SRHE Society for Research into Higher Education

Graduate Employability in an Era of 'Technological Unemployment'

Scoping Award Research report

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Jisun Jung – The University of Hong Kong

Contents

Disclaimer: The views expressed in this report are the authors' and do not necessarily reflect those of the Society for Research into Higher Education

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Executive summary

With the exponential technological advancement, it is not difficult to find projections of how many jobs will disappear in the coming years due to automation and robotization; this phenomenon is generally defined as ‘technological unemployment’. This project examined the impact of technological development on the labour market transition for university graduates and discussed the role of universities in supporting students' employability.

The objectives of the research project were;

- To project the impact of automation on economic structure and labour market conditions
- To conceptualise the graduates' employability in the changing labour market condition with technological development
- To explore the role of universities in interpreting and supporting employability for students

The project followed a qualitative design of the scoping review, which aims to search and map a study's key concepts and themes and synthesise the scope of an area of inquiry. The findings helped us understand the related concepts and issues of technological unemployment caused by automation and the fourth industrial revolution in various national contexts. The existing studies evaluate the impact of technological development on the labour market differently, either utmost or minimal, by occupations or tasks. Studies have also assessed the effects differently by limiting them to routine tasks or including cognitive work. Studies commonly emphasise the effect as ‘uncertainty’ and have consensus on universities’ need to focus on flexibility and adaptability as essential skills for the future labour market.

Scoping review process

To provide a comprehensive summary of current literature relevant to the research questions, the project followed a qualitative design of the scoping review. Based on Arksey and O'Malley (2005), the scoping review was conducted with the following steps:

1. Searching for relevant studies
2. Selecting studies based on pre-defined inclusion criteria
3. Extracting data
4. Collating, summarising, and reporting the results

The process was iterative rather than linear. We reflexively engaged with each stage, repeating steps to ensure the literature was covered comprehensively (Arksey & O'Malley, 2005). The data collection was based on the SCOPUS Database. The search scope was limited to journal articles written in English since the 1980s. The search was conducted from June to July 2020. We used the keywords in the article title, abstract, and keywords as search criteria. The inclusion and exclusion criteria for searching keywords are described in Table 1. We used the keyword 'university graduates' rather than 'higher education', mainly because most articles about technological advancement and higher education focus on the learning aspects (i.e., using technology in a university classroom).

Table 1. Inclusion and exclusion criteria for searching documents

Inclusion criteria	Search keywords combination (number of articles) • technological unemployment/higher education: 58 • technological unemployment/ university graduates: 11 Expanded to the • automation/higher education/employment: 35 • automation/higher education/labour: 23 • automation/university graduates: 64
Exclusion criteria	• Duplicate items: • Field-specific journals (i.e., Medicine, Chemistry, Marketing, etc.): • Industry-specific articles (i.e., Use of technology in agriculture, banking • Manual checking for relevance (i.e. secondary school-based research, study about specific software development in using the classroom), using learning management system: although some papers about using technology in higher education context in a broad sense were included. • Non-accessibility to the full text:
Total: 191	Remove duplicate: 164

After the first screening stage, we read the abstracts of selected articles and further divided the articles based on their relevance to the topic, as Table 2 displaces.

Table 2. Searching documents

Important/relevant	Partly related/relevant	Not-important
In-depth analysis	Abstract reading; and decide how we will include/exclude them in the analysis	Delete/exclude them in the list (if they are clearly irrelevant) A brief summary/category of articles, if there are some important points

Thematic analysis

Based on the scoping review, we first created the key themes of technological unemployment and its impacts on the labour market transition among university graduates. We categorised them based on the research questions of the project. Table 3 presents our key themes and keywords from the analysis.

Question 1: How is the topic of automation and technological unemployment identified in the existing literature? • Accompanied global issues: globalisation, offshoring, demographical changes, more disadvantages to the developing countries • History, definition, vision, the scope of automation and technological unemployment • Projection to the economy: Positive (production increase, economic prosperity, business cycle efficiency); Negative (Job loss, skill polarisation); which industrial sector will be the most affected? • Projection to the society: Positive (reducing working hours, more leisure time); Negative (digital divide, human value, inequality, ethical issue) • Policy suggestions: Basic income, social welfare for unemployed
Question 2: How is the relationship between technological development and the labour market described in higher education research? • Job seeking (Job searching): Credits become more important (AI screening) vs. Skills become more important. • Job seeking: differences in preferences for different sectors (Public sector, Service sector, Manufacturing, entrepreneur) • Employment status: Flexible vs. Unstable • Employment outcomes: Wage (polarisation), Job satisfaction (changes in working value, work ethics)
Question 3: How is employability constructed in the context of technological development? • Transferable skills/soft skills/generic skills Implications • Whether today's disciplinary structure will be maintained or not. • Will the emphasis on employability in higher education continue as it is?

