Education in the Era of Digitization: An 'ABCDE' Model

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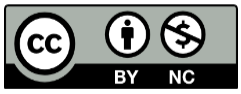

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Abstract

This study aims to explore the answers to the questions of how and what technology is bringing about radical changes in human life and how and what education system can make humans able to cope with the challenges posed by technology. To get the answer to these questions, I have followed the desk review strategy as a methodology. I essentially reviewed some related literature, heavily relying on internet-based literature. A systematic review process was followed to gather the relevant data from the text. The review was carried out in three steps: locating data sources to be used, defining criteria for rating the quality of the studies, and presenting and analyzing the findings. As the information was secondary as well as theoretical; themes were developed and then analyzed and interpreted accordingly. Exponential development of technology is bringing about unprecedented changes in various aspects of society. Now we are facing a radically changing situation in the job market. It is estimated that up to half of the world's jobs are at high the risk of disappearing due to automation in the near future. It is the first time in human history that we have the possibility to follow everybody all the time and get to know someone better than one knows oneself. Inequality among human beings is mounting rapidly. Human abilities are gradually downgrading due to technological advancement. The study proposes an 'ABCDE' model of education to make children able to cope with the changing situation.

Keywords: adaptive, digitization, downgrading, education, revolution, technology

Introduction

Knowledge is now considered as a 'revolutionary wealth' (Toffler, 2007; p. 2) in the era of digitization. According to Kvanvig (2003; p. 34), knowledge is a 'fundamental epistemic good' through which the value of other goods is determined. Based on our knowledge, we understand the nature of reality. It helps not only to analyze and understand objective reality but also to change reality. All the innovations ever explored were the results of our knowledge. It was used as a crucial means of production in the industrial age. Knowledge workers were in the

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majority of the job markets in the industrial era. They produced goods and services with their minds. The quality of goods and services largely depended on the level of knowledge of the workers. So, highly knowledgeable people were demanded in the job market (Xu et al., 2018).

In this post-industrial age, knowledge has been essentially used in two ways: as a means and as a product. As a means, it is used to know the objective world, and as a product, it is used as a sellable good. Data are an example of knowledge products that are sellable in the market. Many renowned universities in the world have been getting big brains (knowledgeable people) from all over the world to produce knowledge. They are now selling the knowledge on the market in various forms. The brain drain problem is observed in developing and underdeveloped countries since developed countries are pulling talented minds towards their countries (Iravani, 2011)

The idea of human capital is directly associated with 'knowledge capital' (Hanushek & Woessmann, 2020; p. 25), which can be capitalized to produce or reproduce and then generate an economy. In this context, we can see that countries with knowledgeable people are rich and powerful (Iravani, 2011). Besides, the 'destructive technologies' (Coccia, 2020) are the product of human knowledge, which in turn challenges the existence of human beings. In this regard, some critical questions raised in my mind: is there any possibility of replacing human beings with machines (computers, Artificial Intelligence (AI), robots, etc.)? What will the job market be like in the coming future? Are our skills learned now useful in the days to come to be sellable in the job market? Is the present education system really on the right track given the way the world is changing? How and what education system can make humans able to cope with the challenges posed by the new technology? To seek the answer to these questions, this research was carried out. I assume that reality is multiple. A single and precise answer is not possible, as these questions are related to the social sciences. However, this paper will provide scholars with a basis for further discourse in this potential area.

Methodology

To explore the answers to the questions mentioned above, I have followed the desk review strategy. A qualitative research design is applied to this study. A systematic review process was followed to gather the relevant data from the text. The review was carried out in three steps: locating data sources to be used, defining criteria for rating the quality of the studies, and presenting and analyzing the findings.

Locating the Data Sources

I reviewed the literature only relating to education in the digital era available in Google Scholar and Research Gate.

Criteria for Evaluating the Quality of the Studies

The search term strings utilized were "4 IR" (Fourth Industrial Revolution), "job market", "education in the digital world", "education in the technological age", "impact of AI, robots, and automation", which appeared in the title, abstract, and keyword fields. The total number of publications identified from these database searches was 152. All of the initial 'hits' bibliographic details and abstracts were exported from each database and integrated into the EndNote X9 software for managing and citing the references. Duplicate references were eliminated. After deleting duplicates, the total number of publications was reduced to 108. The studies were subsequently identified using the titles of publications and abstracts. The criteria used are explicated under the headings that follow.

