United Nations Educational, Scientific and Cultural Organization

UNEVOC International Centre for Technical and Vocational Education and Training

Virtual conference on Artificial Intelligence in education and training

Virtual conference report

UNESCO-UNEVOC TVeT Forum, 11 to 15 November 2019
Moderated by Kelly Shiohira and James Keevy,
JET Education Services, South Africa

Education 2030

Virtual conference report

AT A GLANCE

A considerable amount of attention has been placed on Artificial Intelligence, its impact on innovations in various sectors, and its implications for the transformation of the workforce and the labour market. Many of the professions that will most likely be affected by labour market transformations brought about by AI are linked with technical and vocational education and training.

While some jobs will be completely automated, many more will incorporate some degree of automation. This trend is perceivable in the middle-skills jobs, whose routine-oriented work, repetitive tasks and predictable environment can be easily replaced by machines. These changes mean that institutions must offer a changing set of skills – including digital and transversal skills – to students in order to ensure students' continued employability.

An education system which is responsive to labour market demands will incorporate AI both in its own systems and in the education and training provided to students.

The virtual conference on the Artificial Intelligence in education and training was held from 11 to 15 November 2019. It was open to all members of the UNESCO-UNEVOC TVeT Forum, an online community with more than 6500 members. The conference sought to gather knowledge, insights, experiences and practices from the international TVET community on the opportunities and challenges of integrating Artificial Intelligence in education and training.

Key reflections

While the TVET sector shows interest in AI, this has not yet translated into institutional practices on a large scale
While the international TVET community is very aware of the types of potential impact AI will have on both the labour market and the education and training sector, there is a lack of understanding about how these systemic changes affect the practices of institutions.

The needs of multiple stakeholders must be considered in order to build truly responsive learning opportunities
Trends such as AI, digitization, innovation and the transition to green economies have various impacts on individuals beyond the world of work, meaning that many types of stakeholders need to be consulted.

Changes in practice are needed to prepare students not only for the current labour markets, but also for future disruptions
Changes include creating, integrating, deploying and maintaining artificial intelligence and related technologies, and an increased emphasis on skills to build a foundation through which students can formally or informally continue their own education.

TVET providers should seek to engage as drivers of AI innovation as well as suppliers of talent
TVET institutions are becoming relevant actors in the development of technologies and innovation, but need support to do so.

Developing countries – particularly in Africa – face additional macro-level challenges in adopting AI
Competing priorities such as the lack of power, poverty, food insecurity and high youth unemployment means that resources are sometimes not available to support the integration of AI in education and training.

Background

A considerable amount of attention has been placed on Artificial Intelligence (AI), its impact on innovations in various sectors, and its implications for the transformation of the workforce and the labour market. One of the immediate obvious shifts created by AI in the workforce is towards higher-skill occupations, a trend that has been observable for some time in higher-income countries. Current shifts and future projections of job growth indicate a 'hollowing out' of certain skill level professions, with growth in both low-skill and high-skill employment far outstripping intermediate-skill labour demand (Autor, 2010). Workers with intermediate-level skills are at particular risk because technologies that can replace them generate considerable cost savings for employers. Expert observers foresee increased polarization of labour markets as the middle-income jobs assumed by intermediate skilled workers become increasingly scarce, a process that is well underway in many countries (World Bank, 2016; 2019).

Intermediate-skill occupations are located at skill level 2 as explained by the International Labour Organization (ILO) . Occupations at skill level 2 typically involve tasks such as operating machinery, driving vehicles, maintaining and repairing electrical or mechanical equipment, and manipulating or storing information. Most of these occupations require relatively advanced literacy and numeracy for the purposes of reading instruction manuals, recording information or events, and performing routine calculations. Educational requirements generally include completion of the first stage of secondary education, with many also requiring specialized vocational education and on-the-job training.

In other words, many of the professions most likely to be affected by labour market transformations brought about by AI are integrally linked with technical and vocational education and training (TVET). While some jobs will be completely automated, many more will incorporate some degree of automation. An estimated 61% of the jobs are comprised by medium or high (above 30%) volume of tasks that are susceptible to automation. This trend is more easily perceivable in the middle-skills jobs, whose routine-oriented work, repetitive tasks and predictable environment can be easily replaced by machines. This speaks to the changing set of skills, including improved digital and transversal skills, which institutions must offer to students in order to ensure students' continued employability.

