

GALLUP PRESENTS ...

Technology and Education

The Power of the Personal Computer

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In most cases, the assumption that wealthy countries tend to have better education systems than poorer countries is correct. However, the association between national wealth and educational achievement scores is far from perfect. The United States, for example, ranks near the top of Organisation for Economic Cooperation and Development (OECD) countries in GDP per capita, but it typically ranks closer to the middle of the pack in academic assessments.

Studies have shown that factors other than the wealth of a country also matter for educational attainment; for instance, the degree to which the state prioritizes education and the level of the country's income inequality both have significant effects on education. Our report, on the other hand, illustrates the educational advantage bestowed by access to computers. The evidence indicates that the level of computer propagation in a country is strongly associated with its students' scores on the Programme for International Student Assessment (PISA), a standardized international test.

The Problem: How to Educate a Planet

Education researchers, government officials, and the international development community often have different ideas about the best approach to improving educational attainment across the globe. Two prominent contemporary approaches to improving education in developing countries are the United Nations Development Programme's (UNDP) longstanding goal of establishing universal primary education (UPE) and Nicholas Negroponte's more recent and equally controversial One Laptop per Child (OLPC) program. These programs represent two very different approaches to improving education. The UPE approach is traditional and straightforward; its goal is to place more youth into classrooms. The other approach—giving students special laptops—is high-tech

and experimental.

Among educators, comparing UPE and OLPC has sparked intense debate over the fundamental efficacy of their two distinct approaches to education. Critics of the UPE program have argued that its goal is unrealistic and inefficient; they propose that adolescent and adult education is a more cost-effective way of improving functional education in developing countries. Advocates of UPE counter that many of today's prospering "middle income" countries, such as China, Chile, Singapore, and Uruguay, were once poor countries that made strong commitments to universal primary education. In other words, nothing else has yet been proven as effective as UPE, and it is the necessary standard against which other approaches must measure.

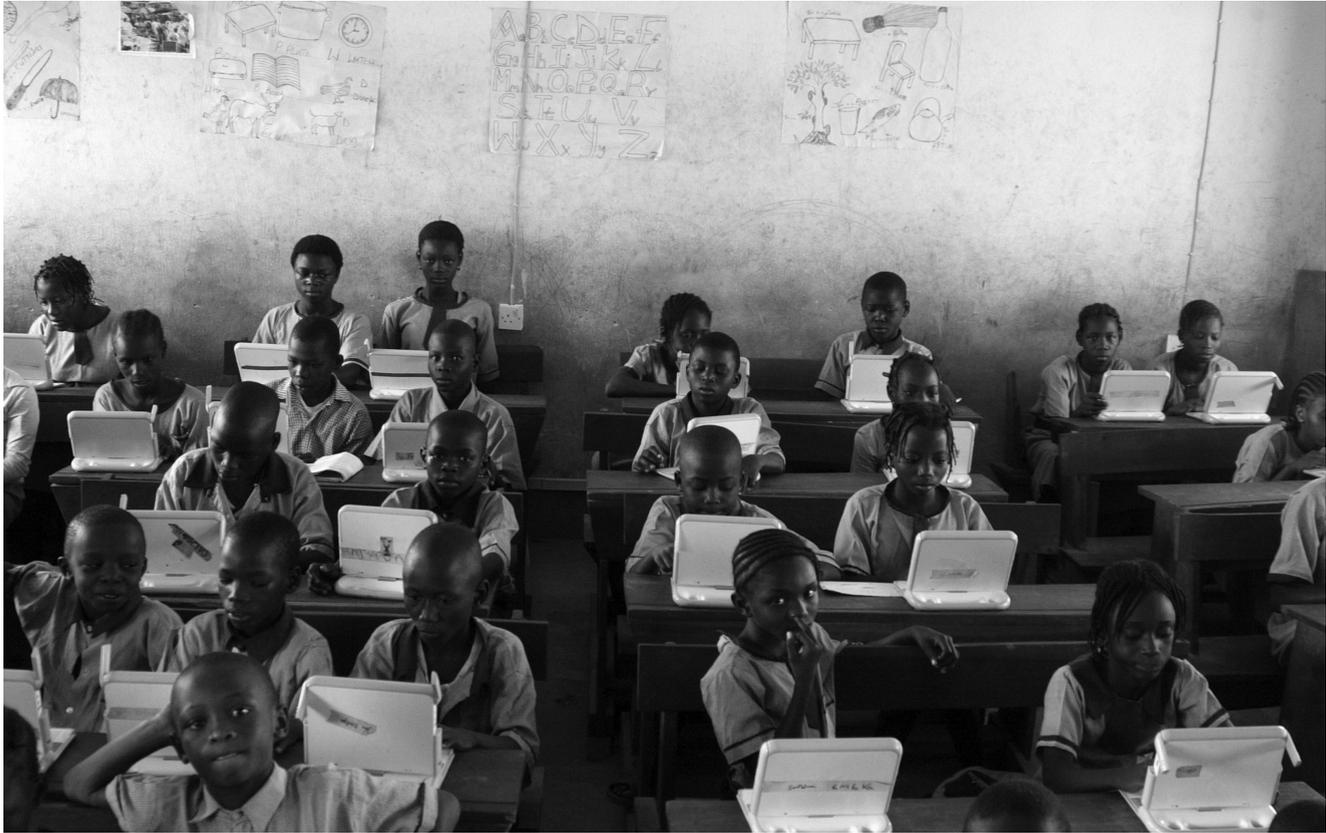
The OLPC program also has many critics. They argue, for example, that building schools and libraries should be a bigger priority than providing computers. Negroponte and other advocates of the OLPC program have countered that the XO-1 machine, the centerpiece of the OLPC program, is specifically designed to operate effectively even in places where there are no classrooms. For example, the XO-1's screen is clearly visible even in bright sunlight, and the XO-1 is roughly 25 times more energy efficient than traditional laptops. Other critics have argued that despite OLPC's best intentions, the laptops will end up on the black market while poor children continue to go without pencils or paper. It appears to be too early to assess the gravity of this second problem.