Findings

Automation and technological unemployment

The impact of technological advancement on the labour market transition among university graduates is companied by several other global challenges, such as globalisation, offshoring, and demographical changes. Jung's (2020) study described that globalisation and global competition for knowledge production are the most apparent trend in today's higher education. Although technological advancement has brought several positive changes in human life and education, there are concerns about the employment and labour market. For example, due to the changes in economic growth patterns, more demands can be easily handled without creating more jobs. Some innovative suppliers often create new demands, which means that only businesses that can create new value-added products will increase their profits substantially and create more jobs.

Thus, the future of labour is a topic of broad academic and public policy interest (Dodel & Mesch, 2020; Persons, 2018). Several studies showed widespread technology adoption would substitute middle-wage workers who engage in routine tasks (Nguyen, 2018; Rauf et al., 2021; Mkansi and Landman, 2021). Globalisation has further changed management and professional work as many of them are digitalised with most tasks broken down into more specialised sub-tasks and even moved across international boundaries (Herbert et al., 2020).

With technological advancement and labour market changes, studies have examined the concept of technological unemployment in recent years. Keynes (1933) suggested that the original term referred to the loss of jobs with technological changes. The term has been revisited today, mainly caused of automation and robotisation. Most related studies have pointed out the trend of job loss driven by automation; however, it was found that the term has diverse forms according to the different contexts. They are artificial intelligence (AI), big data, machine intelligence, SSC (shared service centre), and the fourth industrial revolution (Gardberg et al., 2020; Gownder et al., 2018; Howcroft & Richardson, 2012). Although each term has technically different meanings, they are, in many ways, becoming catch-all terms for a range of technological changes at work. Frey and Osborne's (2013) study is the most widely cited research on automation to the

dramatic impact on the labour market. Yet, many scholars have pointed out its limitations, including the ambiguity in task and occupation automation.

The study by Rauf et al. (2021) provided a wide range of definitions concerning automation and artificial intelligence (AI). For example, ‘AI is a machine’s ability to carry out human cognitive functions, such as reasoning, learning, problem solving or creativity, as well as sensory functions, such as visual perception and speech recognition’ (p. 187). Studies about automation at work have started to rise again due to the exponential increase in computing power (Clifton et al., 2020; Colvin, 2016). Those studies have projected the risks to professions' work and concluded that many areas with a repetitive nature of tasks, such as administrative work, will be replaced by machines. Workers with less complex, non-creative, or routine management jobs will disappear sooner or later (McKinsey Global Institute, 2018). The Future of Jobs (2016) report stated that more than 4.7 million routine white-collar office jobs would be lost due to the impact of AI and automation (World Economic Forum, 2016). More than 7.1 million jobs across various occupations are at risk in the near future (Frey & Osborne, 2013; Frey & Rahbari, 2016). A similar project was presented in the study of Mkansi & Landman (2021) using the fourth industrial revolution concept. Mkansi (2017, p. 218) presents the fourth industrial revolution as the “convergence of physical objects (things) and digital worlds (virtual representation that is embedded with sensory, actuator and smart devices) such as the cloud, smart phones, radio-frequency identification devices (RFID), necessary and required to control the entire value chain”. With such changes, the study of Mkansi and Landman (2021) showed that repetitive jobs, routine jobs, and blue-collar workers are more likely to be vulnerable to automation in the coming years.

Besides projecting the loss of occupations and tasks, several studies have examined the effect of technological advancements on the economy. Some studies have focused on the positive effects on the economy, including production increase, economic prosperity, and business cycle efficiency. In contrast, other studies have focused on the negative effects, such as job loss and skill polarisation. More specifically, studies have projected economic growth, which the technology will support. The technology will boost productivity and accelerate GDP growth (McKinsey Global Institute, 2018). The technology is also expected to provide authentic solutions for many pressuring issues in industries. Even for the decision-making for public policies, the technology is expected to make an

optimal decision based on the algorithm without any bias from the stakeholders. They also may provide advantages for skilled and adaptable employees (Dodel & Mesch, 2020).

