

21st Century Education: Preparing learners for the New World

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Abstract

*In their working paper *The Future of Employment: How Susceptible are Jobs to Computerisation?* Frey and Osborne [1] provide a forecast of what will happen to employment in the 21st century with the advent of new technologies, specifically the effects of computerization on job markets. While computers started to disrupt the job market many decades ago with what Schumpeter denominated “creative destruction”, the speed of disruption will be much higher and the effects of creative job destruction much more dramatic in the 4th industrial revolution. While formerly economic growth meant higher levels of employment, nowadays due to computerization it is possible to have a “jobless growth”. The creative disruption of technology in the 21st century will have effects that go well beyond business: As labor markets change so do the set of skills that graduates have to possess to transition to the business world. The aim of this paper is, first, to present the skills that, according to business executives and scholars will be required by employers in the era of the 4th industrial revolution; second, to discuss the implications for education, specifically for higher education, and how programs will have to be modified so that the skills obtained by graduates match those demanded by the labor market.*

1. Introduction

The Frey and Osborne [1] calculate that around 47% of all jobs in the United States are at risk of disappearing because of automatization. However, not all jobs will be affected in the same manner: There will be a substantial increase in the demand for jobs that require sophisticated cognitive tasks. The authors point out that, while routine tasks can be substituted for by artificial intelligence, it will take longer for jobs involving non routine tasks to be taken over by artificial intelligence. The authors provide a brief history of how technological revolutions have affected employment in the past. Citing the Austrian economist Joseph Schumpeter, Frey and Osborne [1] state that, while creative destruction has created colossal wealth, it has not been without negative social consequences. They state that social pressure, specifically from guilds and unions, has been a hindrance to technological progress [1].

According to Clark [2] as cited in Frey and Osborne [1] despite the displacement of workers created by mechanization, unskilled workers have been the greatest beneficiaries of the industrial revolution. The process that took place under the industrial revolution was that work that was usually performed by artisans was broken down into smaller, specialized sequences which required fewer skills but more workers.

The Ford Motor Company and its assembly line provide an example of how in the late 19th century technology complemented the labor of unskilled blue-collar workers. As Frey and Osborne [1] point out, electrification allowed many stages in the production process to be automated, which in turn created a demand for relatively skilled blue-collar workers. Later on, with more advanced technology, office machines reduced the cost of the processing of information and increased the demand for office workers. However, a greater supply of office workers than demand for clerical jobs led their wages to decrease.

Autor and Dorn [3] as cited in Frey and Osborne [1] point out that the computerization of labor has had as a consequence a polarization of the labor market, with increasing rates of employment in high skill jobs and low-income manual occupations. At the labor market level, the effects of technological progress are as follows:

- Firstly, creative destruction, where workers are forced to reallocate, and
- Secondly, a capitalization effect, namely, that industries enter markets where productivity is high, thus creating an expansion of labor in those industries.

However, one major problem posed to labor by technological progress and the creative destruction of jobs that have been made redundant by automatization is that displaced workers, due to age or to a lack of skills, or to other factors like place of residence, often cannot find employment in other, more sophisticated industries with higher educational demands: While lifelong learning programs are becoming more popular, it is unrealistic to assume that workers who are approaching their retirement age will find a job in an industry that requires a new set of skills. Another major problem posed by

automatization is that even highly skilled workers are being displaced by automatization and forced to take jobs formerly performed by low-skill workers, pushing the latter even further down the occupational ladder and even out of the labor market.

The historical analysis that Frey and Osborne [1] provide of creative destruction on the labor market is accurate and observable, the most relevant part of their working paper is the technological revolution of the 21st century and its impact on labor markets. Frey and Osborne [1] state that Big Data has had a dramatic effect on the computerization of non-routine cognitive tasks. As an example of how Big Data aids artificial intelligence in non-routine cognitive tasks, they provide the example of how Google Translate, using algorithms, can perform translation tasks. Yet, whoever has used Google Translate knows that it does not always recognize the contexts in which words are used, nor can it recognize simile or other language constructions like metaphors, which makes Google translations awkward at best and totally inaccurate at worst. While the authors state that computers are much better at performing large calculations using large datasets, and that algorithms do not have human biases, and therefore decision-making will profit from “impartial algorithmic solutions”, they fail to acknowledge that algorithms per se lack judgment. While managing enormous databases is of great advantage for example for lawyers, and artificial intelligence can be of great utility to lawyers performing paralegal tasks, it is unlikely that they will ever perform the cognitive tasks of lawyers. Regarding manual tasks, robots equipped with sensors and manipulators will be able to perform non-routine manual tasks.