Data Display and Analysis

Abstracted data were subjected to content analysis (Patton, 2002). The bulk of the reviews were reduced using content analysis in order to find categories. This study employed an analytical framework approach to content analysis. In this technique, I first listed the researchers' deduced assertions. I then examined the data of theory-derived sensitizing notions or applied someone's else's theoretical framework (Patton, 2002). It implies that, following or in addition to the deductive phase of analysis, I examined the data again for previously unexplored trends and emerging knowledge (inductive analysis). I began with the deductive phase of analysis, which included creating categories based on reviews and categories. Following that, the inductive technique was employed for 'open coding and category identification' (Petticrew & Roberts, 2006). As the data were secondary as well as theoretical, some themes were developed manually and then analyzed and interpreted accordingly. I presented the draft of this paper in a webinar organized by the Graduate School of Education, TU. The comments and suggestions of the participants and experts were also incorporated into the paper.

Results and Discussion

Technological Revolution: Changes in Social Dynamics

The exponential development of technology is bringing about unprecedented changes in various aspects of society. The development of technology is not merely an enhancement of technology but also a revolution. New technologies such as information technology, biotechnology, genetic engineering, brain editing, etc. are also known as "destructive technology" (Harari, 2018; p. 46). This revolution is also known as the fourth "industrial revolution" (Schwab, 2017). According to Schwab, "we are now in a world where individuals move between digital domains and offline reality with the use of connected technology to enable and manage their lives" (Conko et al., 2016; p. 206). Humans have never experienced such a life before. Therefore, this is a great revolution like the agricultural and industrial revolutions, which have had multiple impacts on various aspects of society. In this section, very few but the key aspects of society have been considered to be studied.

Effects on the Political Economy

The economy has been taken as a "base for all the social aspects" (Edara, 2016; p. 205). According to Karl Marx (1848), "the base is the social relation between humans who create and produce materials that are eventually put up for exchange" (Therborn, 2018; p. 6). Basically, there are two types of structures: the base and the superstructure. Base refers to the production forces (materials and resources that generate the goods needed for society), which indicates the economy. On the other hand, the superstructure describes all other aspects of society, such as politics, education, religion, culture, etc. Marx and Engels argue that "the superstructure grows out of the base" (Therborn, 2018).

After the fourth industrial revolution, the base has also been changed. Data have not remained only data, but they are used in both forms: "as a good and a service. Data are the product of human knowledge, which determines social relationships. With the invention of the steam engine, "the first industrial revolution started, allowing the transition from farming as well as feudal society to the new manufacturing process" (Xu et al., 2018; p. 76). In this period, coal was used as the main source of energy. With the advent of the internal combustion engine in 1900, the second industrial revolution started. This revolution propelled society to an age of "rapid industrialization" (Mokyr & Strotz, 1998). In this era, oil and electricity were used as sources of energy to power mass production. The popular third industrial revolution began in 1960, which led to an era of "mass production using electronics and information technology to automate production" (Schwab, 2017). The 21st century is the era of "the fourth industrial revolution, which involves computer-generated product design and three-dimensional (3D) printing, bio-engineering, AI, robotics, etc." (Xu et al., 2018; p. 10). According to the World Bank report (2021), "the digital economy is equivalent to 35% of global Gross Domestic Product (GDP), growing two and a half times faster than global GDP over the past 15 years." Moreover, about 70% of the total economy involves digital intelligence (World Bank Report, 2021, as cited in Kobilov et al., 2022). Artificial intelligence, robots, and automation will likely replace the human workforce in the production and service sectors. It will bring about changes in the mode of production in society. If the mode of production is changed, this will bring changes to the superstructure.

