Review Article

Technological Unemployment, Skill Mismatch and the Future of Higher Education in Post-Pandemic Nigeria

Hazzan Moses Kayode[1]

1. University of Ibadan, Nigeria

Technological advancement is one of the main drivers of economic growth and development. It propels increased productivity, boosts per capita income, affects consumption patterns, and significantly alters the nature of work in both developed and developing countries. The issue of unemployment has traversed different historical epochs, with several scholars proffering solutions to the problem based on their conceptualisations of the problem's causes. In recent times, technological unemployment (TU) has assumed critical proportions among scholars looking at the issue from different perspectives, thereby offering divergent insights into its impact on job creation and destruction in the present and the prognosis of what may happen in the future. The post-pandemic period has brought about a phenomenal increase in the utilisation of e-learning and other technological devices for effective and efficient modes of teaching and learning. The effects of technology on employment have become apparent due to its attendant consequences: rising inequality, rising unemployment, the rapid advancement of artificial intelligence (AI) and robotics, and increasing digital automation of manufacturing processes - the so-called Fourth Industrial Revolution (4IR). This chapter critically examines the changing patterns of education delivery before, during, and after the pandemic, the 'work-less society' in the context of TU; the nexus between TU and skill mismatch, as well as TU and the future of higher education in post-pandemic Nigeria.

Correspondence: papers@team.qeios.com — Qeios will forward to the authors

 doi.org/10.32388/XHR1TA

1. Introduction

Technological progress is the main driver of economic growth and improvements in living standards. It increases productivity, thereby boosting per capita income and consumption. In the same vein, technology influences the nature and quality of work and the structure of societies (Geels, 2005). Conversely, unemployment is a complex phenomenon. Several scholars in the field of Economics had hitherto shown the distinction between frictional unemployment (which involves individual mobility of workers between jobs); structural unemployment (consequent upon the decline of particular sectors or occupations); and cyclical unemployment, resulting from general but transitory falls in economic activity (Campa, 2018). To this list, one can add technological unemployment, which has been a matter of utmost concern from time immemorial.

Throughout history, the topic of technological unemployment (TU) has reached critical proportions among experts studying the phenomenon from many angles. For instance, Adam Smith's optimistic viewpoint dominates classical economics, emphasising the positive impacts of mechanisation and the self-regulating character of market economies. He presents evidence of a causal nexus between high taxes and unemployment, or excessive profligacy of landlords and unemployment (Smith, 1976), rather than between the application of machinery and unemployment in his masterpiece An Inquiry into the Nature and Causes of the Wealth of Nations. Machinery is primarily seen as a technique for increasing the output of labourers, which could be increased phenomenally.

Similarly, Marx (1867) made a caustic comment on Aristotle's philosophy of technology while examining the causes behind the Luddite insurrection in 18th and 19th century Europe: 'Oh! Those pagans! They knew nothing about the political economy or Christianity. For example, many were unaware that machinery is the most reliable way to extend the working day. Both the Luddites and Marx noticed that machinery did not free humans from labour, but rather caused unemployment and the inhumane exploitation of the proletariats who are still employed. However, they proposed different remedies - the Luddites saw the panacea in the destruction of the machines, while Marx and the socialists advocated that the proletarians' benefits are predicated upon a revolution aimed at taking full possession of the machines - the means of production (Campa, 2014).

The concept of TU is regaining momentum among economists, sociologists, educationists, and other scholars in kindred fields. However, one of the most startling findings in the debate is the significant lack of agreement on the actual existence of technological unemployment as a problem. Some analysts see TU

as a colossal monster that is fully destabilising the global economy, while others decide that this picture is a figment of doomsayers' imagination (Ford, 2015; World Economic Forum, 2016; Cedefop, 2017; Campa, 2018). Hence, TU can be studied at various economic system levels: at the level of individual actors, companies, productive sectors, countries, or the global economy. For instance, the fact that at least an individual loses his/her job because the employer purchases a machine that can accurately perform his/her duty is a historical fact that can hardly be denied. Also, the fact that some companies have been automated and that this process has resulted in a drastic reduction of employment is noticeable in some organisations.

Technological unemployment, according to *The Oxford Dictionary of Economics is defined* as follows: "unemployment due to technical progress. This kind of unemployment applies to particular types of workers whose skills are made redundant because of changes in production methods, usually by substituting machines for their services" (Black, 2012: 405). What could be deduced from this conceptualisation is that TU is a concept that already includes a theory since it puts into causal relationships two distinct phenomena: technological progress and unemployment. The disagreement between the several schools of thought and perspectives mainly concerns the existence of this causal relationship.

The debate about the impact of technology on employment has been reignited recently, and the evident characteristics of this phenomenon have ineluctably been the concern of both developed and underdeveloped countries: increasing inequality, a high unemployment rate, the rapid advance of artificial intelligence and robotics, and the increasing digital automation of production processes – the so-called Fourth Industrial Revolution. Therefore, if the epoch of the Industrial Revolution (IR) could be aptly regarded as the First Machine Age, and Electricity as the Second IR, while Electronics served as the Third IR, it might be plausible to amplify that the Internet functionalizes the Fourth IR as a platform (Peters & Jandrić, 2019). Hence, studies on technological unemployment, by and large, agree that the Fourth Industrial Revolution destroys a plethora of jobs more than it creates, so advantages created by innovation and critical thinking are necessarily limited temporally and geographically (Peters & Jandrić, 2019).

Recent predictions that automation will produce massive unemployment in the next few decades have generated various responses to the question of whether the technological change will be different this time. Put simply, massive automation and technological unemployment will likely make things worse, but in unfathomable ways (Sellar, 2019). Predictions that automation will affect large numbers of jobs are

based on assumptions that the pace of change in the level of technology is increasing exponentially (Brynjolfsson & McAfee, 2014) and, by implication, unemployment could concern economic actors who have attended higher education institutions and invested much time and money to acquire their professional skills.