An education system which is responsive to labour market demands will incorporate AI both in its own systems and in the education and training provided to students. In fact, a large part of Sustainable Development Goal 4 on Quality Education has to do with an education system's responsiveness to both social and labour market demands in order to produce citizens who are socially and economically active within their societies.

This virtual conference focused on the latter aspect, and particularly on the ability of TVET systems to both leverage AI to maximise their own systems and processes, including teaching and learning, and to ensure students are adequately prepared for the current labour market. This was also stressed in the Beijing Consensus on Artificial Intelligence and Education, adopted at the International Conference on Artificial Intelligence and Education held in Beijing, China in 2019. In the field of education, AI offers opportunities to improve governance, delivery and alignment to other sectors. Many educational institutions are already leveraging AI in various ways to meet their objectives.

International Labour Organization. International Standard Classification of Occupations

Skill level	Description
Skill level 1	Occupations at skill level one typically involve the performance of simple/routine physical or manual tasks. Basic literacy and numeracy may be included but would not be a major part of the work. Educational requirements may be primary education or the first stage of basic education, and/or a short period of on-the-job training. Examples include office cleaners, kitchen assistants, freight handlers, etc.
Skill level 2	Occupations at skill level two typically involve tasks such as operating machinery, driving vehicles, maintenance and repair of electrical or mechanical equipment and manipulation/storage of information. Generally, these occupations require relatively advanced literacy and numeracy for the purposes of reading instruction manuals, recording information or events and performing routine calculations. Educational requirements generally include completion of the first stage of secondary education, with many also requiring specialised vocational education and on-the-job training. Examples include butchers, secretaries, police officers, hairdressers, etc.
Skill level 3	Occupations at skill level three typically involve the performance of complex and practical tasks requiring an extensive body of knowledge in a specific field. These occupations require a high level of literacy and numeracy and well-developed interpersonal skills. Educational requirements usually include completion of secondary education and 1-3 years of study at a higher education institution and/or prolonged on-the-job training or experience. Examples include shop managers, technicians in various fields, legal secretaries, etc.
Skill level 4	Occupations at skill level four typically involve complex problem solving, decision-making and creativity based on an extensive body of knowledge in a specific field. These occupations require extended levels of literacy and numeracy. Educational requirements generally include 3-6 years of study at a higher education institution and the award of an associated qualification. Examples include managers, engineers, medical practitioners, musicians, teachers/lecturers, etc.

Overview

The aim of the virtual conference was to:

- Better understand the link between Artificial Intelligence and TVET, including the impact Artificial Intelligence on intermediate skills or occupations
- Explore the role of national legal frameworks and policies/strategies that promote the improvement of the quality of TVET through Artificial Intelligence
- Determine examples and practices of Artificial Intelligences impact on TVET, with a particular focus on intermediate skills and occupations

The following topics were opened for discussion during the virtual conference:

Thread 1: The impact of AI on the labour market and skills

Intermediate-skill occupations are occupations that generally require some level of post-secondary education and training, and include many of the occupations included in technical and vocational curricula. This thread sought to collect views and evidence on how policy-makers and TVET institutions understand, track and interact with labour market shifts in relation to intermediate skill occupations. It sought to gather information on contextual factors such as the data on which curriculum and programme decisions are made and the policy frameworks in which TVET institutions operate. Participants were asked the following questions:

- How are intermediate-skill occupations being affected by AI?
- What are the prominent shifts in the labour market being observed in developed and developing contexts due to the widespread use of AI? What are commonalities and points of divergence in these contexts?
- What data is available to policy makers on labour market shifts (training-to-work transition, work-to-work transition) and specifically the influence of AI on occupations?
- Do countries have a policy/national strategy that addresses AI and labour market shifts? What types of policy responses are being/should be pursued in the education and training space in response to AI and labour market shifts?
- How are governing structures of AI involved in reskilling efforts for the current and previous workforce?

Thread 2: Innovative education and training pathways

The field of education and training is changing with new and innovative offerings such as MOOCs and other forms of combined or distance education. Innovations are further being made in the areas of recognition of knowledge, skills and competencies, recruitment practices and links between jobs and people. Today, we see the strong presence of qualifications frameworks across more than 140 countries, and with at least 4 regional qualifications frameworks at different levels of development, not to mention the move towards the development of a continental qualifications framework for Africa (CEDEFOP, 2018). Slowly but surely, qualifications frameworks are being impacted by new thinking on digital credentials (Keevy and Chakroun, 2018) and also by emerging platforms that enable more authentic validation of learning records (Shiohira and Dale-Jones, 2019).