According to a report from Oxford Economics (2020), "the robotics revolution is rapidly accelerating as fast-paced technological advances in automation, engineering, energy storage, artificial intelligence, and machine learning converge" (Slater, 2020; p. 55). Now, machines have become more efficient than human beings in terms of not only physical power but also intellectual power. In this context, human beings will presumably be replaced by robots and artificial intelligence in the job market. It is assumed that "the far-reaching results will transform the capabilities of robots and their ability to take over tasks once carried out by humans" (Karanikola & Panagiotopoulos, 2018; p. 2). Existing business models in many sectors will likely be seriously disrupted. In this context, humans

will be losing their economic value and will remain an economically useless class. The classes may not exist, as Marx said. People will have to fight for their economic value rather than their political rights. So, this will no longer be merely a technical issue but also a political issue.

Likelihood of a Job Market in the Future

Now we are facing a radically changing situation in the job market. It is estimated that "up to half of the world's jobs are at high risk of disappearing due to automation in the near future" (World Economic Forum, 2016; p. 20). Developing countries like Nepal are likely to lose 80 percent of their job opportunities as they are mostly consumer societies of technology. According to the study by McKinsey Global Institute, "between 400 million and 800 million human workers could be replaced by AI and automation technologies and need to find new jobs by the year 2030. In total, 75 million to 375 million may need to learn new skills and switch occupational categories" (Manyika et al., 2017; p. 65). Another study of the same organization shows that "nearly 50% of human work tasks will be performed by automation technologies by the year 2055" (Manyika et al., 2017; p. 28).

Based on historical facts, we can assume that every revolution creates more new jobs in place of old ones. For instance, after the invention of machines, many jobs were replaced by machines, but more jobs were created in service sectors. But present trends show that new technologies are not creating new jobs at any scale; they are eradicating them. Moreover, due to the "changing nature of work within industries and beyond, demand for high-level skills will likely grow, whereas many low- and medium-skilled jobs will become obsolete" (Stephany & Lorenz, 2019). Meanwhile, in job families and groups that involve little or no automation but that do require compassionate human interaction tailored to specific groups such as health care, social services, and certain teaching occupations, the demand for human skills will increase as well. However, jobs created for those "without high-level skills will often be insecure and poorly paid" (Ron et al., 2018; p. 99). The present scenario shows that there is a vast gap between the demand for jobs and the skilled human resources needed. According to a report by the International Commission on Financing Global Education Opportunity (2018), "about 40 percent of employers globally are finding it difficult to recruit people with the skills they need" (p. 23).

According to Youval Noha Harari, humans have two types of abilities: physical and cognitive (Harari, 2018). In the industrial era, there was competition between humans and machines in terms of physical abilities, while humans had more abilities than machines, which were cognitive abilities. Therefore, manual jobs in agricultural farms and industries where physical power was required were automated, and in turn, new service jobs emerged where cognitive skills such as learning, analyzing, communicating, etc. were required (Petropoulos, 2018). Only human beings possess these cognitive skills. Now, AI also possesses both physical and cognitive skills. So, AI is now "beginning to outperform humans in more and

more of these skills, including the understanding of human emotions" (Harari, 2018; p. 204).

Besides, AI works more efficiently than humans, as it has the ability for fast connectivity and adaptability. Since humans are individuals, it is difficult to connect them to one another and to make sure that they are all up to date. In contrast, computers aren't individuals, and it is easy to integrate them into a single flexible network. Hence, what we are facing is not the replacement of millions of individual human workers by millions of individual robots and computers. Rather, "individual humans are likely to be replaced by an integrated network" (Harari, 2018; p. 22). One thing we should note is that humans have certain core abilities, such as empathy, imagination, creativity, and emotional intelligence, that cannot be replaced by any kind of technology developed so far. These abilities will likely be more valuable in the future to save human existence. Based on the literature, we can say that the job market will be shrinking, the nature of jobs will be fluid, and countries must build an adaptive workforce.