The 'Internet of Things,' including cloud computing, big data, and machine learning, creates a threat to jobs for middle-skilled workers, which places young people who lack experience at a disadvantage. A polarisation of employment has been observed, with jobs at medium skill levels declining and non-routine jobs increasing, both manual (low-skilled) and cognitive (high-skilled) (UNCTAD, 2016). While digital automation enables some governments and enterprises to manufacture goods and services on a previously unimaginable scale, boosting labour productivity and expanding operations at minimal cost may reduce the need for humans. As a result, recent advancements and developments in automation have the potential to cause a drastic reconfiguration of employment.

While these new technologies hold enormous promise, they are also viewed as a threat, with the potential to disrupt labour markets and contribute to (income) inequality. The most serious issue is that automation, robotics, and AI-based technologies will systematically replace human labour, resulting in enormous unemployment - and, as a result, widespread poverty - around the world. Such worries are not new. Since the early nineteenth-century industrial revolution, there have been multiple bouts of popular concern over the job-destroying impacts of technology. In the analysis of technological growth and unemployment, Campa identifies four possible scenarios akin to work automation: (i) the unplanned end of work scenario, in which jobs evaporate as a result of a free-market economy; (ii) the planned end of the robot scenario, in which a Luddite solution prevails; (iii) the unplanned end of the robot scenario, in which deindustrialisation occurs as an unintended consequence of poor public policy; and (iv) the planned end of work scenario, in which governments decide to address the challenges of TU through the scheduled retirement of the entire human race (Campa, 2014).

Non-orthodox economists saw a bleak thesis hidden in the folds of the calculations: whereas the Luddites blamed unemployment on machinery and the Marxists on the exploitative system of capitalism, neoclassical economists blamed workers who refused to work for a peanut, or on social democratic governments that peremptorily imposed a minimum hourly wage so that workers could at least survive. While the trends of automation and digitalisation continue to develop in developed countries, the question arises about whether this is also happening to the same extent in developing countries, such as Nigeria, Ghana, Tanzania, etc. According to a 2016 study by the *World Economic Forum*, technically highly

equipped countries such as Switzerland, the Netherlands, Singapore, Qatar, or the US are considered to be particularly well prepared for the fourth IR (World Economic Forum, 2016), while most developing countries still pay lip service to this unavoidable reality. Unarguably, Nigeria has a long way to go before completely embracing the concept of innovation, particularly product innovation, which has been established to enhance global employment development. There is, however, evidence that new technology is gaining traction. Given the quick pace of technological innovation and the high number of jobs in danger in the country today, one of the problems at stake is how prepared Nigeria is for TU (Oyegoke & Wasiu, 2021).

Skill mismatch (SM) is a phenomenon that is characterised by unemployment, recruitment difficulties, skills becoming outdated, and people doing jobs not using their potential. It is a situation where skill supply and skill demand diverge. Skill mismatch is a complex phenomenon, given that it is multidimensional and manifests itself at different levels (Cedefop, 2018). However, some of the eventualities often create times of heightened concern among policy-makers and the media regarding the tremendous changes in skill demands that will arise from the proliferation of digitalisation (including new forms of virtual work), artificial intelligence, and robotics in economies and societies (Brynjolfsson & McAfee, 2014; Cedefop, 2017; Ford, 2015; World Economic Forum, 2016). Such accelerating change in technologies and skill demands spurs continuous debate about whether individuals will manage to adapt their skill sets sufficiently quickly to reduce the risk of being relieved of their jobs completely by machines (Cedefop, 2018).

Employability is the possession of knowledge, aptitudes, skills, and other traits required by employers (British Council, 2014). Skills mismatch refers to gaps between the skills possessed by graduates and those required by businesses (Proctor and Dutta, 1995). As a result, a larger skills gap leads to decreased employability. The impact of Artificial Intelligence (AI) on the problem of unemployment cannot be overemphasized. For instance, the employment of AI means that typically the so-called white-collar jobs can now be automated. This could inevitably create inequality, as low-skill workers may continue struggling to adapt and thereby limit themselves in the race against technology.

Higher education's relevance is frequently measured in terms of the match between what society expects of institutions and what they do (UNESCO, 1998), as well as its ability to meet its social objectives of full employment, enhanced productivity and income, and economic growth (Longe, 1999). Unfortunately, there are regular and vociferous accusations that Nigerian university products are unemployable and, in reality, half-baked (Kayode, 2009; Adeyemo, Ogunleye, Oke, & Adenle, 2010); with too much theory and

not enough practical material. Even the National Universities Commission doubts Nigerian graduates' capacity to meet the needs of employers (NUC, 2004).

The aim of this chapter is to x-ray and critically look into the issues of TU, SM, and the future of higher education in post-pandemic Nigeria. The methodology used in this paper involves a comprehensive and analytical literature review conducted to locate papers (journal articles and theses or dissertations) on TU, the historical trajectory of dynamics in the level of unemployment right from the era of the industrial revolution, perspectives on the concept of a 'workless society', TU and SM: analysis of evolving issues in Nigeria. Also, the chapter attempts a prognosis of the likely pattern or trend of the future of higher education in resolving the problem of unemployment created by TU and SM in post-pandemic Nigeria. However, literature related to the foregoing is incorporated into the review and analysis. By extension, the selection of the journals and research works, which specifically focused on the issues relating to TU and SM and reported the results of empirical works of researchers, is critically looked into. Even though several studies have been conducted on TU and SM, studies that specifically deal with TU, SM, and the future of higher education in the post-pandemic period are still scarce.

2. Technological Unemployment: Is the world moving towards a "workless" society?

It is more often than not expected that the new wave of technological innovation will fundamentally change the future of jobs. The debate on the impact on jobs, however, is controversial. While some expect a jobless future characterised by a 'workless society', others argue that it will be business as usual, for history will inevitably repeat itself - new technologies will eventually create new and better jobs. Taking a critical look at the trend of unemployment in some Western countries, Frey and Osborne (2013) anticipated that 47% of occupations in the United States will be vulnerable to automation. This prediction has recently fueled concerns about automation and TU. Since then, governments and international institutions have prioritised the issue. The estimates are also scary outside of the United States; for example, the figure offered for Australia was 44%, and separate research indicated that 59% of employment in Germany is at risk of automation (Bowles, 2014).

