Education and the economy of the future

Technology is a key element in the improvement of people's living standards: it is thanks to technology that we live longer and healthier lives, that we work fewer hours and that we enjoy whims that not even our grandparents could have imagined. Yet, despite all this, we are still scared by the effects that the machines of the future may have on our lives. The reason for this is that, despite the clear benefits of technology, its adoption can lead to significant costs in the short and medium term.

These costs could be bigger in the current phase of technological revolution. Big data, artificial intelligence or the new age of hyper-connected robotics could be transformations that prove even more disruptive than those of the previous three innovation waves of the past.[1] By way of illustration, several empirical studies provide estimates on the jobs that could be potentially affected or lost due to the new wave of automation. Even the most conservative estimates suggest a considerable impact: between 10% and 50% of current workers worldwide will be substantially affected.[2]

Institutions as a force for enhancing profits and controlling costs

Daron Acemoglu, an expert in political economics at MIT, and Andrew G. Haldane, chief economist at the Bank of England, consider that technological advances (or «ideas», in the words of Haldane) need another ingredient in order to make a substantial positive and lasting contribution to economic growth: institutions that aim to enhance the benefits of technological advances, but also mitigate their costs.[3]

- To the extent that this new industrial revolution marked by the digital economy has the potential to be enormously disruptive, our institutions will need to incorporate changes that are also disruptive in most areas: education, labour, tax and regulation, among others (see «The data revolution: competition and responsible use» in this very Dossier for a discussion of regulation relating to competition).

The table below provides a summary of some of the needs and proposals for change in the field of education and labour. In the rest of the article, we will focus in detail on the educational field.

Educating in creative, social and emotional aspects... without forgetting knowledge... and throughout life

The education system is one of the institutions that will need to undergo the biggest changes. The acquisition of knowledge will be marked by two overarching trends: demography and the nature of the technological revolution. Although the focus of this

Institutions: proposals for change

Field of action	Change towards...	Proposals
Education	• Interdisciplinary. • Intergenerational. • Greater balance between knowledge, creativity, social and emotional skills. • Closer relationship with the workplace.	• Promoting creativity at all times. • Education from 0 to 3 years (key in emotional and social development). • Higher studies: – more interdisciplinary studies – accessible to different ages – with the option of shorter and more flexible programmes.
Labour market	• Greater balance between flexibility and security. • Greater emphasis on continuous training. • Closer relationship with the field of education.	• Managing the new types of workers that appear (as a result of technological change), with certain labour and social rights: increased social security coverage, the right to collective bargaining, etc. • Individual Activity Accounts (Austrian system). • Reduce differences in the level of protection between the different types of workers. • Active policies that encourage continuous education in companies, with shorter programmes that also facilitate transitions between jobs. • Training allowance.

Source: *CaixaBank Research.*

1. See E. Brynjolfsson and A. McAfee (2014). «The second machine age: Work, progress, and prosperity in a time of brilliant technologies». WW Norton & Company.
2. See Adrià Morron (2016). «Will the Fourth Industrial Revolution come to Spain?» in the MR02/2016, for the case of Spain, based on C.B. Frey and M.A. Osborne (2017). «The future of employment: how susceptible are jobs to computerisation?». Technological Forecasting and Social Change, 114, 254-280.
3. See D. Acemoglu and J. Robinson (2012). «Why nations fail: The origins of power». Prosperity, and Poverty, 2. And also A.G. Haldane (2018). «Ideas and Institutions – A Growth Story». Speech at the Guild Society on 23 May 2018.

article is on the technological revolution, the extension of life expectancy will no doubt lead to an extension of our working lives, so continuing to learn throughout our lives will be essential.

By focusing on the second trend, the nature of the technological revolution, in a world of «thinking machines», the workers of the future must have a greater balance between knowledge, creativity and social and emotional skills:

- Machines will be able to solve a large number of problems, but solving complex problems will still be left to humans. Abstract and creative thinking will be essential in solving these complex problems.

  An example of this can be found in the confrontation between the supercomputer AlphaGo and the grand master of the highly complicated game of Go, Lee Sedol. Although AlphaGo won overall in the five games they played, the fourth game teaches us the importance of human creativity. In move number 78, Lee Sedol took a decision that was completely unexpected by the machine and by most experts of the game. It was a rather rare move (and, therefore, unlikely according to the machine). After the move, AlphaGo began to play erratically and lost the game. The supercomputer was not prepared for a move that we could define as «imaginative» or «creative». Our brain's extensive capacity for change and adaptation, which is known as neuroplasticity, is an inimitable characteristic (for the time being, at least).

- Social skills will also be needed in solving complex problems, since these will require collaboration among people.

- An environment of greater complexity can generate situations of stress that are easier to handle with a good level of emotional development.

  As an example, in a recent empirical study based on surveys of Japanese workers, it was noted how the use of artificial intelligence and information technology in companies generates greater satisfaction in the type of work being performed, but also higher levels of stress. Technologies allow workers to focus on tasks that are intellectually more complex, which are more satisfying but also more stressful.[4] The higher levels of stress associated with the use of ICTs has also been observed in Spain. In particular, according to a 2016 study covering Spain and Latin America, 32% of workers believe that ICTs oblige them to work to much tighter deadlines, and 25%, to work against the clock.[5] Furthermore, according to a report by the OECD, performing tasks under pressure is the main cause of stress in the workplace.[6]

- But more technical and analytical knowledge must not be set aside. In this regard, the US Bureau of Labor Statistics points out that occupations that will require scientific and/or engineering knowledge (the so-called STEM occupations, which is an abbreviation for Science, Technology, Engineering and Mathematics) will continue to experience a much higher than average growth.