This thread sought to determine ways in which the TVET sector is responding to these changes, and to gather participant views and experiences with regard to new and emerging education and training pathways, including the influence of digital credentials, micro-credentials, MOOCs, skills development platforms and other similar initiatives. Participants were asked the following questions:

- How are/should education and training institutions develop curricula responsive to labour needs? What constitutes an "adequate timeline" for developing responsive curricula?
- How is the role of formal and informal learning changing in the era of AI?
- How are learners, employers and industries benefitting from new and emerging education and training pathways?

Thread 3: Innovative AI practices in education and training

AI has been used in education to improve administration and to augment teaching and learning. AI is built on databases that can include historical and current data. Algorithms identify trends based on this data that may not always be apparent to human examinations. Examples of AI applications in the education sector include predictive building maintenance, predictive enrolment, monitoring labour market trends and targeted learner support.

This thread sought to understand how participants are currently or are planning to engage AI in their institutions; to identify success factors and obstacles in engaging with AI; and to determine how AI influences effectiveness and cost in these institutions. Participants were asked the following questions:

- What types of AI are currently employed by education and training institutions? What AI is employed by education policy-makers at the system level?
- What are the perceived/realized benefits and limitations of using AI in education and training?
- How is/can AI be leveraged for skills development, curriculum planning and training delivery/provision at the institution level?
- What kind of changes and/or differences have been observed in education and training outcomes between using AI and without using AI (or before and after using AI)?
- What kind of changes and/or differences have been observed in the cost of education and between using AI and without using AI (or before and after using AI)?

Thread 4: The role of partnership in AI for education and training

This thread sought to understand the roles of different players in supporting the use of AI in education and training, and to extent to which and ways education and training institutions and policy-makers leverage partnerships in the integration of AI into their systems and processes. AI is an area with scarce skills, and practitioners are in high demand. As a result, they are difficult to draw to academia. This discussion centred on what partnerships have been formed to improve the availability and use of AI for education and training. Participants were asked the following questions:

- What are the perceived and actual roles of different sectors, learners, households, communities in realising the benefits of AI in education and training?
- What kind of partnerships do education and training institutions develop with industries and employers?
- What partnerships have been formed between government, industry, academia, the private sector and/or third sector organizations in order to enhance or leverage the use of AI in education and training? What are the goals of these partnerships?
- What benefits do learners, employers and industries gain from partnerships? What benefits to direct and indirect beneficiaries result from partnership approaches?

Thread 5: Barriers and enablers to AI implementation in education and training programmes (including training at institutions and the workplace)

AI has uses both within and across institutions, including for system administration and governance, teaching and learning, and work-based components of education and training. This thread discussed the enabling conditions and barriers to implementing activities at the different levels at which AI is or could be applied. Participants were asked the following questions:

- What are some of the challenges institutions and education/training systems face in attempting to integrate AI into system and institution-level administration and teaching and learning (on training components at institution, at workplace)?
- What are critical success factors/enablers for integrating AI into systems and institutional practices?
- What ethical concerns are raised in the incorporation of AI into institutional and system practices? How can these concerns be addressed or mitigated?

Key reflection

While the TVET sector shows interest in AI, this has not yet translated into institutional practices on a large scale

Discussions during the virtual conference showed that, while the international TVET community is very aware of the types of potential impact AI will have on both the labour market and the education and training sector, there was a lack of understanding about how these systemic changes would affect the practices of institutions and, in particular, participants' own work. Participants engaged most in discussions that focused on macro-issues surrounding the use of AI in education and training, with only few examples being shared that detailed concrete uses of AI in education and training.

Some participants did summarize institutional uses of AI currently taking place in TVET institutions. These included administrative uses, enrichment, and student support. Administrative examples included the use of technologies such as biometrics, CCTV, big data and real-time data to enhance security, analyse the locations of students, track attendance and monitor engagement with courses. An enrichment opportunity described was the use of virtual reality to 'enable students in rural India to see and feel new things and new technologies outside the village'. Support uses of AI suggested focused on assessment and risk analysis. One example of current practice was presented:

- 'A project in the Netherlands, which uses data from self-analyzed skills derived from student questionnaires to analyze their 21st century skills…The analysis then allows for predictions of future performance, which can help students and tutors, and the school, in finding the best learning routes for individual students.'