Bowles (2014) repeated these estimations for the European labour market and found that, on average, 54% of EU jobs are at risk of automation. By contrast, it has been argued that a major limitation of Frey and Osborne's hypothesis is that it focuses on deriving predictions over occupations as being threatened

by automation rather than tasks (Arntz, Gregory & Zierahn, 2016). In this way, it could be extrapolated that perhaps Frey and Osborne overestimated the automation risks and therefore gave an astonishing figure. Meanwhile, by using the information on the task content of jobs at the individual level, Arntz, Gregory & Zierahn, (2016) conclude that only 9% of US jobs are potentially automatable. Whether these statistics seem conflicting cannot remove the fact that there appears to be a problem emanating from technological advancement.

Incidentally, the present wave of technological change has created a controversial debate on the future of the world of work. Some researchers believe that the new wave of technological change and its attendant innovations will ineluctably destroy jobs on a mammoth scale, thereby creating room for a jobless future (Ford, 2015; Hawking, 2016; McAfee & Brynjolfsson, 2014). Historically, the problem is far from new: as it has been emphasised in some recent articles and elsewhere, 'concerns over the displacement of human labour by machines are as old as capitalism itself' (Means, 2017&2018). On the other hand, optimists are confident that the novel technologies will galvanise adjustment and processes that will create new jobs (Perez, 2002; Vivarelli, 2007). This optimism is predicated on the historical experience championed by most economic historians (Bessen, 2015; Mokyr, Vickers & Ziebarth, 2015).

According to Adediran and Adelowo (2021), Nigeria has also experienced substantial technological advancements in recent years, but at a slower pace than many other industrialised countries. As machines and automation take over duties previously performed by humans, technological developments have resulted in the displacement of workers. As a result, job security has decreased and competition for fewer positions has intensified. Job displacement occurs when employees lose their jobs owing to a variety of factors such as technical advancement, economic restructuring, or changes in industry demand. Job displacement as a result of technological progress has been a serious concern in Nigeria, particularly in industries such as manufacturing, agriculture, and services. Many old jobs are becoming outdated as technology progresses, and employees must learn new skills.

Following the 2008 financial crisis, there was a surge of articles on Artificial Intelligence, which is viewed as the demiurge of a jobless society. To name a few, authors such as Martin Ford (2009, 2015), Erik Brynjolfsson and McAfee (2012, 2016), Stan Neilson (2011), and Kaplan Jerry (2015) are persuaded that technology is a 'wonderful thing,' but it will inevitably leave humans obsolete. This implies that employment opportunities will be more limited and mainly confined to many higher-skilled tasks, often in different locations, for the design, manufacture, maintenance, and repayment of the new equipment. Thus, a future of widespread joblessness and erosion of work and livelihoods seems frightening,

especially for young people, who will encounter intensification of competition for a decreasing pool of available jobs with higher entry qualifications and conditions and lower wages. According to Peters (2020):

“Now after several waves of technologies, the question of the social and kind of ‘workless’ society, or at least a society not so heavily defined by work, has become an urgent need for analysis and imagination. There are plenty of dystopian views that provide a picture of what might happen when there is no work or when work no longer structures our post-industrial society” (Peters, 2020, p 486).

As reflected in the preceding scenario, the future of work looks bleak even if it is admitted that the process is not one of the simple elimination of jobs through sophisticated automation and the application of intelligent systems to the world of work (Peters, Jandrić & Means, 2019).

3. Technological Unemployment and Skill Mismatch: analysis of evolving issues in Nigeria

Over several decades, technological advancement has resulted in significant changes in the job structure and salary distribution in both developed and emerging nations. Meanwhile, skill mismatch can be understood in the context of skill demand and supply, which is one of the hallmarks of the centrality of technology-driven changes in employment composition and unemployment rates. Furthermore, empirical research suggests that the proportion of tertiary-educated workers in routine employment is substantial (Marcolin et al., 2016). However, one of the pertinent issues that frequently arise among scholars and researchers in the field of economics of education in particular, and education in general, is whether the problem of skill mismatch is a result of technological advancement or a disconnect between the skills acquired in schools, as exemplified by curricula provisions, and the skills required in the labour market as demanded by labour employers.

Skill mismatch is frequently concerned with: employers being unable to fill openings despite high unemployment (skill shortages) or employees′ skills failing to meet workplace needs (skill gaps). However, skill mismatch (underutilization of an individual′s credentials and skills) is a more common occurrence (McGuinness et al., 2017). It is a term that is frequently used in policy discussions and documentation; however, the concept of skill mismatch is fairly broad and can include a range of measurements. Vertical mismatch (usually measured in terms of overeducation, undereducation, overskilling, and underskilling), skill gaps, skill shortages (usually measured in terms of unfilled and

hard-to-fill vacancies), field of study (horizontal) mismatch, and skill obsolescence are all examples of skill mismatch. The term is mainly limited to mismatches affecting employment or firms that are already hiring or looking to hire workers (Rens, 2015).

The issue of skill mismatch in the context of TU has piqued the interest of not only labour employers but also a variety of concerned stakeholders worldwide. It has been strongly stated that worldwide education systems must adjust to the shift brought about by automation as soon as possible and teach children the skills that will allow them to fully benefit from the present wave of technology adoption. These include cognitive and social intelligence, as well as the abilities required to function in a digital context as both specialists and users of digital technologies (OECD, 2018: 4). It is frequently maintained in a variety of policy studies and organisations (Cedefop, 2018; OECD, 2018) that the aforementioned non-cognitive and soft skills, which are critical for protecting individuals from the coming threat of job substitution and displacement by machines, are in short supply.