- Furthermore, philosophy and ethics will play a fundamental role in the era of artificial intelligence. The inappropriate use of drones, biases or prejudice generated by machines when learning from our own history, or decisions over which lives an automated car should protect (the occupants, pedestrians or does it depend?) are just some examples of areas in which these disciplines must intervene.[7]

- Social and emotional skills will take on a substantially bigger role in professions like those in the health or care sectors, among others. This is because machines will be able to assume the more mechanical aspects: with a technology that can provide very good diagnostics, we will probably want to discuss our options with a human professional who can provide a large dose of empathy.

The educational proposals of the future

Various educational proposals seek to cover the needs mentioned above. These include the following:

- The public provision of education from 0 to 3 years. At this early age, important aspects are developed that will determine many of the non-cognitive skills and abilities that are more related to emotion, socialisation, the individual.[8] This is especially

4. See Isamu Yamamoto (2019). «The impact of AI and information technologies on worker stress». VoxEU (19 March 2019).
5. See the 2016 study by the Observatory for Workplace Risk Prevention in collaboration with the Jaume I University, «Informe sobre tecnoestrés».
6. See the «OECD Employment Outlook 2014».
7. In June 2019, Stephen Schwarzman, president of the Blackstone Group, donated 188 million dollars to the University of Oxford for the study of ethics in artificial intelligence. This is the biggest contribution that the University of Oxford has received in its history.
8. See J.J. Heckman and Y. Rubinstein (2001). «The importance of noncognitive skills: Lessons from the GED testing program». American Economic Review, 91(2), 145-149. We have also addressed this topic on more than one occasion in our *Monthly Report*: «Education as a lever for inclusive growth», in the Dossier of the MR01/2019, and «Measures to improve equality of opportunities» in the Dossier of the MR03/2018.

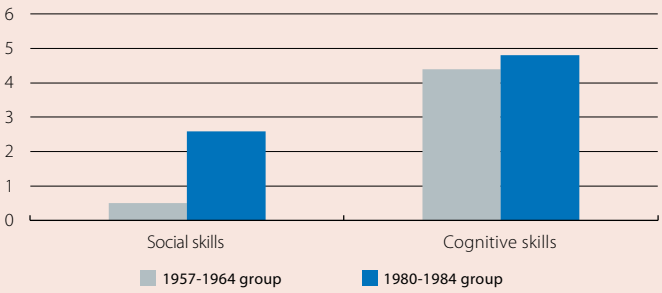
important in a world in which these skills will play an increasingly important role – a phenomenon which, in fact, we have already begun to see (see chart).

- Providing education in emotional and social aspects, beyond the early years. Singapore has already taken a significant step in this direction, since it has developed a programme in schools that enhances emotional and social skills.[9]
- Educating in creative skills in all stages of learning in order to encourage and stimulate them. We are all born with creative gifts and the educational stages should enhance this gift.[10]
- In the field of higher education, we can consider the concept of «multiversities», proposed by Andrew G. Haldane, as a much more open and flexible form of institution than the universities of today. These new higher education institutions should be:
  - More interdisciplinary, to help us to solve complex problems like those mentioned above and to facilitate the leap between professional careers, in a context of technological change that could render some occupations obsolete (particularly faced with the prospect of longer working lives).
  - More open to all ages, to facilitate the continuous learning that is needed.
  - With shorter and more flexible programmes, which should also be better adapted to different types of prior knowledge. In increasingly changing times, very long programmes do not make as much sense.
  - Combining study and work should also be encouraged, especially if we have to go back to university during our professional life.
- Finally, companies must also partake in the education of citizens, especially in their adulthood. The World Economic Forum stresses the role of companies in this regard and, among other factors, proposes the idea of partnerships with local universities and educational institutions that enable their employees to undertake both theoretical and practical training.[11]

Clàudia Canals

Effect of social and cognitive skills on the rate of full-time employment

Increase in the likelihood of being in full-time employment (pps)



Notes: *The increase in likelihood in the US, for individuals aged between 25 and 33, is associated with an increase of one standard deviation in skills. Social skills are measured based on surveys that estimate the degree of extroversion, while cognitive skills are measured using standardised test scores.*
Source: *The Hamilton Project - Brookings («Seven Facts on Noncognitive Skills from Education to the Labor Market», October 2016).*

9. SEL (Social and Emotional Learning) programme. For more information: https://www.moe.gov.sg/education/programmes/social-and-emotional-learning.
10. Sir Ken Robinson, an expert on education, comments on this in many of his articles and books on the ability to teach creativity. Furthermore, in the most viewed Ted Talk in history, this same expert claims that the current education system (at least the vast majority of it) «kills» creativity (https://www.ted.com/talks/ken_robinson_says_schools_kill_creativity).
11. See World Economic Forum (2017). «Accelerating Workforce Reskilling for the Fourth Industrial Revolution». White Paper.