On the other hand, negative projections are described regarding the labour market disruptions, which will be caused by the constant cycles of job loss and job creation. Even if job creation comes from the new business demands, transitioning to new jobs will take time and may disrupt business processes and operations (Agrawal et al., 2017; Morikawa, 2016; Morikawa, 2017). In particular, studies have warned of the risk of job polarisation. In other words, there will be improved employment opportunities for high-skilled, high-wage jobs; conversely, there will be disadvantages for low-skilled, low-wage jobs and less favourable developments for middle-skilled jobs. Campbell's (2018) study has shown the polarisation more concretely; for example, at one end of the skill spectrum are the 'abstract tasks' which require more human interaction, such as creativity, collaboration, intuition, and persuasion. These tasks are found in professional, leadership, technical and analytic fields. Individuals in these positions hold college degrees, are more likely to adjust to computing advancements, and are at the top of the earnings scale. At the other end of the spectrum are the 'manual tasks' which require "situational adaptability, visual and language recognition, and in-person interaction" (Autor & Price, 2013, p. 2–3).

The impact of technological advancement has also been mentioned in the social dimension (Holder et al., 2018; Mokyr et al., 2015). Some expect the positive changes we will have in society using advanced technologies. For example, Carpenter (2019) states that automation is fueled by the ubiquity of data and technology that are combinatorial across the entire spectrum of human activities (i.e., hyper-connectivity, supercomputing, big data, internet of things, blockchain, and open application program interfaces or APIs), which, in turn, disrupt the creation of economic value and, ultimately, new business and working models. Machines may be the more intelligent decision-makers in data-driven fields such as healthcare, courtrooms, and stock markets (Frey & Osborne, 2013). Machine and calculation costs have decreased over recent years, allowing for greater utilisation of machines in workplaces (Arntz et al., 2016).

However, most projections are relatively negative. For example, the value of degree credentials will be diminished in an expanding global graduate labour pool. As professional works can be increasingly digitised and broken down into sub-tasks that are 'location free' (Herbert et al., 2020), these related jobs can be performed remotely with lower wages, depending on the national economic standard. This will significantly affect university

graduates who do not have a higher educational level or social and cultural capital as they have to compete for jobs (Herbert et al., 2020). There are other problems, such as increasing inequality. Low and middle-skilled workers will suffer from the salary reduction with automation; in the meantime, the gains in productivity increase will not be shared by the employees; instead, only the business owners will gain higher profits. Such income inequality might create social unrest because the wage reduction of unskilled workers will be dissatisfied with their working conditions and life quality (Kim et al., 2017; Pham et al., 2018).

Not all jobs and workers have been equally out-competed and financially threatened by machines and computers. Many middle- and lower-class wage-earners became unemployed after their jobs became obsolete, while a few highly educated and skilled professionals and business owners ~~capitalists~~ enjoyed most of the computerization's financial benefits. In the words of Brynjolfsson and McAfee (2014), new technologies began ''encroaching into human skills in a way that was completely unprecedented.'' High-paying occupations, including those of executives and entrepreneurs, have enjoyed more excellent pay, as computers have only aided their creativity and problem-solving abilities. The lowest-paying service jobs, including janitorial and manual positions, have remained relevant because human workers in such professions do not require training in particular skills. Using machines would only increase costs. However, computers' greater efficiency renders many middle-class jobs, such as managerial and clerical work, redundant (Kim et al., 2017).

Studies have made policy suggestions in economic and social aspects to overcome such challenges caused by automation and technological unemployment. The most common suggestion is the continuous support of education and training for the employees to equip them with the right qualifications and skills (Mok & Jiang, 2018; Rauf et al., 2021). Other studies like Dodel and Mesch (2020) showed the anxieties of technological unemployment of employees and argued that labour policies should focus on vulnerable workers and provide sufficient support. Universal basic income (UBI) is another policy suggestion to address technological unemployment. It aims to provide the minimum financial support to the citizens and residents unconditionally and broadly to reduce economic inequality (Campbell, 2018). In the same study, Campbell (2018) also introduced the concept of a robot tax, which targets corporations to pay taxes based on the profits they made by using the technology and causing job losses.