Globalisation, the knowledge-based economy, and current technological breakthroughs have increased the competitiveness and complexity of the business world. These changes have increased the level and breadth of knowledge, skills, and abilities that employers expect from employees, widening the already significant gap between employers' expectations and the actual skill levels and abilities of graduates who enter the labour pool to apply these skills. Various surveys on labour market skills demand and employer assessment of graduate employee performance across private and public organisations in Nigeria show that there is a mismatch between the job skills acquired by employees from academic institutions and the actual skill set required to execute tasks in the Nigerian labour market. A 2012 study that looked at skills mismatch among Nigerian university students (Pitan & Adedeji, 2012) discovered a substantial negative link between skills demand and supply, with an estimated skills mismatch of 60.6%. The study found that communication (67.7%) was the least supplied ability relative to demand, followed by ICT (66.3%) and decision-making (65.7%). These findings are consistent with the findings of a 2010 study.

According to the Federal Ministry of Labour and Employment (FMLE, 2017), Nigerian employers of labour have complained about the time it takes to train and bring people up to industry standards. The FMLE further claims that the economy's jobless growth between 2011 and 2015 highlighted industrial adjustment challenges and a mismatch between educational institutions' supply of labour skills and industry skill requirements for employment, which will boost growth. According to Aminu (2019), the likelihood of unemployment owing to skill mismatch is based on the graduate's field of expertise. Aminu (2019) discovered that specific types of graduates (medical sciences, engineering, social sciences, and

business) had a lower probability of unemployment in Nigeria, whereas graduates with arts, science, law, and education specialisms have a higher probability of unemployment.

The problem of SM in the context of TU has been the concern of not only the employers of labour but also various concerned stakeholders globally. It has been severely asseverated that the global education systems, as a matter of urgency, will need to adapt to the change brought about by automation and teach children the skills that allow them to take full advantage of the current wave of technology adoption. These include skills such as cognitive and social intelligence and skills needed to work in a digital context, both as specialists and as users of digital technologies (OECD, 2018: 4). Many policy papers and organisations (Cedefop, 2018; OECD, 2018) suggest that the above non-cognitive and soft skills, which are critical for protecting individuals from the coming threat of work substitution and displacement by machines, are in limited supply.

4. Theoretical Underpinning

The theory that is advanced to explain the phenomenon of skill mismatch in the context of technological unemployment is the 'heterogeneous skills theory," which has been invariably espoused by scholars (Allen & Van Der Velden, 2001; Green and McIntosh, 2002). Accordingly, heterogeneous skills theory suggests that the nexus between education and skill mismatch is much weaker. One of the basic hypotheses underpinning this theory is that the same educational attainment level does not often confer the same skill endowments and abilities. Put differently, there is a possibility that even among individuals with the same level of schooling, there is significant variability in terms of skill endowments and abilities. Thus, it is not impossible to find employees who appear to be highly educated but, because their level of skills and abilities is at the nadir of the range of people with similar qualifications, they may match more closely those with the appropriate (lower) level of education for the job they occupy. One of the essences of the theory is that educational attainment alone might not be the only panacea to the problem created by TU. Perhaps, the rationale behind the highly educated and 'qualified' workers found to be unqualified compared to their peers with the same or lower level of education who work in jobs for which their qualifications are appropriate is because the former are either less able or have less marketable skills instituted by the new phase of technological advancement, which is not sometimes curriculum- and or school-based. However, this extrapolation is a necessary rather than a sufficient condition for the infallibility of this theory.

5. Technological Unemployment, Skill Mismatch, and the Future of Higher Education in Post-Pandemic Nigeria: a prognostic perspective

The complexities behind the problem of technological unemployment in higher education have agitated the thoughts of various researchers over the years (Rens, 2015; McGuinness et al., 2017; Munoz de Bustillo-Lorente et al., 2018; Peters, Jandri, & Hayes, 2018). Could the problem of unemployment be the result of the recent spiralling and increasing development in the level of technology among the world's countries? Or, may this problem (unemployment) have been exacerbated as a result of a perceived disjunction and disconnect between the skills offered by schools based on curriculum requirements and the skills demanded by labour employers in workplaces?

Technological development has increased, rather than decreased, the overall demand for human work. The disruptive consequences of new technologies should not be overlooked. While job losses caused by technology are typically instantaneous, the development of new jobs often takes time. Furthermore, new occupations frequently differ from previous employment in terms of industry, required skills, and geographic location. This not only increases the potential for worker relocation but also presents policymakers with hurdles. As a result, while open unemployment is low in many countries, underemployment is widespread, which can be linked in part to the development of labour-saving technologies (Pritchett, 2017).

The most crucial component of the skills supply chain is education. Higher education, in particular, plays an important role in the supply of skills in every society. Nonetheless, given recent levels of technical innovation and unemployment, it becomes increasingly improbable that education alone will be adequate to overcome TU concerns (Brown et al., 2010; Lauder, 2010). Predictions of widespread unemployment and credential inflation back up Collins' (2013) claim that education would no longer play the stabilising role it once did, resulting in a crisis for capitalist society. Furthermore, Collins (2013) anticipates that the capitalist crisis will emerge between 2030 and 2050, within the time frame of much current analysis of job-related hazards from automation.

Mismatches in education and skills can sometimes increase the risk of unemployment for a variety of reasons. One of these factors could be the issue of 'overeducated' personnel, who are a poor fit for organisations, increasing the likelihood of being fired. On the other hand, there could be a skill

degeneration process that worsens the quality of the match. Longer periods of unemployment, for example, may increase the likelihood of an employee being mismatched due to skill deterioration related to inactivity and personal qualities (Rose and Ordine, 2015). Within this perspective, mismatched workers may have more lengthy spells of unemployment over their working lives, which may harm their skill endowment due to their failure to find acceptable employment (Ordine and Rose, 2015; Berton, 2015).

It seems as though the problem of unemployment goes beyond the so-called deficiencies of the school curriculum, which is deemed to be addressed by creating an avenue for the inclusion of contents of the expected skills specified by the employers of labour into the school curriculum. However, if this is done, will the problem of unemployment palliate or be resolved? Put differently, can there be full employment if the perceived dichotomy between the skills supplied and skills demanded is resolved by ensuring that the school curriculum reflects the contents of the skills demanded by the employers of labour? Can structural reconfiguration of school curricula take care of the unemployment induced by an exponential increase in the level of technological advancement, which may equally displace the 'skilled workers'?