Another factor that will favor the substitution of human labor by artificial intelligence are decreasing robot prices: “As robot costs decline and technological capabilities expand, robots can thus be expected to gradually substitute for labor in a wide range of low-wage service occupations, where most job growth has occurred over the past decades” [1]. Frey and Osborne state that hindrances to further computerization persist, in the form of what they call “engineering bottlenecks.” However, some of these bottlenecks can be relieved by task simplification.

The jobs that Frey and Osborne see less threatened by the advent of new technologies are those that require creative intelligence, social intelligence and complex perception and manipulation tasks. According to these scholars, the jobs that will very soon be taken over by computerization are jobs in transportation, logistics, production, as well as administrative support that does not require sophisticated cognitive tasks. However, “human labor will still have a comparative advantage in tasks requiring more complex perception and manipulation” [1].

2. Does Automation mean Job Loss and Greater Inequality?

According to the International Labor Organization (ILO) the risk of automation poses the highest risks for the jobs held by young people [4]. The ILO report, like the working paper of Frey and Osborne [1] states that the speed and the scope of automation depends on 3 types of engineering bottlenecks, which are social intelligence, creative intelligence, and perception and manipulation. The report states that young people face the highest risks of automation both in developed economies as well as in low- and middle-income countries. However, the risk of automation is greater in the latter group of countries [4]. Young people are at high risk of automation because younger people tend to start their careers with more automatable jobs, moving later to jobs that require more problem-solving skills. “This is independent of formal education; rather, it is driven by the level of accumulated work experience” [4]. Another problem mentioned by the ILO study is the education-occupation mismatch common in entry-level jobs. Thus, institutions of tertiary education need to adapt to the evolving needs of the labor market and provide their graduates with the skills (both hard and soft) needed by employers. Furthermore, a new macroeconomic policy framework is required to level uneven growth and mitigate inequality. While, according to the ILO report [4] young people in low- and middle-income countries are more educated than ever, the decreasing returns to tertiary education show that there is an imbalance between the supply and the demand for tertiary education. Thus, adapting education and skills development to the new labor market needs will ensure a successful school-to-work transition and equip young people to subsequent professional transitions. Another aim should be to provide specific targeted support to young people who have already lost their jobs as a result of automation: Due to the fact that technology automates tasks and not occupations, young people would benefit from re-skilling and skill upgrading so that they can be employable again [4].

Young workers are usually more affected by inequality than older ones. This has to do with the notion that the jobs available to young workers are usually more heterogenous and unstable than the jobs available to older workers. While returns to education had been rising despite growing enrolment numbers, this trend was reversed after the 2008 economic crisis, especially in low and middle-income countries [4]. If the income gap was already wide between college graduates and those who only possessed secondary qualifications, the gap has widened after the crisis: This trend is confirmed by Autor et al [5]: productivity has been decoupled from wage growth: Alongside low wage growth for rank-

and-file workers, this decoupling has created low-paid, insecure jobs for non college graduates, low labor-force participation, high levels of inequality and employment disparities among ethnic groups. For Autor et al [5], there are three factors that explain these developments:

- The advancing digitalization of work, which has made qualified workers more productive and the less qualified replaceable.
- An increasing globalization which has favored imports and labor outsourcing to cheaper countries.
- The weakening of institutions, like trade unions, that defend workers' rights.

Another negative development that technology has had on labor is an increasing polarization of employment into high-wage and low-wage occupations, at the expense of middle-tier jobs. Middle-tier jobs in production, logistics, clerical and administrative support have been most impacted by automation. Artificial intelligence has displaced workers who perform routine, codifiable cognitive tasks like bookkeeping and repetitive production tasks. The impact of automation for routine labor has increased the productivity of highly qualified workers whose work relies on calculation, communication, information and problem-solving while it has displaced middle-skill workers whose tasks were information-collection, organization, and calculation tasks [5].

Digitalization has nonetheless had a small impact on service-sector jobs like for salespeople in fast-food restaurants, cleaners, janitors, caregivers, security guards, etc. Performing these jobs requires dexterity, visual recognition, face-to-face communication, and adaptability- skills that artificial intelligence does not possess but that modestly educated workers can accomplish. The decrease in middle-skill jobs has had as a consequence that service-sector occupations have become a central job category for those who lack a college degree. While there will be no unemployment in the service-sector jobs, “Two-thirds of those jobs are projected to occur in occupations that pay below the median wage” [5].

3. Education Institutions: Adapting to the Demands of the 21st Century Labor Markets

The effects of increasing automatization in the labor market require new sets of skills that schools, and universities have to offer: both “hard” and “soft”. While hard skills, i.e., the skills necessary for a given profession, compose the academic curricula of tertiary education programs, soft skills are not

usually taught as separate topics.