The conference participation and postings also indicated that few participants have a concrete understanding of how AI works and its potential uses in education, or hands-on experience in implementing AI in education and training. Some participants were quite straightforward about this:

- 'I know very little about artificial intelligence. My understanding is that the applications of this are limited to routinized processes, and exclude creative adaptations.'
- 'I think that AI use is still in the very early stages particularly in the field of TVET…many stakeholders are overwhelmed by the speed of technological developments and are hesitant to explore how the use of technologies can improve education.'

Others indicated that while there was knowledge at the instructional level, it was hindered by the bureaucracy inherent within institutions:

- 'The problem we in the education sector [are] facing now is the problem of "analogue" administrators leading the "digital" instructors…the earlier those in the helm of the educational affairs realize the effect of AI and restructure the curriculum to that effect, the better.'

The responses from participants indicate that considerable advocacy and upskilling will be necessary across different aspects of the sector, and even to government, for either the administrative or instructional potential of AI to be fully realized by institutions.

Key reflection

The needs of multiple stakeholders must be considered in order to build truly responsive learning opportunities

One universally recognized need was for TVET institutions to be afforded the support and/or flexibility necessary to create more responsive curricula and/or courses. A challenge to this which was prominently noted was the slow pace of curriculum development or redevelopment, which participants saw as limiting their opportunities as practitioners to respond appropriately to industry demands.

Beyond even this significant challenge was a deeper conversation around who is served by TVET, and who the primary stakeholders for consultation in the design and development of programmes, courses and curricula should be. Some participants felt that the key stakeholder to be consulted was industry:

- 'Development of responsive curricula should be industry-led. Experts in the various industries are to work closely with TVET providers to ensure that the appropriate occupations standards are generated to inform curriculum development.'
- 'It is important to involve those who will employ the graduates in defining what they should learn, and where they learn it.'

However, other participants felt that while labour needs were one consideration, it was crucial to understand the demands on TVET from multiple perspectives, from employers to students, teachers, trainers, parents and so forth:

- 'The "consumer" of TVET is not clearly identified and includes a number of agencies that attempt to articulate demand and are biased and focused on their, often differing, agendas. These agencies include Industry, Governments, Students and the training institutions.'
- 'While there should be strong links to the world of work one should not focus narrowly on employer's needs. This is particularly true in developing countries where advanced industries may still be emerging.'

The understanding of practitioners was that the 'curriculum is not just for employers' needs; it is for our complicated life needs'. It was also pointed out that trends such as AI, digitization, innovation and greening of economies have various impacts on individuals beyond the world of work, affecting political, economic and social spheres. In one example of a prominent social and personal effect, a participant noted that consumers are in some cases 'becoming the product', and 'our browsing profiles and personal data are the new oil for companies that market with our big data'.

In response to this and other social changes, the interest of TVET institutions was seen not to lie exclusively with labour and labour market shifts, but instead must consider preparing students for a complex reality in which multiple aspects of life would require regular critical reflection and adaptation.

In a related point, it was noted by a number of participants that it was not only concrete skills requirements that were shifting, but the actual nature of work itself. These shifts are brought on by forces such as globalization and digitization – aspects which may not be prominently visible to or considered by industry alone. Participants noted the elimination of 'intermediaries in the sale

of services and products', leading to a changing business landscape which encompasses the gig economy, platforms, and new avenues of collaborative funding and problem-solving. Related changes to the nature of work noted by participants included the growth of more flexible work, the shift of workforce composition towards contractors/freelancers, increases in technology-mediated services and interactions, the integration of AI and digital skills into existing occupations and the rise of cross-functional and team-based work.

The need for TVET institutions to respond not only to changing skills demands but also to equip students with the necessary skills to manage new types of work environments was discussed, with participants suggesting business acumen, design theory, financial management, creativity, presentation skills, social skills, collaboration, problem-solving and independent learning as important contributions to student skill sets.

Key reflection

Changes in practice are needed to prepare students not only for the current labour markets but also for future disruptions

A prominent theme throughout the conference was the need to prepare students for future disruptions. Many respondents felt that industry was a prominent stakeholder whose needs should be considered, and focused on the developing and adapting teaching and learning to concrete skills necessary for students to be marketable to current labour. As one participant noted:

- 'For AI to be actualized in low developing countries […], TVET curriculum content must be improved by adding new technologies such as AI, Robotics and so on so that students are up to date with new technologies.'