When societies develop, institutions must adapt to remain relevant to changing socioeconomic situations and difficulties. Crises are viewed as opportunities for reform, as they induce a condition of shock that allows for bolder engagement (Cepiku & Sauvignon, 2012). Also, crises or other external occurrences are seen to create the circumstances for transformation. A crisis can make previously inconceivable innovations suddenly inevitable... (Photopoulos, Stavrakas & Triantis, 2021). Hence, the exponential expansion of technology has given rise to possibilities that were previously unthinkable: explicit international communication, unlimited and continual access to knowledge, democratised production and dissemination of information and digital material, and so on (Hazzan, 2022). Hence, universities will need to redesign their learning environments so that digitalisation widens and complements student-teacher and other relationships to remain relevant (Schleicher, 2020).

One of the unavoidable consequences of the COVID-19 pandemic is a knowledge gap. Given that the twentieth and twenty-first centuries are connected with computer development or, more accurately, Information and Communication Technology (ICT) (Okanezi & Ebradouye, 2021). With the expansion of globalisation in the twenty-first century, many universities have taken a new course, requiring higher education institutions (HEIs) to redefine their responsibilities, aims, goals, and functions. They are increasingly expected to be engines of socioeconomic growth as well as engines of political, cultural, social, and technological change. As a result, in today's culture, the quality of higher education (HE) is judged in ways other than education (Elnaggar and Sharaf, 2022). One of the significant issues identified

that may have ramifications for the post-COVID-19 pandemic era is the sluggish integration and limited usage of ICTs for teaching and learning in Nigerian universities (Akinde, 2021).

There is a possible link between education, literacy rate, and unemployment. For example, Nigeria's adult literacy rate in 2018 was 62%. Adult (15+) Literacy Rate in Nigeria, 2018. This is reflected in Nigeria's unemployment rate, which was 27.1% in the second quarter of 2020, indicating that approximately 21 million Nigerians were still unemployed (Olawunmi & Nwamaka, 2021). According to this research (Olawunmi & Nwamaka, 2021), Nigeria's unemployment and underemployment rate of 28.6% is a combined 55.7%, reflecting the country's substandard education initiatives. According to Oyekanmi (2020), the unemployment rate among young people aged 15 to 34 years was 34.9%, up from 29.7% in the third quarter of 2018, while the percentage of underemployment for the same age group jumped to 28.2%, up from 25.7%.

When compared to other age groups, these rates were the highest. It is significant to realise that contemporary Nigerian HE is primed to tilt towards the realisation that creativity, curiosity, critical thinking, entrepreneurship, teamwork, communication, growth mindset, global competence, and a plethora of other talents are on the rise (Duckworth and Yeager, 2015; Zhao et al. 2019). Therefore, humans must not compete with machines to prosper in the age of smart machines. Instead, they must become more human. Being distinctive and having social-emotional intelligence are distinguishing human attributes that machines do not have (yet) (Zhao 2018a, 2018b). Given shifting labour market demands, the Nigerian government, particularly the Federal Ministry of Education, is expected to enable the alignment of future labour market entrants' training to the labour market's increasing skill requirements.

Misalignments between the supply of skills and the demand for skills, which is currently undersupplied, are mostly driven by the increased demand for cognitive skills, which are frequently required in new-economy sectors such as ICT and consulting. Although the usage of cognitive skills is increasing in Nigeria, existing information suggests that physical skills continue to dominate the manufacturing process (Favara & Appasamy, 2015). One probable explanation for this phenomenon could be the enormous magnitude of Nigeria's informal sector. This is especially relevant considering the growth and quick dissemination of new technologies in Nigeria (Favara & Appasamy, 2015), as well as the structural shift of the Nigerian economy from an agrarian to an economy dominated by services (Alemu, 2015). These activities have undoubtedly impacted labour market dynamics, particularly the occupations and skills required. Recent information from employment surveys conducted by the National Bureau of

Statistics (NBS) shows that job openings in knowledge- and technology-demanding fields are increasing. For instance, according to the NBS (2016), employment opportunities were concentrated in three industries: trade and services, consultancy, and information and communications technology (ICT)/telecommunications.

Unarguably, Nigeria has a long way to go in fully adopting the concept of innovation, particularly product innovation, which has been established to boost job creation globally. Realistically, the notion that a university degree does not necessarily guarantee a future of stable and safe jobs is exacerbated by TU's emerging global dilemma confronting humanity (Peters, Jandri, & Hayes, 2018). However, there is an indication that new technology is gaining traction. Given the rapid pace of technological advancement and the high proportion of jobs at risk in the country today, how prepared is Nigeria for technological unemployment (Oyegoke & Wasiu, 2021)?

Because labour markets are imperfect, some degree of skill mismatch is unavoidable; nonetheless, severe mismatch has negative economic and societal implications (Cedefop, 2018). Individuals who can survive and thrive in the digital economy, as well as those who are suited to the skill requirements of future jobs, have a healthy mix of cognitive (problem-solving, creativity, learning to learn) and socio-emotional (communication, collaboration) skills. Providing suitable skills to existing and future workers is a critical policy subject. The educational system and on-the-job training have an impact on the supply of workers at each skill level.

The nature and evolution of SM during a person's job tenure are determined by the balance between the rate of skill growth and the degree of change in the complexity of job activities. It is critical to adapt school curricula to reflect the talents that will be in demand in the future. However, it has been suggested that the relationship between technological advancement and the skills required by various organisations may result in sub-optimal productivity and unemployment outcomes when there are skill mismatches between the demand and supply of labour (Marcolin et al., 2016). As a result, it may be appropriate for education and training institutions to equip people to be flexible and gain new abilities in response to the quick changes in new technology.

One of the most worrying challenges in higher education today is that, as the conventional link between employment and education breaks down, there will no longer be a linkage between university education and a job guarantee (Peters, Jandri, & Means, 2019). As a result, at this juncture, the development of job-related abilities that will be increasingly in demand as 4IR unfolds is essential. Nonetheless, the potential of significant SU necessitates a radical reimagining of educational aims (Means, 2017) and a new shared

vision of humanist education (Peters et al., 2019). As automation, robotics, and artificial intelligence continue to disrupt and redefine the labour market, the question of whether higher education institutions are keeping up with this rate of change is serious (Veronique & Salmon, 2019).