For Lavery and O'Donnell [6] it is crucial to introduce robotics at the secondary level with the aim of developing what they call “Engineering Habits of Mind.” The aims of the VEX Robotics’ Challenge that these researchers describe in their study has the aim of introducing secondary school pupils to building, operating, maintaining and modifying robots and to “research the applications of robotics and pathways into careers in robotics [6]. Students who participate in the program also develop soft skills like teamwork, communication, creative thinking, decision making, time management, problem solving, conflict resolution and flexibility. What they describe as “Engineering Habits of Mind” is a pedagogical approach that cultivates systems thinking, improvement and adaptation, problem finding and problem solving, i.e., “to think like an engineer” [6]. The robots assemble by the pupils are VEX Clawbots. The students, organized in STEM clubs, modify their robots to make them more competitive and practice controlling them with a remote handset. This activity has “introduced the participants to the skills needed to maintain a machine, specifically an electro mechanical robot.” After participating in the activity, the pupils and the staff involved filled out a questionnaire. The responses were in most cases positive. Most pupils were encouraged to study STEM subjects and to apply transferable skills that will be of utility in the labor market.

Rapidly evolving, technology-driven, interconnected economies require skills that are “responsive to dynamic and unpredictable patterns of economic and social development”, that is, resilient skills [7]. For this reason, it is not only academics and teachers who should determine curricula but also labor markets. Soft skills are also called “Qualities and Behavioral Competencies.”

According to the Speaker Board of Canada, soft skills can be divided into 3 main areas:

- Basic skills (communication, information management, problem solving and mathematical thinking).
- Personal management skills (positive attitudes and behaviors like responsibility, flexibility, willingness to learn and safety practices).
- Teamwork skills which entails being able to work with others, to participate in and contribute to projects [7].

4. Skills Demanded by 21st Century Employers

The job markets are demanding not just graduates who are competent in their fields of study, but who

are also flexible and adjustable and can work in complex and multicultural environments. Soft skills, which are also called generic or transferable skills, integrate human capital competencies like personal talents that are relevant beyond the academic setting. "Soft skills include a wide range of competencies that are not dependent on formal curricula" [8]. Some generic examples are motivational and dispositional attitudes, operational skills, and interpersonal competency. Specifically, Dias and Soares [8] mention 21 soft or generic skills, namely: decision making, problem solving, organization and planning skills, critical thinking, creativity, communication (oral, written and in a foreign language), information management, CT information and communication technologies, teamwork (working in intercultural as well as interdisciplinary teams), interpersonal relationships (negotiation and conflict management), strive for excellence, capacity to adapt to new situations, innovation, lifelong learning, entrepreneurship, leadership, ability to work independently, personal and social responsibility, sustainability awareness, ethical behavior, and cultural awareness.

In their study about the skills needed for the future, Tigerstedt and Fabricius [9] stress the importance of soft (or generic) skills. These Finnish researchers cite a Forbes report from September 2019 that argues that soft skills are crucial for the labor market due to the increasing needs of interconnectedness and flexibility. Tigerstedt and Fabricius [9] see that the transition from college to work is hard for young people because they did not receive the training needed during their studies. For them, soft skills "refer to what a person needs to understand as well as develop within him- or herself ... when interacting with others." These skills usually include social competences, intellectual competences, and organizational competences. Soft skills are also called 'generic' or 'transversal' because they are not limited to the education sector or to a specific discipline of study.

Moreover, 'transversal skills' include competences that are not related to a specific job or task, but that can be used in a variety of situations and labor settings. Some examples are innovative thinking interpersonal skills and intercultural competence.

Tigerstedt and Fabricius [9] state that soft skills are often ignored by institutions of higher education because they are not academic and because the teaching staff are not always competent to develop them. For this reason, these researchers state that the best place for students to learn and practice soft skills is through university-industry collaboration schemes, like for example internships. Nonetheless, there is a problem in the assessment of soft skills: Whereas "hard skills" are quantifiable, soft skills are more difficult to measure due to their qualitative nature. In

their analysis, the researchers came with 12 most mentioned skills, which are: communication, cultural competence, teamwork, flexibility, innovation, leadership, digital skills, creativity, critical thinking, analytical skills, ability to learn and problem solving. They conclude that assessing these skills is challenging, and that generic skills are at risk of being neglected because they are not taught as separate subjects, if at all taught.

