# The skills that matter in the race between education and technology


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The threat of automation implies a race between education and technology.[1] In most developing countries, education systems are not providing workers with the skills necessary to compete in today's job markets. The growing mismatch between the demand and supply of skills holds back economic growth and undermines opportunity. At the same time, the returns to schooling are high in most developing countries, and growing skill premiums are evident in much of the world.[2] Automation simultaneously results in deskilling and a need for new skills, and is changing what education will need to look like in the future.

To promote success in today's labor market, countries need to invest early, and then in relevant skills. Education systems that do well prepare children early on, reform continuously, and use information for improvement. High returns suggest it makes sense to expand higher education as well. The three biggest policy priorities for governments, investors, and the development community include:

1. Focusing on basic skills, early childhood development (ECD), and measuring and improving early reading
2. Giving opportunities to workers to invest in relevant skills that make them benefit from, and remain immune to, automation
3. Using evidence from labor market returns to education to implement financial innovations—and use future earnings to finance higher education

## Robots are coming!

Depending on whom you listen to, automation, robotics, and artificial intelligence (AI) will either solve all our problems[3] or end the human race.[4] The idea that automation could lead to a life of

leisure took on new meaning when Swiss citizens voted recently on a referendum for a guaranteed income. The initiative lost but there are several others being planned, including a trial this summer in Utrecht. A motivating force behind these initiatives is the belief that robots will take so many jobs that many people will be rendered unemployable.

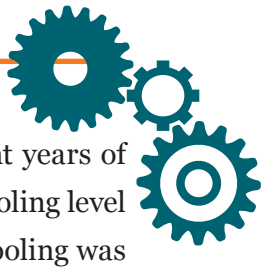
Sometime in the near future, machine intelligence is predicted to surpass human intelligence, a point in time known as "the singularity." Whether the rise of the machines is an existential threat to mankind or not, there is a more mundane issue: Robots are currently being used to automate production. There are more than 300,000 industrial robots in operation in Japan and another 200,000 in North America.[5] Economist Richard Freeman argues that robots can be a substitute for workers, even highly skilled professionals.[6] And MIT professors Erik Brynjolfsson and Andrew McAfee suggest that as computers get more powerful, companies have less need for some kinds of workers.[7]

To grasp how susceptible jobs are to computerization, one need look no further than the United States, where it is estimated that 47 percent of employment is at risk due to automation and technological advances.[8] A strong negative relationship is predicted between wages and the occupation's probability of computerization. In other words, the effect of computerization will not be confined to routine tasks; rather, new technology will be able to substitute for labor in a wide range of non-routine cognitive tasks. Workers in transportation and logistics occupations, together with the bulk of office and administrative support workers, and labor in production occupations, are at risk. Computerization will also create jobs, and highly skilled workers will be needed to work alongside technology. In other words, it is likely that some jobs disappear and others will be created as a result of the same technological revolution. The prospect of a more precarious work environment due to technology is what the "race between technology and education" is about.

Automation could have a bigger impact in developing countries. If computerization makes high-income countries more self-sufficient—less offshoring and more "reshoring"—then developing countries may lose their wage advantage. AI also offers an advantage for high-income countries since they are more likely to own the patents. Employment in manufacturing is already peaking in many developing countries, due precisely to the fact that manufacturing is much more automated these days. Besides slowing employment growth, automation may also increase income inequality. Technological disruption is widely being debated in industrialized, high-income countries. However, policymakers in developing countries need to start worrying about the impact of automation as well.

## The returns to schooling are high, but the quality of schooling is low

Despite the growth of education systems, the returns to schooling are still high, and in some cases still rising. There has been a tremendous increase in education attainment in recent decades. In



2010, the world population aged 15 and above is estimated to have an average of eight years of schooling, having increased from just over five years in 1980.[9] In 1950, the average schooling level of the population in advanced countries was six years; it is 10 years today. Average schooling was less than two years in sub-Saharan Africa in 1950; it is more than five today. Globally, in 1900, people had less than two years schooling on average; only two years by 1950, but more than seven by 2000, and are projected to have more than 10 by 2050—a more than five-fold increase in a century and a half.