6. Conclusion and Recommendations

Technologies of the present seem to destroy more jobs than they create - and this trend is likely to continue (Peters & Jandrić, 2019). What type of education is needed to meet big corporations' needs in post-pandemic Nigeria? Despite the fact that a few previous studies on TU had hitherto prognosticated that new technologies would eliminate a significant number of jobs, more recent estimates indicate the risk has been overstated (Ra et al., 2019). For instance, it is suggested that automation is more likely to modify duties and activities within an occupation rather than annihilate jobs completely; increased demand from rising earnings is anticipated to counteract job losses from technology, which is especially true in developing countries (Asian Development Bank [ADB], 2018), and technological adoption may not be cost-effective.

Significantly, the paper has x-rayed the issue of SM in light of the problem of TU in post-pandemic Nigeria on one hand and the problem of disconnect between the skills required by employers and the skills acquired by employees on the other hand. Hence, the treatise posits that the problem of unemployment is made complex and complicated by not only the advancement in the level of technology but also by the SMs occasioned by the discrepancies between the contents of the school curriculum in respect of the skills acquired and the skills expected by employers of labour. Be that as it may, the chapter makes a foray into probable turns in the future of higher education and how the current level of unemployment could likely influence the change in the school curriculum and/or mode of instruction.

However, in a world that does not offer enough work for everyone, education might not be a panacea for the challenges of TU (Peters et al., 2019). Therefore, it is suggested that a nexus may be created between higher education and the world of work in Nigeria. So, rather than taking a passive wait-and-see approach, Nigerian governments can and should influence the trend of TU by systematically restructuring education at the higher level of learning. And since the new technologies have not only ineluctably changed the *modus operandi* of teaching and learning in higher education in Nigeria, but also the nature of skills demanded in the labour markets, curriculums in higher learning institutions can be adapted while on-the-job and life-long learning opportunities are promoted. Imperatively, to salvage the country from the trend of seemingly upcoming savagery of unemployment, the government could

establish uniform standards around 21st-century skills, ensure that higher-order skills are embedded in the curriculums, and provide both the funding and test environments needed for further research.

References

- Adediran, O. S. & Adelowo, A. A. (2021). The implications of technological changes on industrial relations in the Nigerian banking sector. Advances in Economics, Business and Management Research, 166, 91-100.
- Adeyemo, S.A., Ogunleye, A.O., Oke, C. O. & Adenle, S. O. (2010). A survey of factors determining the employability of science and technology graduates of polytechnics and universities in the Nigerian labour market. Journal of Science and Technology Education Research, 1(5): 99 – 106.
- Akinde, T.A. (2021). Inhibitors to the electronic teaching and learning of library science in the Nigerian universities of the post-COVID-19 pandemic era and the way forward. American Journal of Information Science and Technology, 5(2): 30-39. http://www.doi.org/10.11648/j.ajist.20210502.13
- Alemu, Z. G. (2015). The challenge of job creation in Nigeria. Africa Economic Brief (AEB), 6(8), 116. Available at: http://www.adb.org/Documents/EDRC/Policy_Briefs/PB044.pdf. (Accessed: 22 April 2023).
- Allen, J. & Van der Velden, R. (2001). "Educational mismatches versus skill mismatches: Effects on wages, job satisfaction, and on-the-job search." Oxford Economic Papers, 3, 434-452. https://www.doi.org/10.1093/oep/53.3.434
- Aminu, A. (2019). Characterising graduate unemployment in Nigeria as education-job mismatch problem. African Journal of Economic Review, VII (2): 113-130.
- Arntz, M., Terry, G., & Ulrich, Z. (2016). "The risk of automation for jobs in OECD countries: a comparative analysis." OECD social, employment and migration working papers, No. 189, OECD Publishing, Paris.
- Asian Development Bank. (2018). Asian Development Outlook (ADO) 2018: How technology affects jobs. Manila, Philippines: Author.
- Berton, F., Devicienti, F. & Grubanov-Boskovic, S. (2017). Employment protection legislation and mismatch: Evidence from a reform. IZA Discussion Papers 10904, Bonn.
- Bessen, J. E. (2016). How computer affects occupations: Technology, jobs and skills. Boston University School of Law. Law and Economics Research Paper 15-49. SSRN Scholarly Paper No.ID 2690435.Social Science Research Network. Rochester, NY. https://www.doi.org/10.2139/ssrn.2690435

- Black, J., Nigar H., & Gareth M. (2012). A dictionary of Economics. Oxford: Oxford University Press. https://www.doi.org/10.1093/acref/9780199696321.001.0001
- Bowles, J. (2014). "The computerisation of European jobs". In Bruegel, July 2014. Available at: http://www.bruegel.org/2014/07/the-computerisation-of-european-jobs/ (Accessed: 22 April 2023).
- British Council (2014). Going global: can higher education solve Africa's job crisis? Available at: http://www.britishcouncil.org/education/ihe (Accessed: 24 April 2023).
- Brown, P., Lauder, H. & Ashton, D. (2010). The global auction: the broken promises of education, jobs and incomes. Oxford: Oxford University Press.
- Brynjolfsson, E & McAfee, A. (2012). Race against the machine: how the digital revolution is accelerating innovation, driving productivity, and irreversibly transforming employment and the economy. Lexington MA: Digital Frontier Press.
- Brynjolfsson, E. & McAfee, A. (2014). The second machine age: Work, progress, and prosperity in a time of brilliant technologies. WW Norton & Company, New York.
- Brynjolfsson, Erik, & Andrew, McAfee. (2016). The second machine age: Work, progress, and prosperity in a time of brilliant technologies. W. W. New York and London: Norton & Company.
- Campa, R. (2014). "Workers and automata: a sociological analysis of the Italian case." Journal of Evolution and Technology, 24(1): 70-85.
- Campa, R. (2018). Technological unemployment: a brief history of an idea. Orbis Idearum, 6(2): 57-79.
- Cedefop (2017). People, machines, robots and skills. Briefing note. Available at: http://www.cedefop.europa.eu/en/publications-and-resources/publications/9121. (Accessed: 24 April 2023).
- Cedefop (2018). Insights into skill shortages and skill mismatch: learning from Cedefop's European skills and jobs survey. Luxembourg: Publications Office. Cedefop reference series; No 106. Available at: http://www.data.europa.eu/doi/10.2801/645011. (Accessed 25 April 2023).
- Collins, R. (2013). The end of middle-class work: no more escapes. In I. Wallerstein, R. Collins, M. Mann, G. Derluguian, & C. Calhoun (Eds.), Does capitalism have a future? New York: Oxford University Press.
- Duckworth, A. L. & Yeager, D. S. (2015). Measurement matters: Assessing personal qualities other than cognitive ability for educational purposes. Educational Researcher, 44(4): 237–251.
- Elnaggar M. E. & Sharaf, R.S. (2022). A proposed E-learning technology management model for universities in response to the COVID-19 global crisis. European Scientific Journal, ESJ, 18(12): 58. http://www.doi.org/10.19044/esj.2022.v18n12p58.