In Portugal, Araújo et al [10], interviewed 13 human resources managers or company owners for their study about skill shortages in the labor market. These researchers state that there is a mismatch of skills between higher education and the labor market in Portugal, and that 11 out of the 13 interviewees stated that college graduates lacked soft skills. These researchers differentiate between skill shortages and skill deficits: While there is a consensus among the managers that college graduates have good technical skills, they emphasize that they often lack soft skills, or social and behavioral skills, specifically communication and teamwork skills and work attitudes [10].

Managers often blame higher education for the lack of soft skills, and 11 out of the 13 managers stated that they provided training to new candidates to compensate their lack of skills. Furthermore, there is little cooperation between higher education institutions and enterprises, as managers usually limit their contact with colleges to have access to the best candidates: "This is... a more passive type of engagement that views HE institutions as merely a recruitment channel and not as a close partner in the development of desired skills" [10]. While Araújo et al [10] analyze the skill needs in the Portuguese labor market, Ozola and Rivza [11], analyze the opinions of employers in Latvia, regarding the employability skills they seek in university graduates, based their study on a survey given to 112 employers in Latvia and in 250 job advertisements in one of the most popular job posting websites of that country. The most often mentioned skills, in order of priority, were teamwork, creativity, foreign language skills (especially English), IT skills, interpersonal communication skills and problem-solving skills. However, managers also mentioned non-cognitive skills like honesty, responsibility, cooperation, determination, and a pro-active attitude.

The analysis of the job advertisements showed that the first skill sought by employers was professionalism in the area of the job (88%) followed by IT skills (86%) and English language skills (67%).

Regarding personal values, many advertisements sought a high degree of responsibility. Likewise, the surveys carried out with the employers showed that after specific professional skills related to the position, the most sought-after skills were communication, teamwork, problem-solving, IT,

creativity, foreign languages, perseverance and leadership [11]. These two Latvian researchers concluded that; 1. labor market trends have changed and that a skill shift is expected to happen by 2030. The jobs of the future will need 26% more hours of work requiring social and emotional skills and 60% more hours requiring technological skills; 2. Following industry-specific skills, mentioned in 88% of the job advertisements, 86% of the advertisements required IT skills followed by English skills; 3. The ads show a tendency that candidates with good soft skills are in high demand for different kinds of jobs, and 4. The requirements of the Latvian labor market match the tendencies observed globally [11].

Other, seldom mentioned skills that will be required in the 21st century workplace, are, according to Scholz [12] agility, metac intelligence, creativity and mindfulness. Veale, Feyaerts and Forceville [13] define mental agility as “a matter of perception and action working in concert, so that an agent may rapidly construe a situation, perceive what choices are available actively construing those choices where necessary and so decide on an effective course of action. Furthermore, these authors see in ambiguity an opportunity rather than a problem: “The opportunity is to perceive an unexpected choice where others perceive confusing indeterminism”.

Metic intelligence, a concept developed by the ancient Greeks, “is an intelligence that relies on skill, strategy and a general knack for handling whatever comes along” [13], [19]. Creativity is described by Scholz as a problem solving strategy that can involve creativity or not; what it means is to take the right decision at the right moment. It also involves “creating an opportunity of what is real and what is possible and what is responsible by acting according to good judgement...” [13]. The last of the skills described by Scholz is mindfulness: “Mindfulness is defined as an active state of mind... characterized by being i. Situated in the present; ii. Sensitive to context, and iii. Guided but not governed by rules and routines” [13], [20].

5. The Disruption of Labor Markets brought about by Technology

Rather than eliminated, working roles will be reconfigured by intelligent technologies [14]. The automation of tasks will have as an effect that the importance of certain skills will increase while the importance of others (the automatable skills) will decrease. Intelligent technologies are subverting the skills mix, and competences like complex reasoning, creativity, socio-emotional intelligence, and sensory perception will increase in importance [14]. However, these skills are not taught at higher education institutions, but rather “acquired through practice and experience over long periods of time.”

To solve the skills mismatch, Accenture [14] proposes a 3-step strategy: The first step is to speed up experiential learning. This means that knowledge should no longer be transmitted from the top to the bottom but learning by hands-on application; the second step is to shift focus from institutions to individuals. This entails combining skills within each individual, as tasks nowadays require complex blends of competencies. The third step is to empower vulnerable learners by making lifelong learning programs accessible to all workers, especially the ones whose jobs are most vulnerable to disruption as a result of technological innovation. These workers must be identified for targeted interventions [14].