The relationship between technological development and the labour market

The above-mentioned technological development significantly affects the labour market transition among university graduates. It will also bring several changes in the higher education landscape. Existing studies have pointed out the potential changes in the higher education sector, including teaching and learning, degree as a credential, job searching, job preparation, and employment outcomes. For example, studies suggest that college students' learning will change (Swanson, 2017; Herbert et al., 2020; Jung, 2020). Students will face a new reality where they cannot rely on the knowledge and skills they obtained from traditional universities and curricula. Instead, they need to integrate multiple learning opportunities from multiple sources, including online accreditation programmes, work-integrated learning, apprenticeships, short-term boot camps for skill training, and postgraduate degrees. They would also need continuous upskilling to advance their careers (Swanson, 2017). The more competition takes place, agentic capital among graduates will become necessary. Graduates need to take action in planning their education and careers by focusing on aspects such as self-development to prepare for the uncertain labour market condition and fill the skill gaps.

Their job searching process will also change. Graduates will emphasise more their work experiences during the study programmes. Studies have highlighted how the transition from education into work will change and found that adapting to the workplace will become more challenging due to the frequent changes in the demanding knowledge and skills. Swanson's (2017) study showed that the future job market is not necessarily based on occupation; instead, they will become the taskification of work, and most tasks will be arranged based on the supply and demands in the online platforms (Graham et al., 2017; Rotman, 2013). According to the same study, future generations will not only have a different notion about the meaning of work and jobs, but they will also bring those expectations to education, such as using peer networks and platforms to acquire skills and knowledge and to help develop a professional network. Related studies have also focused on the changing concept of professional identity among workers. In the changing workplace, researchers argue that graduates must learn vocational identity more flexibly by maintaining their ethical commitments (Jackson, 2016; Herbert et al., 2020). University

learning can be the most critical place for graduates to develop their pre-professional identity (PPI) by internalising the set of employability attributes and behaviours (Jackson, 2016).

Employability in the context of technological development

There were several attempts to construct the concept of employability among university graduates (i.e. Jackson, 2016). In the changing world of work, how the concept of employability will change, and what skills will be more emphasised in the emerging labour market? Several studies described the different skills to be strengthened for university graduates, including hard and soft skills. Many emphasise the importance of flexibility and adaption as the most critical employability in the future as the labour market is unstable, uncertain, and fluid. Depending on the changing labour market conditions, individual employees will have to change their careers and jobs. In addition, STEM and EQ skills are critical in the automation era and provide future-proof employability, regardless of changes in the labour market (Chamorro-Premuzic & Frankiewicz, 2019).

Although it was not very specific to automation or technological unemployment, the study by Herbert et al. (2020) made a distinction between the concepts of 1) employability as being appointable through graduate credentials, 2) employability as actually getting a job and 3) employability as achieving work-readiness in terms of becoming competent and confident in doing a job. Their studies showed the importance of multiple soft skills for job seekers; for example, graduates should have the necessary cultural values and behaviours. They argued that university pedagogy and curriculum should also change to enhance the employability credentials of all students, especially those from disadvantaged backgrounds.

Neubert et al. (2015) also showed that highly-skilled workers in technical areas are better positioned if they possess unique non-technical skills such as problem-solving, emotional regulation, politicking, moral sensibilities, and communication. The study by Azmi et al. (2018) also defined the non-technical skills employers demand as communication skills, especially in English, teamwork skills, critical thinking and problem-solving skills, entrepreneur skills and computer skills. The importance of such skills is widely discussed in employability studies. For example, Popkova and Zmiyak (2019) highlighted communication skills, giving people more digital literacy and social

competencies. They believed that the social and technical competencies of digital personnel would become more critical in performing the tasks for industry 4.0. Those who work in technical areas must now have complex and collaborative problem-solving skills, including emotional regulation, politicking, moral sensibilities, and communication (Neubert et al., 2015). Studies showed that the graduates expressed that “growth in virtual networking,” “digital connectivity,” and “data availability” are essential changes for their careers.

The world of work for today’s graduates will be network-based, which requires employees who can work flexibly with information use and retain themselves to adapt to new skill demands. These changes have required us to redefine the social understanding of works differently. In this context, Nguyen’s (2018) study provided meaningful implications for university teaching. Universities should stop focusing on producing ‘work-ready’ graduates based on delivering disciplinary knowledge and expertise to students. Their work will require more engagement and technological innovation. Thus, the university should move into preparing graduates with the flexibility and independence that allow them to reprogram their skillset.