Other participants pointed out that it was not only unnecessary but impossible to keep up with the rapidly-shifting demands of labour, and suggested instead the need for curricula which could 'stand the test of time' and which would incorporate more transversal skills. Throughout the discussion a prominent need for TVET institutions to emphasize and provide the skills necessary for lifelong learning was emphasized, with the latter aspect forming a core component of 'employability':

- 'Employability will depend more on the abilities for the permanent formation and the capacity of adaptation to put in practice what is learned (competence)…learn to learn as a guarantee of employability against the disruptive innovation that will characterize the 21st century.'

Thus, the first change in practice proposed was the development of new forms of training that are needed. These include specific expertise in creating, integrating, deploying and maintaining artificial intelligence and related technologies, both generally and in specific fields, and an increased emphasis on skills to build a foundation through which students can formally or informally continue their own education (learning to learn) and, by doing so, mitigate the personal effects of further disruptions in the labour market. The '4Cs' skills – Critical thinking, Creativity, Collaboration and Communication – were discussed as a starting point.

- 'As the technology gets more complicated and as the innovation cycle becomes more rapid, the TVET education and/or training should become more general in the technical skills training and more focus[ed on] transversal skills.'
- ' The education system must [develop] the competencies and qualifications that best adapt to the new labour market scenario and enhance, among others, the creative capacity and proactive attitude to lifelong learning.'

In addition to shifts to the initial curriculum, participants saw a new opportunity in the increased emphasis on lifelong learning and continuous upskilling:

- 'There may be a chance in blurring the lines between formal and informal learning. Informal learning should be seen as an important element of learning, given the fast pace of change and the enormous possibilities for learning outside formal contexts.'

Participants saw this continuous learning as possibly leveraging current shifts towards more flexible and open learning, and noted which the additional benefit of greater flexibilities than qualification-linked curricula . A potential model for continuing TVET was proposed which would allow training providers to 'propose preformatted training courses, curricula and practical training programmes intended to respond to the demand'. It was further noted that while these initiatives could be linked to new ways of integrating informal and non-formal education as well as new forms of credentialing and 'the push to recognize and "credential" more minor achievements and learning outcomes', how these aspects apply to TVET are not well-explored at this point.

Together with new forms of credentialing and increased avenues of learning come a series of challenges related to both data ownership and ensuring comparability of attainment across context. In addition to providing a method for more efficient mapping of skills needs through the provision of AI as a Service (AIaaS), such as that provided by Burning Glass Technologies, AI also holds potential solutions for mapping of credentials and micro-credentials across contexts, while technologies such as blockchain enable movement towards not only secure digital credentialing but also the establishment of self-sovereign identity (SSI), or the ability of individuals to own and control their digital data, including learning records.

Key reflection

TVET providers should seek to engage as drivers of AI innovation as well as suppliers of talent

A number of factors related to TVET institutional operations were raised as barriers to AI implementation and integration. These included institutional transformation and investment in the necessary hardware and software; the attitudes of lecturers who 'often fall back on lectures as a tool that is the most flexible, easiest to change, and to coordinate the activities of learners', and 'lack the creativity or imagination to find alternative uses of class time'; and institutional policy. One participant gave an example of blocks in institutional policy which prevent adaptation to the digital era:

- 'A college has an expressed policy of no smartphone use during class time, and does not provide computer access to all learners, but does not provide a textbook on the premise that all of the information may now be found online – for a curriculum published in 1997.'

However, a larger number of critical success factors identified by participants existed externally to TVET institutions. Interestingly, ultimately most participants did not view TVET as a driver of or even as a key leverage point in AI development or change, and instead framed their institutions or work as affected by rather than affecting AI development. Many perceived prominent challenges as outside the control of institutions. Such challenges included the development of adequate infrastructure in terms of basics such as affordable electricity and the expansion of wireless or other internet connections, national curricula and the pace of their development, lack of national funding for TVET, the policy direction of the country, the use of AI and related technologies by existing industries and the pace of industry development.

However, an important counterpoint to this view was offered:

- 'TVET institutions are becoming relevant actors in the development of technologies and innovation, no longer working exclusively with skills formation services, but also adding other types of products and services such as applied research projects, consultancy, product development, or even promoting innovation calls. In this scenario, TVET institutions act as innovation drivers and therefore seem to be more capable of recognizing new technologies and skills demands.'