An organization that has adopted a learning management system with the aim of developing 21st century learning and employability skills of communication, participation, networking and sharing in their staff is the Canadian Foreign Service Institute. The Institute created a blended learning program that provided an active learning experience that was social, participatory and supported by rich media [15]. They chose the topic of human rights, and the blended learning program consisted of 4 learning activities: a self-directed online course, post-activity discussions, self-directed learning assignments, and peer feedback and discussions. [15]. Some of the lessons learned by the Institute were: the importance of an online facilitator; the choices of subject matter; the effective and timely provision of instructions; the group should be large enough to enable discussion; the learning management system should be functional and user-friendly; the participation of subject matter experts, and the availability of the learning platform 24/7. While enterprises and organizations remain the prevailing employers, the evolution of the digital economy has created and enhanced a phenomenon called the Gig Economy. Currently, 20 to 30% of the working force in the United States and Europe is engaged in some type of independent work [16]. Whilst freelancing is by no means a new form of working, digitalization is transforming the way freelancers work and creating a broader range of alternatives for people who, for different reasons, cannot or do not want to have a traditional “full time job.” This group includes, among others, creative young entrepreneurs as well as people who have been displaced from their jobs and who are too old, and therefore ‘undesirable’ for companies. There are two key drivers that have enhanced the rise of the Gig Economy:

- An increasing number of people are seeking independent work, either full time, part time or as supplementary income source.
- Digital connectivity and ease of communication. These developments have created labor-sharing

platforms like Upwork, that enable matching skills with customer needs [16].

6. The advent of a new economic paradigm

Stevens [17] points out that technology is very attractive for the owners of capital: Robots work without earning a salary, do not need sick leave, vacation, lunch breaks, are not conflictive members of trade unions... “are less prone to err and more productive than human beings.” Therefore, it is difficult for people to compete with machines for the same type of jobs. However, as it has been stated above, there are human cognitive skills that machines do not possess; for this reason, human workers and machines will complement, rather than compete with each other. While education has to provide other types of skills that make graduates employable, Ford, as cited in [17] believes that “there is often little relationship between level of education, skill, and losing one’s job to automation.” As Frey and Osborne’s [1] study shows, the jobs that will be hardest hit by automation are the ones involving routine cognitive, repetitive tasks that can easily be learned by artificial intelligence. However, low-skill jobs that require human skills like dexterity, face-to-face communication and adaptability will not be jeopardized by technology. However, these jobs are low-status, low paid, and low security, and in many cases do not allow the people who hold them to live above the poverty line.

It is unrealistic to suppose that equal education will be accessible to all. Even if governments implemented policies to guarantee equal education for all, differences in cultural capital, intelligence endowment, perseverance, stamina and motivation will always persist among students. Furthermore, other social problems like alcoholism, drug addiction and the temptation of making money through illegal activities will be a hindrance for many young people to complete an education, which requires hard work, commitment, and perseverance, and to obtain a decent job later.

Stevens [17] states that technology innovation provides many non-employment related benefits and creates new types of work. However, many theorists say that the 4th industrial revolution is different because technology is affecting all areas of the economy, not just one or two. Furthermore, they cite Moore’s Law, which reflects the doubling of digital capabilities every 18 to 24 months. It is inevitable that there will be some left behind due to lack of basic skills, illness, addiction, or other reasons. It is unrealistic that young people will stop dropping out of school, and that lacking basic skills they will be able to obtain low-skill jobs when more qualified displaced workers will compete for those jobs

7. Conclusion

It is neither realistic nor reasonable to limit the advances of technology with the aim to protect jobs. The labor market of the 21st century will have its winners and losers. However, both winners and losers will still be consumers.

The economics professor J.K. Galbraith wrote more than 60 years ago that economics was a discipline based on the paradigm of privation and scarcity. Unbridled capitalism has created stark inequality, as has an economy based on the premise of production and not on social welfare. Economic growth no longer has the effect of increasing employment; However, technology -and creative destruction- have brought with them enormous amounts of wealth. The paradigm of privation and scarcity is thus no longer applicable in the 21st century. While, as Galbraith [18] stated, “The community is affluent in privately produced goods. It is poor in public services. The obvious solution is to tax the former to provide the latter”.

The idea of Universal Basic Income, also called government income scheme is as old as 1918, when it was proposed by the British philosopher Bertrand Russell. This idea was later advocated by Milton Friedman in the 1960s. A universal basic income would eliminate what Galbraith calls “insular poverty”, that is, communities where everyone is poor. Insular poverty affects everyone in the “island” and reproduces itself [18].

Poverty is inherited, restraining children from obtaining a decent education and participating in the labor market later on. Thus “To secure to each family a minimum income...would help ensure that the misfortunes of the parents, deserved or otherwise, were not visited on their children” [18]. A universal basic income would benefit all in the society as crime that is motivated by social marginalization would greatly diminish. As numerous studies suggest, inequality is one of the breeding grounds for crime and violence.

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