More education leads to higher earnings. Economists measure this as the rate of return to education, which equates to the value of lifetime earnings of the individual to the net present value of costs of education. For an investment to be economically justified, the rate of return should be positive and higher than the alternative rate of return. The global average rate of return to investment in one extra year of schooling is 10 percent. There are also high social returns to primary schooling, with the highest returns in sub-Saharan Africa. The rate of return to schooling for women is 12 percent versus 10 percent for men. Returns to primary schooling are just above 10 percent, returns to secondary schooling are seven percent, while returns to university schooling are 15 percent. Average schooling has increased by 2 percent per year while the returns to schooling have declined by only 0.1 percent, making education is a good investment globally.

The high returns to schooling are due to demand, given global competition for skills; and supply, since the poor quality of education in many countries places a premium on scarce skills. Thus, for policymakers, it makes sense to expand schooling. Policymakers could use the returns evidence to guide their investments; for example, further expansion of university education appears to be very worthwhile for the individual, meaning that governments need to find ways to make financing available. Also, high rates of return are generated by investing in girls' education. But given the low quality of schooling in many countries, the expansion of schooling at any level must be guided on information about quality. After all, the demand is for skills that enhance productivity. Therefore, policies should focus only on expansion of quality schooling, measured by high cognitive and non-cognitive scores.

Returns to schooling vary around the world. Some countries are doing very well because of their investments in schooling, while others are struggling. Workers' ability to reap the benefits of schooling is handicapped by the poor performance of traditional education systems in much of the developing world. Schools in many developing countries are failing to teach basic skills like reading and math. In some developing countries, early grade reading tests reveal that only low proportions of primary school students can read a simple sentence with ease and comprehension.

The picture is bleak in middle-income countries as well. Only four percent of 15-year-old students in lower middle-income countries and only 13 percent in upper middle-income countries are

proficient enough in math to succeed in further education and in work. By contrast, 32 percent of students from Organization for Economic Cooperation and Development (OECD) member countries are proficient. A majority of students in middle-income countries are functionally illiterate.

Technology rapidly changes the workplace and the skills demanded, immediately making current workers less employable. Meanwhile, education systems are slow to change in terms of the creation of new skills.

## There is a critical skills gap

As the demand for new skills increases, the challenge will be to anticipate what those skills might be. For some the answer is science, technology, engineering, and mathematics (STEM) skills as well as coding so that people can develop or work with the technology. But an alternative approach is to think about the kind of work that technology cannot replace. The Oxford Martin School studies on the vulnerability of jobs to automation point to those that draw most on creative and social skills, and complex perception and manipulation. Future workers need to make themselves "immune" to automation as much as possible. But this does not mean that basic skills do not matter. In fact, we are seeing high returns to cognitive skills, especially non-routine skills. These skills can be summarized as follows:[10]

- Problem-solving skills to think critically and analyze
- Learning skills to acquire new knowledge
- Communication skills, including reading and writing
- Personal skills for self-management, making sound judgments and managing risks
- Social skills for collaboration, teamwork, management, leadership, and conflict resolution

Automation implies both deskilling and the need for new skills. For many developing countries, nurturing basic skills remains the most urgent priority. Early reading fluency is paramount, since in the digital economy lifelong learning becomes the key to success. Assuming education systems in developing countries do master the delivery of basic skills any time soon, anticipating what relevant additional skills are needed is a challenge.

Further, skills needed for success are not likely to come from the usual sources. Occupational skills are too often assumed to be what vocational systems produce. Yet all too often, vocational education systems are removed from the world of work. Vocational education in many developing countries can be a "dead-end" schooling track and is often the second choice of students.

Technology not only shapes what skills are in demand, but also how skills may be acquired. It is changing the way we teach—scripted lesson plans in many low-income countries facilitated by

technology; higher levels of accountability with technology, such as teacher monitoring; better flow of assessment information; and online courses (massive open online courses, or MOOCs).

The new model of education to emerge from the technological revolution is not yet known. MOOCs may not replace the traditional university teaching model, but they do have tremendous potential in the world where lifelong learning is valued. In the developing world, technology may well be a force for increased accountability and the production of skills, including teacher training.

## Invest smartly by investing in education systems

The most promising models of education and training that can deliver basic and new skills focus on the elements of effective education systems. Systems that do well prepare children early on, reform continuously, and use information for improvement and accountability.

