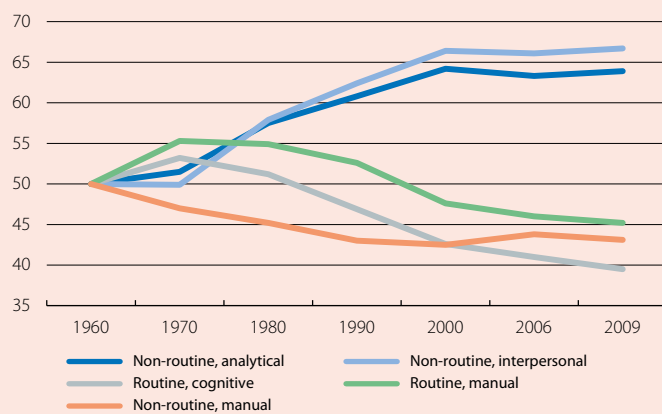


Teaching to learn: education in the era of technological change

The term «industrial revolution» may conjure up pictures of 18th-century steam engines and cotton mills while the term «technological revolution» may suggest a futuristic world of flying cars. Nevertheless, the technological revolution is upon us. Over the past 50 years our economies have undergone a far-reaching transformation. They have gone from predominantly manufacturing-based to tertiary economies where services and the production and consumption of knowledge have prominent role. This process, known as the Third Industrial Revolution because of the role played by digital technology, has been preceded and accompanied by substantial developments in education. For instance, the percentage of adults with a secondary and/or tertiary education in the US has gone from around 25% in the early 1940s to over 80% today. The fact is that education goes hand in hand with technological change. It does not merely train present and future inventors but provides the whole population with the necessary tools to adapt to and make the most of new technologies. Riding on the back of digital technology, we might be on the verge of the Fourth Industrial Revolution, based on artificial intelligence. As in the previous revolutions, these new waves of technological progress will affect how education works.

Tasks in the US labour market

Index (50 = 1960)



Source: CaixaBank Research, based on data from Autor and Price (2013), «The Changing Task Composition of the US Labor Market: An Update of Autor, Levy, and Murnane (2003)».

One fundamental change brought about by digital technology is that we can now store and access an almost infinite amount of data. It is therefore impossible to think of education as merely a process of passing on information. Unlike the traditional emphasis on memorising facts, in a digital era with fast evolving technology, education must teach people how to learn. Although knowledge is just a click away, reaching it is not as easy as it looks. It requires certain competences such as being able to identify relevant information, interpreting, processing and, increasingly importantly, communicating it. Essential in such competences are critical thinking, problem solving, creativity and innovation, cooperation, a questioning mind and communicative skills. The demand for labour has actually reflected the importance of such skills for some time now. Autor and Price have analysed the types of tasks in the US labour market and how these have evolved over time.¹ As can be seen in the first chart, the labour market has gradually

abandoned manual routine tasks and replaced them with activities requiring analytical and interpersonal skills. Such trends have been amplified by improvements in automation, potentially resulting in the Fourth Industrial Revolution we mentioned earlier. As analysed in the article «Will the Fourth Industrial Revolution come to Spain?» in the Dossier of MR02/2016, technological advances in artificial intelligence and sensory capacities have the potential to automate more tasks and alter the world of work. Professions requiring emotional and creative intelligence will come to the fore: the skills pointed out above as a priority for the educational system.