- Favara, M. & Appasamy, I. (2015). Nigeria: Skills for competitiveness and Employability. World Bank, Washington D.C.
- Federal Ministry of Labour and Employment. (2017). National Employment Policy. Federal Republic of Nigeria: National Employment Policy. Abuja, Abuja: Federal Ministry of Labour and Employment.
- Ford, M. (2009). The lights in the tunnel: Automation, accelerating technology and the economy of the future. USA: Acculant TM Publishing.
- Ford, M. (2015). Rise of the robots: Technology and the threat of a jobless future. New York: Basic Books.
- Frey, B. & Michael, O. (2013). "The future of employment: how susceptible are jobs to computerisation?" Working paper. Oxford martin programme on technology and employment. Available at: http://www.oxfordmartin.ox.ac.uk/publications/view/1314. (Accessed: 23 April 2023).
- Geels, F. (2005). "Co-evolution of technology and society: the transition in water supply and personal hygiene in the Netherlands (1850–1930)—a case study in multi-level perspective." Technology in Society, 27(3): 363–97. http://www.doi.org/10.1016/j.techsoc.2005.04.008.
- Green, F. & McIntosh, S. (2002). "Is there a genuine under-utilisation of skills amongst the over-qualified?" SKOPE Research Paper No. 30.
- Hawking, S. (2016). This is the most dangerous time for our planet, in: The Guardian, 1 December 2016. Available at: http://www.theguardian.com/commentisfree/2016/dec/01/stephen-hawkingdangerous-time-planet-inequality (Accessed: 12 April 2023).
- Hazzan, M. K. (2022). Deception in the era of digital technologies and the distortion of reality and facts: an x-ray of Nigerian peculiarities. E-Learning and Digital Media, 0(0): 1–16. http://www.doi.org/10.1177/20427530221124002.
- Kaplan, J. (2015). Humans need not apply: a guide to wealth and work in the age of artificial intelligence. New Haven: Yale University Press
- Kayode, A. (2009). Bridging the skills gap in Nigeria: Framework for dialogue between universities and employers of labour. A keynote address presented at the 24th Conference of the Association of Vice Chancellors of Nigerian Universities, University of Ilorin.
- Lauder, H. (2010). 'Hugh Lauder (Part 1 of 4): How the global auction for jobs is breaking the promise of education'. Available at: http://www.youtu.be/hyDVQpktyVY. (Accessed: 13 April 2023).
- Longe, R. S. (1999). Investment in Nigerian education: Relevance, quality and governance at the eve of the third millennium- Inaugural lecture Faculty of Education, University of Ibadan, Ibadan.

- Marcolin, L., Miroudot, S., Squicciarini, M. (2016). The routine content of occupations: New cross-country measures based on PIAAC. OECD Science, Technology and Industry Working Papers, 2016/02, OECD Publishing, Paris.
- Marx, K. (1867). Capital, volume one, chapter fifteen: Machinery and modern industry.
- McGuinness, S. & Pouliakas, K. (2017). Deconstructing theories of over education in Europe: a wage decomposition approach. In: Polacheck, S.W. et al. (eds). Skill mismatch in labour markets. Research in Labour Economics, Vol. 45. UK: Emerald Publishing Ltd. https://www.doi.org/10.1108/S0147-912120170000045003
- Means, A.J (2017). Education for a post-work future: Automation, precarity, and stagnation. Knowledge Cultures, 5(1): 21–40. https://www.doi.org/10.22381/KC5120173
- Means, A. J. (2018). Platform learning and on-demand labor: Speculative projections on the future of work and education. *Learning, Media, and Technology,* 43(3): 326–338. https://www.doi.org/10.1080/17439884.2018.1504792 .
- Mokyr, J., Chris V., & Nicolas, L. Z. (2015). "The history of technological anxiety and the future of economic growth: is this time different?" *The Journal of Economic Perspectives,* 29 (3): 31–50. http://www.doi.dx.doi.org/10.1257/jep.29.3.31 .
- Munoz-de Bustillo, R., Sarkar S., Sebastian R., & Antón, J.I. (2018). Educational mismatch in Europe at the turn of the century: Measurement, intensity and evolution. *International Journal of Manpower, 39*(8): 977-995. https://www.doi.org/10.1108/IJM-10-2018-0327
- NBS. (2016). *Employment Report*. Available at: http://www.nigerianstat.gov.ng/report/397. (Accessed: 15 April 2023).
- Neilson, S. (2011). *Robot nation: Surviving the greatest socio-economic upheaval of all time*. New York: Eridanus Press.
- NUC (National Universities Commission) (2004). Labor market expectations of Nigerian graduates. *Report of National Needs Assessment Surveys,* 174. Abuja, Nigeria.
- OECD. (2018). *Putting the face behind the jobs at risk of automation.* Policy brief on the future of work. Paris: OECD. Available at: http://www.community.oecd.org/docs/DOC-132202. (Accessed: 20 April 2023).
- Okanezi, B. & Iyalagha, E. (2021). Applying technology innovation to education to bridge the knowledge gap occasioned by Covid-19 pandemic lockdown in Nigeria. *International Journal of Research and Innovation in Social Science (IJRISS)* Volume V, Issue V, |ISSN 2454-6186.