The discussion on the role of universities in enhancing students’ learning and employability has been continued in many studies (i.e., Chamorro-Premuzic & Frankiewicz, 2019). The central idea of debates is whether university education aims to train work-ready graduates or teach them flexible skill sets for the changing nature of work. The concern for the nature of employability is supported by empirical studies examining the effect of higher education on the current employment outcomes. For example, Frey and Osborne’s (2016) study concluded that wages and education level does not correlate with the automated job markets. If so, what are the implications for the universities regarding curricula, equipment, and teachers’ knowledge for the career paths among graduates? Mkansi and Landman (2021) pointed out that curriculum development in universities had focused on catching up the technological advancement; however, they should be repositioned ahead of the technological revolution. They provide examples of opportunities to develop unique capabilities and algorithms in fields such as mining, agriculture and healthcare to address societal challenges.

Jung's (2020) study also criticised the boundary between academic fields in universities has been too firm. Experts in each field only tend to highlight the importance of their fields, with a lack of a collaborative approach based on cross-disciplinary efforts. Similar emphases are found in different studies. Azmi et al. (2019) and Gunkel (2017) highlighted that universities should expose students to interdisciplinary teaching, research, innovation and valuable industrial training. Schwab (2017) pointed out that the current higher education system emphasises career incentives and pressure for academic research grants. In this environment, academics prefer to focus on traditional and safe research topics rather than innovative or risky ones. New modes of knowledge creation and dissemination demand new modes of appraisal and evaluation in universities (Braun, 2008). Herbert et al. (2020) emphasised employer and higher education partnerships to provide authentic student learning in a real working context. Students graduate into work that requires problem solvers with the abilities to evaluate situations at a systems level and collaborate with others on continually improving their organisation (Campbell, 2018; Gleason, 2018). Studies also highlighted that students' roles must be changed to the curriculum co-design and co-creation (Aoun, 2017; Caballero & Walker, 2010; Nguyen, 2018). Swanson (2017) further presented the three key strategies for higher education institutions; developing deeper partnerships with the employment sector, deeper partnerships with the employment sector, and diversifying course delivery offerings.

Conclusion

This scoping review project has aimed to search and map the studies on technological unemployment and its effect on the labour market transition among university graduates. The project has been initiated with three research questions. First, how is the topic of automation and technological unemployment identified in the existing literature? Second, how is the relationship between technological development and the labour market described in higher education research? Third, how is employability constructed in the context of technological development? We collected a wide range of journal articles using search keywords to achieve the research purpose and conducted a thematic analysis.

We identified the scope of the studies and their critical arguments according to the research questions. First, the studies about automation and technological unemployment accompanied many other global issues, such as globalisation, offshoring, and

demographical changes. Existing studies explored the issues by reflecting on the history, economic and social definitions of related concepts and identifying the scope of automation and technological unemployment. Some studies have projected the effect in positive or negative perspectives. For instance, there are optimistic projections of automation in the economy, such as production increase, economic prosperity, or business cycle efficiency. On the other hand, the pessimistic projections included job loss and skill polarisation. The effects also exist in society, including positive changes such as reducing working hours and more leisure time, but negative changes such as the digital divide, human value, inequality, and ethical issues. Accordingly, there were several policy suggestions, such as basic income and social welfare for the unemployed. This project focused on the effect of technological unemployment on university graduates and reflected the role of university learning in the changing environment. Technological advancement has changed the labour market condition for university graduates from their job-seeking process to outcomes. The polarisation in the skills and wages has been worsening, and the mid-skills of employees will be affected to maintain their jobs. Then, what will be the focus of university learning? Based on the scoping review, the project introduced the critical construct of employability by applying the concepts of technical and non-technical skills and digital literacy. Those changes will accompany individual efforts and, at the same time, institutional and policy support.

The scoping review results provided significant implications in the changing labour market conditions for university graduates. However, it also helped to identify the research gaps and directions for future studies. First, several conceptual ambiguities existed in using the key terms in related studies, including automation, AI, technological advancement, and robotisation. Although they have different meanings according to the sectors and disciplines, several terms have been used without distinction. Future studies need to address such differences and use the terms more accurately. Second, a similar ambiguity existed in defining the skills, competencies, and employability. In higher education research, more studies are needed to focus on a different construction of terms and develop follow-up studies in learning and curriculum. Third, more interdisciplinary approaches are needed to examine the related issues, particularly economics and policy studies. The technological changes and their impact on the labour market have been actively discussed in economics and policy studies; however, there were a lack of linkage

to educational research. Multiple approaches from different disciplines will help the researchers have more comprehensive views on analysing the topic.

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