

## **The Future of Education in the Age of ICTs and Robotics**

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Recent advances in information and communication technologies (ICTs) and the acceleration of automation continue to transform the nature of work and workplace. Robots will quickly replace human for routine and repetitive tasks. For example, South Korea's manufacturing sector has the highest density of industrial robots in the world with 631 multipurpose robots for every 10,000 workers, while it struggles with a fall in employment in the manufacturing sector and a high youth unemployment. Jobs in the US industries decreased due to the increased use of robots as presented in Daron Acemoglu and Pascual Restrepo's study. A study by Carl Frey and Michael Osbornes estimated that, 47 percent of jobs in the United States were at risk of automation over the next 15 years. Deeper integration of robots and artificial intelligence (AI) into everyday lives raises concerns about the future job opportunities.

On the other hand, however, technological progress can create new jobs. The development of motor vehicles drove horse-drawn carriages and related jobs to go extinct, but generated millions of factory jobs as well as in the fields of road construction and tourism. Studies show that robots improve workers' productivity and wages while not significantly reducing total employment. Also, a recent study using Japanese data provides evidence for positive impact of robots not just on productivity and wage, but also on employment.

The production and utilization of advanced technologies requires new skills that cannot be just granted. The race is on between skills and technology—and the outcome will determine whether the dividends from new technologies are realized and the benefits widely shared.

Preparing current and future workers for adequate skills is essential for fostering inclusive labor markets. The recent increase in inequalities of job opportunities and wages that many countries experienced was due to the gap between those who have skills that can make productive use of new technologies, and the others who do not have skills in new technologies.

Education has a vital role in meeting the current and future demands of the labor market in the age of AI and robots. It must ensure that everyone has the right skills to command and complement with new technologies. It can also help workers develop a broad range of skills—

not just technical skill but also non-routine cognitive and interpersonal skills such as the 4Cs (critical thinking, creativity, collaboration and communication).

Current education falls far behind technological progress in many countries. Formal education systems often fail to produce graduates with both adequate skills and technical competencies relevant to the labor market. According to a 2015 report by the Economist Intelligence Unit (EIU), 64% of executives surveyed were dissatisfied with the level of attainment of young employees and 52% pointed out a skills gap as an obstacle to the firm's performance. Meanwhile, only 44% of the students aged 18 to 25 believed that their education system provided adequate skills.

Education system should be reformed to prepare today's youth for the "skills of tomorrow". Basic education must be designed to equip all students with basic ICT skills as well as solid cognitive skills and abilities to use ICTs effectively. Good-quality basic education early in the life-cycle helps students to start off with a higher stock of human capital so that they can reap more benefits from subsequent education, skills training and labor market participation.

Upgrading quality of teachers (and school administrators) is a key factor to improving learning outcomes at schools and skill training programs. Teachers should be well-trained and qualified. Along with pecuniary and nonpecuniary incentives to stimulate the teachers' motivation for training, continuous, long-term investment in their professional development is necessary for building a quality teaching force. In addition, improving flexibility in curriculum design will make education and training programs more responsive to changing technologies and market demand.

Lifelong learning is essential in the era of ICTS and robots. Through lifelong learning, workers must keep their skills up-to-date with new technologies. With the strong incentives for employees and firms to re-skill and up-skill in response to the rapid technological change, workers need to take continued learning opportunities voluntarily. One way to promote lifelong learning is to give workers vouchers that they can use to pay for training across multiple jobs rather than just for building specific job or company related skills. Ensuring access to lifelong learning through various channels including private firms and trade unions alongside government support would be helpful.

A wider use of ICTs can help make quality education and training inclusive. Although the evidence using data from OECD survey shows limited and mixed impact of ICT use on improving learning outcomes, ICTs have great potentials for enhancing the delivery of education and skills training. In the 2015 EIU report, only 28% of secondary school students think that their school is actively using technology in lessons. To facilitate the potentials that ICTs bring, improvement in education system, including availability of ICT-related school materials, new curriculum and teacher quality, must come together. Various forms of ICTs in the classroom including distance learning, online learning communities, and access to vast educational resources possibly expand access to quality-education and -skills training. Like the MIT OpenCourseWare and my experience in teaching students at both Korea University and Peking University via video conferencing, students around the world can reach teachers in advanced countries using ICT.

In this new age, a role of education in equipping workers with future skills must be highlighted. Moreover, new technologies can provide flexible, life-long learning opportunities through formal and informal channels worldwide.