- Olawunmi, K. & Nwamaka, O, G. (2021). COVID-19: Ensuring continuity of learning during scholastic disruption in Tertiary Institutions in Nigeria. *World Journal of Education, 11*(3). https://www.doi.org/10.5430/wje.v11n3p30.
- Ordine, P. & Rose, G. (2015). Educational mismatch and unemployment scarring. *International Journal of Manpower, 36*(5): 733-753. https://www.doi.org/10.1108/IJM-03-2013-0048
- Oyegoke, E.O. & Wasiu, W.A. (2021). Does technological innovations affect unemployment in Nigeria? *CBN Bullion,* 45(40): 13 - 24.
- Oyekanmi, S. (2020). Nigeria's unemployment rate jumps to 27.1% as at 2020 Q2. Nairametrics.com. Available at: https://nairametrics.com/2020/08/14/breaking-nigeria-unemployment-rate-jumps-to-27-1/UNESCO. (Accessed: 19 April 2023).
- Perez, C. (2002). *Technological revolutions and financial capital: The dynamics of bubbles and golden ages* (London, Elgar). https://www.doi.org/10.4337/9781781005323
- Peters, M. A. (2020). Beyond technological unemployment: the future of work. *Educational Philosophy and Theory, 52*(5): 485-491. http://www.doi.org/10.1080/00131857.2019.1608625. Available at: http://www.tandfonline.com/loi/rept20. (Accessed: 18 April 2023).
- Peters, M. A., Jandric, P., & Means, A. (Eds.). (2019). *Education and technological unemployment.* Singapore: Springer. https://www.doi.org/10.1007/978-981-13-6225-5
- Peters, M.A. & Jandrić, P. (2019). Education and technological unemployment in the fourth industrial revolution. The oxford handbook of higher education systems and University Management. http://www.doi.org/10.1093/oxfordhb/9780198822905.013.27
- Peters, M.A., Jandrić, P., & Hayes, S, (2018). The curious promise of educationalising technological unemployment: What can places of learning really do about the future of work? *Educational Philosophy and Theory.* http://www.doi.org/10.1080/00131857.2018.1439376
- Photopoulos, P., Stavrakas, I. & Triantis, D. (2021). *Post-COVID-19 Education: a case of technology driven change?* In proceedings of the 13th International Conference on Computer Supported Education (CSEDU 2021) 1, 603-613. http://doi:10.5220/0010481206030613.
- Pitan, O. & Adedeji, S.O. (2012). Skills mismatch among university graduates in the Nigeria labour market. *US-China Education Review* 90-98.
- Pritchett, Lant. (2017). *"Why are geniuses destroying jobs in Uganda?"* Centre for Global Development. Available at: http://www.cgdev.org/blog/why-are-geniuses-destroying-jobs-uganda. (Accessed: 24 April 2023).
- Proctor, R. W. & Dutta, A. (1995). *Skill acquisition and human performance.* Thousand Oaks, C. A.: Sage.

- Ra, S. (2018). *The future of workforce: What's up and what's next on skills development.* Presented at the ASEAN Confederation of Employers Conference on ASEAN Employers: Empowering People, Prioritizing Skills in Manila, Philippines.
- Rens, T. V. (2015). *The skills gap: is it a myth?* Global perspectives series: Paper 5 December 2015 Competitive Advantage in the Global Economy (CAGE) ESRC.
- Schleicher, A. (2020). *The impact of Covid-19 on education insights from education at a glance.* OECD. Available at: https://www.oecd.org/education/the-impact-of-covid-19-on-education-insights-education-at-a-glance-2020.pdf. (Accessed: 25 April 2023).
- Sellar, S. (2019). *Acceleration, automation and pedagogy: how the prospect of technological unemployment creates new conditions for educational thought.* Education and technological unemployment. M.A. Peters., P.Jandrić & A. J. Means. Eds. Springer Nature Singapore Pte Ltd. Chapter 9: 131-144. https://www.doi.org/10.1007/978-981-13-6225-5.
- Smith, A. (1776) An *inquiry into the nature and causes of the wealth of nations*. London: The Electric Book Company
- UNCTAD (2016). *Robots and industrialisation in developing countries.* UNCTAD Policy Brief No. 50. October, 2016. Available at: http://www.unctad.org.en/PublicationLibrary/presspb2016d6.en,_pdf (Accessed: 19 April 2023).
- UNESCO (1998) *Final Report, World Conference on Higher Education in the Twenty-first Century: Vision and Action.* Paris, 5–9 October
- Veronique, R., & Salmon, J. (2019). *"Higher Education and the School-Work Mismatch in an Evolving Labor Market."* Mercatus Research, Mercatus Center at George Mason University, Arlington.
- Vivarelli, M. (2007). *Innovation and employment.* A Survey, IZA Discussion Paper No. 2621. https://www.doi.org/10.4337/9781847207012.00054
- World Economic Forum (2016). *The future of jobs: Employment, skills and workforce strategy for the fourth industrial revolution.* Global Challenge Insight Report. Available at: http://www.weforum.org/docs/WEF_Future_of_Jobs.pdf. (Accessed: 20 April 2023).
- Zhao, Y. (2018a). Personalizable education for greatness. *Kappa Delta Pi Record, 54*(3): 109–115.
- Zhao, Y. (2018b). *Reach for Greatness: Personalizable Education for All Children*. Thousand Oaks, CA: Corwin.
- Zhao, Y., Wehmeyer, M., Basham, J., & Hansen, D. (2019). Tackling the wicked problem of measuring what matters: framing the questions. *ECNU Review Education, 2*(3): 262–278.

Declarations

Funding: No specific funding was received for this work.

Potential competing interests: No potential competing interests to declare.