 years and if it is possible to turnover 15 percent of the teachers each year, one needs hire at just the 52\textsuperscript{nd} to 53\textsuperscript{rd} percentile of teachers each year.\textsuperscript{16} This hiring seems more realistic, but it takes a longer policy commitment – something that itself might take effort.

**Is the Evidence Relevant for Developing Countries?**

The question of course is what portion of this evidence is relevant for India or other developing countries. We know, for example, that the developing world is noticeably behind the rest of the world in terms of simple school enrollment rates. Table 2 provides recent information on net enrollment rates in primary school and gross enrollment rates for tertiary schooling. Developing countries are significantly behind others at primary school and, not surprisingly, this gap expands by tertiary schooling.

India, by recent estimates beats the developing world in primary school enrollment (an estimated 89.7 percent versus 84.6) but actually does worse in terms of tertiary school enrollment (11.8 percent versus 16.2 percent in the rest of the developing world) (see UNESCO (2007)).

Don’t these numbers indeed show that the access and attainment problems should be paramount?

The answer again is that low quality schooling appears to confer few benefits. And the quality issue is real. For a selection of developing countries, Hanushek and Wößmann (2006) calculate the proportion of recent students who both finish grade 9 and are minimally literate by OECD standards on the PISA tests. These calculations

\textsuperscript{16} Note that these calculations assume a moving quality target, because each year the distribution of teacher quality is shifting up.
Table 2. Enrollment Rates by Development Status, 2004

<table>
<thead>
<tr>
<th></th>
<th>Net enrollment rate (primary school)</th>
<th>Gross enrollment rate (tertiary school)</th>
</tr>
</thead>
<tbody>
<tr>
<td>World</td>
<td>85.8</td>
<td>23.7</td>
</tr>
<tr>
<td>Countries in transition</td>
<td>90.7</td>
<td>54.2</td>
</tr>
<tr>
<td>Developed countries</td>
<td>95.8</td>
<td>64.9</td>
</tr>
<tr>
<td>Developing countries</td>
<td>84.6</td>
<td>16.2</td>
</tr>
</tbody>
</table>

Source: UNESCO (2007)
suggest that less than ten percent of 15-19 year olds achieve that level in Ghana or in South Africa or in Brazil. Less than 15 percent meet that standard in Peru, even though almost half of the population does complete grade 9.

Thus, by all accounts, efforts to expand school attainment – which have been significant in recent years – may do little to meet the human capital goals of many developing countries. On this message it appears clear that the research pertains directly to developing countries.

India has not participated in any of the international tests since the early 1970s. Thus, it is difficult to benchmark Indian performance in terms of developed or developing countries of the world.

The larger issue is whether policy implications revolving around teacher quality hold for developing countries. The evidence on the magnitude of teacher quality differences comes directly from the United States. While it has been essentially duplicated in other analyses, little is available for the developing world.\(^\text{17}\)

We do know that the lack of relationships between student achievement and common measures of teacher quality is quite consistent across developed and developing countries (Hanushek (1995); Hanushek (2003)). But that does not establish the impact of variations in teacher quality or the appropriate policies that might be followed. Harbison and Hanushek (1992) do show that, at least for poor areas of Brazil, common teacher measures – such as school attainment of the teachers – bear little relationship to student outcomes even when observed at very low levels. They also indicate that there are huge variations in performance across individual teachers and classrooms, although a portion of this could reflect the composition of students in the classroom.

\(^{17}\) For other related works on teacher quality, see Hanushek and Rivkin (2007).
Nonetheless, the research (and policy) challenge is establishing what drives performance in developing countries such as India and what can be done to alter the current state.

**Conclusion**

Virtually every government is concerned about investments in human capital. These objectives must be put within context, because schooling is different from many publicly provided goods. First, schooling has direct implications for individual outcomes, for national aggregate outcomes, and for the distribution of outcomes across society. Thus, there is a direct economic relationship between government spending and the returns on investments. Second, schooling is not a homogenous commodity but varies considerably in quality. The simple message of existing research is that the quality dimension is overwhelmingly important. Third, policy toward schools is heavily laden with politics that emanate both from students and parents and from teachers and school personnel, making the explicit policies quite contentious at times. It is ultimately very important that countries pursue policies that are successful, even if they may be less popular in the short run.
References


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