Policymakers trying to assess the relative value of programs such as UPE and the OLPC need to understand the social, physical, and economic forces that fuel educational attainment. Designing better educational systems requires identifying the variables associated with exemplary educational performance.

Predictors of Educational Attainment

In 2006, the OECD administered the third PISA assessment across 57 countries that spanned the range of different levels of socioeconomic development. PISA scores are based on tests of reading, mathematics, and science, with emphasis on both abstract knowledge and real-world application. Combining country-level PISA results with other rich, multi-country data sources, such

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Students in Abuja, Nigeria, learn with the aid of computers provided by the One Laptop Per Child initiative. Regression analyses have identified computer penetration as a significant indicator of educational achievement.

as Gallup's World Poll and the World Bank's World Development Indicators, offered an opportunity to identify the country-level variables most strongly associated with higher educational attainment.

For the current analysis, we tested several possible development indicators as predictors of country-level variation in PISA scores. For instance, we assessed whether higher primary school enrollment rates—typically assumed to be correlated with higher PISA scores—were still associated with higher PISA scores after controlling for a country's wealth, as advocates of the UPE program might assume. In addition, to explore the validity of the arguments presented by advocates of OLPC, we tested whether students perform better in countries where more people have computers in their homes, controlling, again, for per capita GDP. Answering these questions provided key insights into which educational policies and programs are most likely to be effective.

A multiple regression analysis allowed us to systematically compare countries that are highly similar in GDP levels but which vary in their level of educational attainment. Few readers will be surprised to learn that, holding the other three predictors constant, wealthier countries perform significantly better on the PISA test than poorer countries. Very surprisingly, however, we found that enrollment rates are not uniquely associated with educational

attainment. That is, so long as one compares countries that are equally wealthy, similar in perceptions of learning opportunities, and equal in computer penetration, there is no educational advantage at all for countries where total educational enrollment is higher. Advocates of UPE might counter (correctly, as it turns out) that PISA scores are only one indicator of a nation's educational achievement. Indeed, when we examined adult literacy rates, a more basic form of achievement in these same data, we did observe a significant, unique effect on literacy from higher enrollment rates. Thus, we suspect that if we had examined more advanced variables for educational achievement (such as world rankings of a nation's most elite universities), we would have observed, as in the case of using PISA scores, weak or non-existent effects of enrollment.