Other participants mentioned existing structures such as work-integrated learning, industry-TVET partnerships, regional partnerships such as the Trades and Qualifications Campus model in France, and even situations in which industry partners had set up TVET institutions within their production facilities. Through such means and other innovative models the potential certainly exists for TVET institutions to play a role in innovation and national development which encompasses but is not limited to skills development. One participant offered an example of how their institution is leveraging AI industry partnerships to enhance their own programming in this direction:

- 'We can see the industries and employers are welcoming our efforts and transformation. They are more than happy to join us in offering their know-how in our program transformation, in offering their experts to teach in our campus, in cooperating with us on AI application research.'

However, while there is evidence of good practice in some areas and institutions, from the responses of participants it would seem that this opportunity has yet to be developed or exploited in many countries and systems.

The Trades and Qualifications Campus model (Campus des métiers et des qualifications, known as CMQ) in France 'brings together secondary and higher education VET institutions, research centres and companies' and 'aims at establishing VET as an excellence pathway, strengthening the linking between the world of education and the world of business'. CMQs can be based in institutions or local networks of at least one educational institution supported by the community and business. Each is built around a sector which corresponds to a national or regional economic challenge.

To receive CQM accreditation, centres or local networks must provide evidence of growth potential and skills needs in the sector supported; be governed by a partnership which includes regional government and an industry representative; offer innovative training pathways; and promote VET and its international visibility through initiatives such as facilitating international exchanges of staff and students. Since May 2018, 95 centers have been awarded the CQM label, covering all regions of France and 12 economic sectors.

A new 'excellence' category has been added to the model, which requires that the model be institution-based and provide infrastructure for education, business development and innovation, and research, as well as supporting student life and culture. These institutions must also foster deeper international connections for purposes such as sharing resources, training platforms, and common qualifications.

For more information: https://www.education.gouv.fr/cid79563/les-campus-des-metiers-et-des-qualifications.html

Key reflection

Developing countries – particularly in Africa – face additional macro-level challenges in adopting AI

A number of TVET practitioners from across the globe responded regarding the need for education and training institutions to adapt in the era of AI. Participants brought up the need for more regular and swifter curriculum reform; the need to integrate AI as a subject at various levels through institutions; a shifting focus towards innovation and entrepreneurship in TVET; the need for institutional policies to change to allow technology use; the need to upskill teachers; and ethical considerations such as ownership of data and the legality of data collection, storage and use. However, participants from developing countries – particularly in Africa – raised a number of concerns with the adoption of AI which were not prominent concerns for others.

These included and emphasis on inclusion in AI, and a need for 'the right policy mix and institutional arrangements' to 'ensure that the benefits of innovation are shared broadly'; competing national priorities such as the lack of power, poverty, food insecurity and high youth unemployment; small industrial sectors which are not anticipated to grow and which do not currently leverage AI; and lack of infrastructure necessary for AI. Budget constraints were also raised prominently as a challenge:

- 'Every year, the budgets are so tight that formulation of policies [is] easier than actualization of policies. Over the years the accumulation of such gaps between the formulation and actualization of policies results in backlog, especially in Africa.'

One of the most prominent concerns raised regarding the value of AI in developing countries had to do with a lack of inclusion and distribution of profit.

- 'Whereas the most prominent shifts in developing countries are seen in acceptance and adoption of [AI] advancements, thus rendering developing nations 'buyers nations' and further enriching the developed nations…it's going to take 150 years to catch up with developed nations.'
- 'Africa is not ready for AI. The promotion of AI is profit-focused and not skills-based. The promotion of AI for Africa is a doom-based methodology unless it is for cheap labour by other investing countries.'

Ultimately, three prominent concerns dominated the African discourse:

- Are AI and related skills relevant to TVET in Africa, given the fact that AI skills are not currently a prominent demand of African labour markets?
- Can AI be leveraged to improve African contexts and mitigate the challenges of African developing countries, given a basis of poor infrastructure and lack of political will to prioritize AI training and development over other immediate concerns such as electricity and food security?
- How can African countries ensure equitable distribution of profits generated by AI (whether nationally or internationally)?