Likelihood of Superhumans: Issues of Inequality

Inequality among human beings is mounting rapidly. After digitization, 2 percent of wealthy people will likely hold 98 percent of global property, and 98 percent of people will have to share only 2 percent of global wealth (Bulturbayevich & Jurayevich, 2020). It will create an economically inequitable society. Few people will be economically superior. Moreover, with the advancement of technology, humans are becoming superhumans, specifically in three areas: "super longevity, super intelligence, and super well-being" (Lima & Belk, 2022; p. 22). New technology will benefit healthy longevity by editing the genes that cause aging. Now it is possible that genes caused by aging can be blocked and genes that help helps for longevity can be developed in our bodies. Besides, gene editing technology has opened a door for super-well-being. This technology "almost exclusively treats several medical problems" (Harari, 2018). Doctors can alter people's genes to prevent incurable and deadly diseases from progressing further. A very popular experiment was done in China into germline gene editing, making genetic changes that can be "passed down from one generation to the next in order to prevent parents from passing genetic diseases to their children" (Zhao et al, 2020; p. 32). Similarly, in 2018, a scientist from the Southern University of Science and Technology China, Jiankui, stated that "due to interference with the human genome, twins were born that were immune to the HIV virus. The first genetically modified girls in the world were called Lulu and Nana. They are completely healthy and feel great." (Cyranoski & Ledford, 2018; p. 33). It shows that genetic engineering has made it possible to directly modify an organism's DNA through targeted intervention in the genome, for instance, insertion, deletion, or replacement of specific genetic material.

Brain engineering is also tremendously making it possible to enhance human brain power. Zhao et al (2020), argue that "integrating electronic components into biological systems can help scientists unlock the secrets of brain function" (p. 54).

Neuroscientists, computer engineers, and psychologists can "ultimately create a computing architecture based on how the human mind works, as they have been working to simulate the human brain" (Cakir & et al, 2019).

In this context, some scientists warn us of the possibility of danger in the future if this type of technology expands. Steffens Hawking argued that "humanity risks being replaced by genetically modified superhumans." Well-intentioned research designed to improve human health and human life will eventually be corrupted as people start to modify humans' lives, be smarter, or be more aggressive and dangerous" (Hooper, 2019, p.24). As very few people will be wealthy in the era of digitization, there is a risk that gene editing will be available only to the wealthiest. Hawking writes, "once such superhumans appear, there are going to be significant political problems with the unimproved humans, who won't be able to compete. Presumably, they will die out or become unimportant" (Davies, 2020; p. 50). With the exponential development of such types of technologies, very few people will benefit from the various opportunities, and they will likely be superhumanly empowered by algorithms and technology. In contrast, a large number of people will not be able to benefit enough from technology as they cannot afford it, and then they will remain an "underclass of disempowered sapiens" (Harari, 2018).

Downgrading Human Ability

Scholars argue that heavily relying on technology directly reduces human ability. According to Tristan Harris (2020), "technology has, intentionally and through unintended consequences, manipulated human weakness" (p. 3). The advancement of technology is the result of humans' innovation. Innovation is for human wellbeing. Reversely, the newest form of technology has become the enemy of humankind. Harris says that "technology has won over human weakness and is now attacking human strengths" (Harris, 2020; p.4). Winning human weakness means increasing some characteristics that hinder further development, which are anger, arrogance, ignorance, inferiority, addiction, and others. In contrast, some positive qualities such as physical strength, intelligence, and consciousness are gradually declining due to the interference of technology.

Nepal Telecom has estimated that "about 96 percent of the households in Nepal use mobile services" (Nepal Telecom, 2021). Approximately "87 percent of Nepalis use mobile data or broadband internet services'' (Acharya, 2078BS). Trends show that it will reach 100 percent soon. According to a report by the Manmohan Memorial Institute (2018), "more than 46% of adolescents are addicted to the internet" (Manmohan Memorial Institute, 2018). A report from the Nepal Burden of Disease 2017 shows that "the life span of Nepali people has significantly increased. The average life expectancy of men and women in 1990 was 58 and 59 years, respectively, but in 2017, it has reached 69 and 73 years, respectively" (NHRC, 2017; p. 19). On average, both have reached 70.9 years of life expectancy. However, the average healthy life expectancy is only 61 years (NHRC, 2017). Based on the

information, it can be said that old age as well as an unhealthy population are increasing day by day, which is a huge challenge in the future.

Coping Strategies: A Paradigm Shift in the Overall Education System

Humanity is facing the great challenges posed by the unprecedented technological revolution. Every revolution demands that the revolutionary education system cope with the changing situation. This is a more critical time than ever before since "once technology enables us to engineer bodies, brains, and minds, we can no longer be certain about anything" (Harari, 2018; p. 275). Now that we are at a crossroads, nobody knows where we are heading to. How can we prepare ourselves and the children for the uncertain world? What should we teach students that will help them survive and flourish in this changing world at a bullet speed?