The most important finding from the analysis, is that the Gallup measure of computer penetration is a unique predictor of educational attainment. Holding all the other variables constant, students in countries where more people own computers performed better on the PISA test. Follow-up analyses suggested that this effect was not merely a reflection of a country's relative level of technological development; for example, replacing computer penetration rates with cell phone penetration rates did not yield a significant effect. This suggests there may be something unique about computer ownership that goes

hand in hand with higher educational attainment.

Although it is difficult to say definitively why greater access to computers is related to greater educational attainment, two possibilities are particularly noteworthy. First, as advocates of the OLPC program argue, computers are powerful learning tools, bringing information to students' fingertips and allowing them to interact with it and synthesize it in ways that would be impossible otherwise. Second, once GDP is held constant, the level of computer penetration may indicate the degree to which a given population values knowledge or education. Countries in which more people choose to purchase computers may be countries in which more people value learning over other social priorities.

For several countries with high levels of PC penetration, including South Korea and New Zealand, average educational attainment is significantly greater than their GDP levels would otherwise predict. For others such as Belgium, however, GDP is a better predictor of PISA scores than is PC penetration. Thus, considering both PC

on education in a country. Finland, for instance, is a positive outlier in our model. Finns are not exceptionally rich – their per-capita GDP is only about three-quarters that of the world's wealthiest countries – nor are they among the countries with the highest levels of PC penetration. However, Finns place a very high social value on education. It is free at every level, from kindergarten to graduate school. Teachers are highly respected and reasonably well-paid. Moreover, children are not tracked based on perceived competencies. Instead, the educational system expects all children, regardless of background or family income, to perform at a very high level.

Moreover, even assuming that computer penetration itself leads to higher PISA scores in the 48 countries studied, the results may not be fully generalizable to the rest of the world. The strongest predictors of educational attainment may not be the same for the more developed OECD countries as they are for highly impoverished countries. For instance, an implicit premise of the OLPC program is that, just as it is more beneficial to feed the hungry than

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penetration and GDP simultaneously provides the most accurate prediction of PISA performance.

Among the few countries which do not fit this model very well is the United States, where mediocre international test scores relative to the country's high GDP have been a regular source of concern. There has been no shortage of theories addressing this issue, but among the most prominent is the relatively inequitable distribution of resources between the haves and the have-nots in American society. American children in affluent areas perform as well as children anywhere in the world, while those in impoverished neighborhoods on average do more poorly, lowering the overall country average.

Caveats and Conclusions

Although our analysis enables the identification of variables that are uniquely associated with educational attainment, it cannot establish causation between the variables and educational attainment. For example, without knowing whether increases in PC penetration tend to precede or follow increases in educational attainment, we cannot say for sure which variable is driving the other. It may well be that the arrow points in both directions: Computers do facilitate education, but being well-educated may also facilitate the ownership and use of computers.

Furthermore, the two variables we considered in this analysis may be proxies for a more overarching, better predictor of education, such as the “social value” placed

to feed those who are already well fed, it is probably most beneficial to bring kid-friendly laptops to students who otherwise have very limited access to educational tools and opportunities. On the other hand, bringing laptops to the world's poorest children could be the educational equivalent of delivering cans of food to people who have no can-openers. Perhaps increasing access to computers is most effective in high to middle income countries, where students have sufficient resources to take full advantage of what computers offer.

Such caveats notwithstanding, these data strongly suggest that educational leaders and policymakers should pay more attention to the role of computers and information technology in facilitating educational development. Despite the commendable efforts of OLPC advocates, there are only a small handful of places where XO-1 laptops have been distributed in large enough quantities to yield even a preliminary assessment of the potential benefits of the OLPC. Thus, it is not yet clear whether the vision of Negroponte and his associates will translate into better educated children throughout the globe. It is clear from our data, however, that naturally occurring rates of computer access are uniquely associated with educational attainment. This suggests that the ability of today's children to participate fully in tomorrow's global economy may be enhanced by efforts to provide them with the technological tools that have so powerfully shaped the modern economic and educational world. ■