Another key fact for the digital revolution is that we can now communicate and interact with an incredibly large number of people thanks to the expansion of the internet and social media. The low cost of this communication is one of the reasons for the recent boom in the gig economy.² The number of freelancers employed by companies has risen, such as journalists, while employment relations are carried out increasingly online (for instance, via Uber or Airbnb). Digital training is therefore vital for all workers as the internet is the way into a new job market. But the emergence of the gig economy can also result in less permanent and more diversified labour relations.³ Lifelong learning is therefore required to help workers constantly adapt. As explained in the article «Beyond qualifications: the challenge of career-long continued training» in this Dossier, the fact that most adult training is carried out between companies and employees with a long-term relationship is due to high training costs with returns that are spread over a long period of time. The less stable employment relations involved in a gig economy may therefore have an ambiguous effect. They might make employers less willing to contribute to their workers' training, even though employers

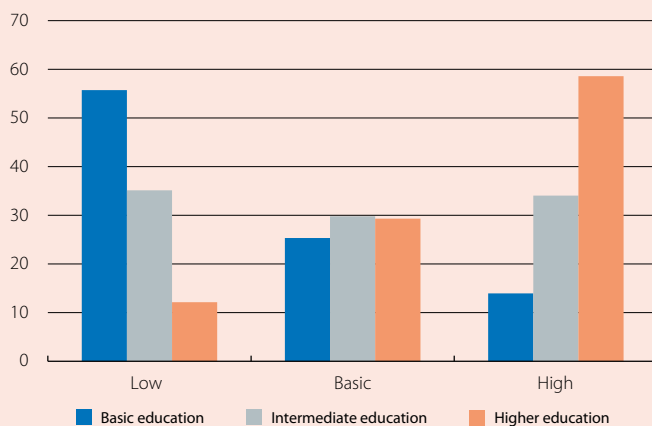
1. Autor, D. and Price, B. (2013), «The Changing Task Composition of the US Labor Market: An Update of Autor, Levy, and Murnane (2003)», MIT Worker Paper.

2. See Katz, F. and Krueger, A. B. (2016), «The Rise and Nature of Alternative Work Arrangements in the United States», NBER Working Paper. In the language of economists, the arrangement of workers into companies can be explained by the existence of transaction costs. The internet and social media reduce these costs, thereby encouraging the emergence of alternative work arrangements.

3. In other words, the same worker will work for more employers.

Digital skills of people aged 25 to 54 in Spain (2016)

(% of total individuals aged between 25 and 54)



Source: CaixaBank Research, based on Eurostat data.

formal education. But beyond this direct benefit lies the debate as to whether using ICTs in the classroom could improve learning overall. For instance, distributing educational materials via videos and IT applications helps to tailor learning to each student. Moreover, as teachers are less involved in passing on information, they can devote more time to individually helping each pupil. Also, given that learning is a social process (empirical evidence shows that knowledge is acquired more effectively when it results from social interaction), the interactive nature of ICTs can therefore be particularly useful in increasing the number of potential social relations (for instance, via social media). Lastly, using digital tools in the classroom means that data on learning can be stored. This can then be used later by the scientific community to analyse which methods work best. So what does the evidence of ICT use in the classroom tell us? The numerous empirical studies have produced disappointing findings: ICTs do not seem to improve students' school performance.⁴ There are different reasons why these findings might not be conclusive.⁵ However, one interesting point resulting from this non-result is whether we are measuring educational performance accurately. In a changing technological environment, the skills which education needs to pass on (critical thought, creativity, teamwork, etc.) are particularly difficult to capture via standardised tests used to evaluate education. How to assess this correctly is therefore still of major concern.

Isaac Newton once said «if I have seen further, it is by standing upon the shoulders of giants». Today our giants are taller than ever. And smart education will help us see even further.

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4. See the review of the literature by Bulman, G. and Fairlie, R. W. (2016), «Technology and Education: Computers, Software, and the Internet», Handbook of the Economics of Education, Vol. 5. Regarding the impact of online teaching, the evidence also suggests that students achieve slightly better results with face-to-face learning than with distance learning. But as online courses are cheaper per student, they might still be cost effective.

5. For instance, for students to take advantage of using ICTs, school investment in ICTs needs to be above a minimum threshold and teachers need to be properly trained. Moreover, the real difference in students' exposure to digital technology may come from outside the school (home use of computers, mobiles, consoles, etc.).