Education systems reforms are needed in many countries. The following six are necessary components to achieve such reforms:[11]

1. Assessment: Measurement is the cornerstone of education planning and reform aiming to improve quality. Countries that are unable to determine where their education system stands currently will find it difficult to make improvements or to reach their goals. One example of success in this area can be found in Jordan, where use of international tests for benchmarking and the use of feedback loops led to impressive gains.[12]
2. Autonomy: Empowering schools will support quality improvements. This includes giving them ownership, resources, and voice.
3. Accountability: Accountability increases time on task and academic achievement. An accountability-based system usually entails a shift of decision making authority from the government to the community, which is represented by school governing boards and integrated by teachers, parents, and community members.
4. Attention to teachers: Studies across the world show that a good teacher—one that adds value to the learning process—can be effective in helping students to improve their learning outcomes. The top-performing school systems recruit their teachers from the top third of each graduate cohort.
5. Attention to ECD: Such programs may be the most cost-effective investment. Empirical evidence demonstrates that quality ECD interventions increase educational success and adult productivity, and decrease public expenditures later on, as in the case of Jamaica.[13]
6. Attention to culture: Culture is important and often neglected. The use of the mother tongue as the language of instruction is one cultural area frequently disputed in many countries. In many countries, a significant number of students do not speak the national language in the home, which has practical implications for education. Schools using mother tongues as the

language of instruction have higher attendance and promotion rates, and lower repetition and dropout rates.[14]

To improve learning outcomes and prepare students for the world of work, countries must develop a system to determine current learning levels and future learning aims. Policymakers need to consider each aspect of the education system in defining an appropriate reform that will provide an inclusive and holistic approach to improving education outcomes.

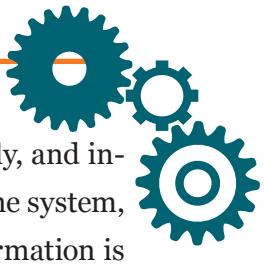
## Focus on results

The new focus on skills will require new investments in education. Many developing countries must expand enrollments while ensuring quality at the same time. New sources of financing will be needed. While more efficient use of existing resources will help, aid, public-private partnerships, and innovative financing are needed. The development of skills can be financed to a large extent through reallocations of spending priorities and innovative financing.

High returns suggest it makes sense to expand higher education opportunities based on efficiency and equity. High *private* returns suggest that the investment is worthwhile for students and that public subsidy is not needed. However, it is difficult for many to borrow for education, which keeps a good university education out of reach for many. This in turn limits the potential social benefits that could be derived if higher education were more equitable.

Given these constraints, some level of public intervention is justified. Governments can offer student loans to those in financial need, but typical student loans are unsustainable and penalize graduates too much. It would be better to factor estimates of graduates' future earnings into the design of financial support for students. This would amount to income contingent loan programs that base future payments on the earnings of graduates. Those who earn more, pay back their loans faster. Those experiencing difficulties finding high paying jobs pay back their loans in smaller increments over a longer period of time, or have their debts forgiven. Income contingent loans, which are available in several countries (Australia, Chile, Ethiopia, England, Hungary, Korea, New Zealand, and South Africa), require payments based on income until the loan is repaid.

A more private sector approach might involve human capital contracts—or income share agreements, where payments depend on income until the repayment period ends. Human capital contracts are a means of financing education through which investors finance students' expenses in exchange for a percentage of students' future earnings. One company, Lumni, already provides such contracts for 7,000 students in Chile, Colombia, Mexico, and Peru. The percentage of income and duration of payments is based on students' expected earnings. Upon graduation, each student then pays a certain percentage of income for a certain number years for each $1 of support received.



But at every level of schooling there is a need for information to guide individual, family, and institutional investments in learning. At the compulsory level, it is useful for improving the system, implementing accountability, and informing choice. At the higher education level, information is needed to improve efficiency and equity. One of the challenges in most countries is getting the disadvantaged to stay in school and to apply for higher education. Even in the United States, where the returns to education are high on average, great variation exists, even if the *average* university graduate will earn 67 percent more than a high school graduate.[15] For those who attend some college but drop out, earnings differences do not justify the decision to enroll. There must be better information for such students and greater support networks to help them take on the challenge of college.

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