The right-based education system and standardized testing were advocated with the move toward mass production in the second industrial revolution. Education was service-oriented, and students were taught under the customer learning model. But, in the "fourth industrial revolution, technologies really blur the lines between the physical, digital, and biological spheres" (Schwab, 2017). So, we need to think about education critically and flexibly since nobody knows what the future will look like. Thus, based on the literature, I propose an 'ABCDE' model of education to make children able to cope with the new situation. However, the validity and reliability of this model have not been tested. So, this model is proposed just for further discussion.

A= Adaptive. The future is uncertain, so we cannot prepare children for the future by providing specific skills. In the past, classrooms were supposed to teach the right answers, but now, most of the things we do not have the answers to. Now, we do not have a shortage of information. But students need the ability to make sense of information. Moreover, students need the ability to deal with change. Education should encourage students to be prepared for an uncertain future by learning adaptive abilities. The ability to learn new things and to "preserve mental balance in unfamiliar situations is essentially required to cope with the changes" (Huda & et al, 2017; p. 20). In order to keep up with the future, children need to "not merely invent new ideas and products; they will, above all, need to reinvent themselves again and again" (Harari, 2018). Continuous learning and the acquisition of new skills must become central to individuals' working lives. Education needs to focus on upskilling and reskilling to adapt to new situations.

B= Building Productive Capacity. Productive capacity is a core ability of humankind. Education is provided to develop the productive capacity of people. The productivity of the nation and organization depends on the productive capacity of the workers. Similarly, a worker's productive capacity largely depends on the education provided. Looking at history, it is seen that "the productivity of each subsequent age (agricultural, first industrial, second industrial, third industrial, and fourth industrial) goes up fifty times over the preceding age" (Xu et

al., 2018; p. 2). Consider, for example, the increase in productivity of the industrial age over the agricultural age. This was possible because of education, which helped people develop their productive capacity. In the industrial age, people tried to make people like machines, but now machines are being made like humans. Moreover, new technologies such as AI and Roberts are far stronger and more talented physically and intellectually. Besides, AIs have more abilities than humankind in terms of connectivity and adaptability. Technologies have much more productive capacity than humans. In the future, humans and machines will be alike, so education should focus on students being creative and innovative, as these abilities will never be replaced by AI. Moreover, individuals should also invest not only in digital skills but also in "meta-skills that will serve them well regardless of shifts in the market" (Neumeier, 2012).

C= Conscientization. Educationist Paulo Frere argues that "education can never be neutral. Either it is an instrument of liberating people or it is used to dominate and disempower them" (Freire, 2009). Now, the situation is different, and technology has become a tool for not only dominating human beings but also a way of "hacking humans" (Harari, 2018). To avoid technological oppression, education needs to involve a new relationship between teachers and students as well as with society. Conscientization is essential for developing a critical understanding of the changing reality, specifically the changes caused by technology. Similarly, many pedagogical experts argue that schools should switch to teaching "the four Cs"—critical thinking, communication, collaboration, and creativity". More broadly, schools should downplay technical skills and emphasize general-purpose skills (Erdogan, 2019). The animal has instinct, the machine has intelligence, and the human has wisdom. In this era of digitization, if we focus only on standardization, we will be replaced by machines. So, education should encourage children to develop wisdom. The government should refocus education systems to develop meta-skills such as logical thinking, reasoning, curiosity, open-mindedness, collaboration, leadership, creativity, and system thinking.

D= Democratic. Popular educationist John Dewey describes schools as 'miniature societies'. He further argues that "the school is not only a preparation for something that comes later but also a community with values and norms embedded in daily experiences" (Dewey, 2008; p. 89). However, digital technologies pose a threat to Dewey's vision of how schools educate for democracy at a number of levels. As the "private individual self is surveilled and commodified by supra-national global technology companies, the datafication of interpersonal interactions has tremendous consequences for what we want young people to learn and how they ought to behave as citizens in the reconfigured power relations between individuals, the state, and the market" (Harari, 2018; p. 205). To survive and flourish in such a world, we need a lot of "mental flexibility and great reserves of emotional balance" (Erdogan, 2019), which promote democratic education. We will have to let kids let go of some of what they know best and feel at home with the unknown. Nobody knows what the future will look like. So, in the past, teachers used to give knowledge to students, but in the future, teachers and students may

work together to learn. In the past, teachers knew more than the students, but in the future, students may know more than the teachers. In this age, there is no problem of lack of information. Children need to learn to choose the right information as required.

E= Equitable. The digital divide is mounting among people, which will create an unequal society. Education is essentially a means to shorten the gaps between those with sufficient knowledge of and access to technology and those without. The government should be much more proactive in trying to create a good learning environment for all irrespective of classes. Carnoy uses the term 'state-generated social capital' which refers to a learning environment in which all the children get equal opportunity to learn irrespective of their socio-economic background (Anders, 2007). This concept would be a pragmatic idea in the context of Nepal to combat the digital divide. Today, the government's spending in most countries strongly favors the richest and most educated and is usually skewed toward higher levels of education. Evidence shows that on average, in low-income countries like Nepal, 46 percent of public education resources are allocated to educate the 10 percent of the most educated students (Learning Generation, 2016). In this context, the approach of "progressive universalism—expanding the provision of quality education for everyone while prioritizing the needs of the poor and disadvantaged" (Anders, 2007) would also be applicable in education in the digital era.

Coping Strategy: Promoting Physical Education

Physical education is a "sequential, developmentally appropriate educational program that provides students with the knowledge, skills, fitness, and attitudes necessary to lead a healthy lifestyle" (Clemente, 2017; p. 20). Shields and Synnot, (2016) found three major advantages of physical activities for children. These are "physical improvement—improved level of well-being and physical health; mental improvement—self-esteem, social awareness, and self-confidence; and behavioral improvement—cognitive improvements—allowing them to access skills that they couldn't challenge within a traditional classroom setting" (Shields and Synnot, 2016; p. 24). Research shows that there is a correlation between technology use and a sedentary lifestyle (Clemente, 2017). Physical activity is a natural means to improve human well-being. As technology is gradually downgrading human ability, physical activity can help people save human ability. Education institutions should provide various sports and physical activity classes that enable children to participate in physical activity so that human ability can flourish.

Looking at the pace of the development of new technology and its use, we can assume that the situation will likely be more complex in the future. Children are more vulnerable to being influenced by the overuse or misuse of technology. Harari (2018; p. 26) argues that students are "prone to being manipulated by a computer algorithm as they indulge in technology for a long time." When children do not participate in physical activity, their abilities degrade. Indeed, we cannot avoid technology, but we must live with it. This is a critical time to be more serious about the health of children. Policymakers, teachers, parents, and students should be well

aware of the negative impact of technology use, and they should create a conducive environment for regular physical activities to cope with the challenges posed by technology. The need for physical education is increasing due to the threat posed by emerging digital technology. Parents should be educated about the side effects of the overuse of technology and encouraged to apply their role in controlling and limiting a child's screen time and access to the internet. All the stakeholders are advised to increase outdoor activities so that they can be physically active.

Conclusion

Like the agricultural and industrial revolutions, the digital revolution is a big revolution. Technological development is not only an incremental change but destructive as it demolishes most of the structures of the economic and social systems prevalent in the past. With the likelihood of merging biotechnology and information technology, everyone in this world is prone to being hacked. Computer algorithms will know us better than we do since all the individual information will be stored in big data centers. Big data algorithms will have godlike power. Robert and artificial intelligence are far more efficient than human beings in terms of economic value. The human workforce will likely be replaced by robots and AI in job markets. Once such superhumans appear, there are going to be significant political problems with the unimproved humans, who won't be able to compete. Physical strength, intelligence, and consciousness are considered the specific abilities of humankind. Technology is downgrading these abilities on a mass level. Now that we are at a crossroads, nobody knows where we are going or which way to go. How can we prepare ourselves and the children for the uncertain world? What should we teach students that will help them survive and flourish in this changing world at a bullet speed? We need to think about education critically and flexibly since nobody knows what the future will look like. 'ABCDE' can be a good model of education to make people able to survive in the future. Moreover, as technology is gradually downgrading human ability, physical activity can help people save human ability in a natural way.

Declaration of competing interest

I declare that I have no competing interests.

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