Shared resources and learning materials

Shared before the conference:

Thread 1: The impact of AI on the labour market and skills

- Bughin, J., Hazan, E., Lund, S., Dahlström, P., Wiesinger, A. and Subramaniam, A. 2018. Skill Shift: Automation and the future of the workforce. McKinsey Global Institute Discussion Paper. https://www.mckinsey.com/~/media/mckinsey/featured%20insights/future%20of%20organizations/skill%20shift%20automation%20and%20the%20future%20of%20the%20workforce/mgi-skill-shift-automation-and-future-of-the-workforce-may-2018.ashx
- NBER. 2019. The Wrong Kind of AI? Artificial Intelligence and the Future of Labor Demand. https://www.nber.org/papers/w25682.pdf
- Nedelkoska, L. and Quintini, G. 2018. Automation, skills use and training. OECD Social, Employment and Migration Working Papers, No. 202, OECD Publishing, Paris. https://www.oecd-ilibrary.org/employment/automation-skills-use-and-training_2e2f4eea-en

Thread 2: Innovative education and training pathways

- AI's Impact on Education, Training, and Learning: Potential and Limitations. https://www.youtube.com/watch?v=UmBQONLoIso
- Keevy, J. and Chakroun, B. 2018. Digital Credentialing: Implications for the recognition of learning across borders. Paris, UNESCO. https://unesdoc.unesco.org/ark:/48223/pf0000264428.locale=en

Thread 3: Innovative AI practices in education and training

- International Task Force on Teachers for Education 2030. 2019. Exploring the use of Artificial Intelligence to support teachers and teacher development. http://www.teachersforefa.unesco.org/
- Gloss, A., Foster, L., Behrend, T., Blustein, D. and Chakroun, B. Big data and ICTs for human-capabilities: Opportunities and challenges for skills- and human-development through the use of information & communication technologies (ICTs) and data-intensive science (big data) in TVET and the world of work. Foster Workforce Development Institute Working Paper. https://www.researchgate.net/publication/313343744_Big_data_and_ICTs_for_human_capabilities
- Popenici, S. and Kerr, S. 2017. Exploring the impact of artificial intelligence on teaching and learning in higher education. https://www.researchgate.net/publication/321258756_Exploring_the_impact_of_artificial_intelligence_on_teaching_and_learning_in_higher_education

Thread 5: Barriers and enablers to AI implementation in education and training programs (including training at institutions and the workplace)

- Furman, J. 2016. Is this time different? The opportunities and challenges of Artificial Intelligence. https://obamawhitehouse.archives.gov/sites/default/files/page/files/20161212_cea_nas_ai_furman.pdf
- Pedró, F., Subosa, M., Rivas, A., and Valverde, P. 2019. Artificial Intelligence in Education: Challenges and opportunities for sustainable development. Paris, UNESCO. https://unesdoc.unesco.org/ark:/48223/pf0000366994
- World Bank. 2016. World development report 2016: Digital dividends. https://www.worldbank.org/en/publication/wdr2016

Mentioned in the conference:

- Butcher, B. 2013. Hollowing out and the future of the labour market – the myth. https://voxeu.org/article/hollowing-out-labour-market-new-evidence
- Frontier Economics. 2018. The Impact of AI on Work: An evidence review prepared for the Royal Society and the British Academy. Report to the Royal Society and the British Academy. https://royalsociety.org/-/media/policy/projects/ai-and-work/frontier-review-the-impact-of-AI-on-work.pdf
- IRENA. 2019. Renewable Energy and Jobs: Annual review 2019. https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/Jun/IRENA_RE_Jobs_2019-report.pdf
- Palak, Z. 2019. Digital Bangladesh: A story of transformation. Daily Sun, 15 July 2019. https://www.daily-sun.com/post/407497/2019/07/15/Digital-Bangladesh--a-Story-of-Transformation
- Petriglieri, G., Ashford, S. and Wrzesniewski, A. 2019. Agony and Ecstasy in the Gig Economy: Cultivating Holding Environments for Precarious and Personalized Work Identities. *Administrative Science Quarterly*, 64(1). 124-170. https://journals.sagepub.com/doi/pdf/10.1177/0001839218759646
- Shiohira, K. and Dale-Jones, B. 2019. Interoperable Data Ecosystems: An international review to inform a South African innovation. Johannesburg, JET Education Services. https://www.jet.org.za/resources/interoperable-data-ecosystems.pdf
- Sovrin. 2018. FAQ: What is self-sovereign identity? http://sovrin.org/faq/what-is-self-sovereign-identity/
- UNESCO. 2017. Beyond Access: ICT-enhanced innovative pedagogy in TVET in the Asia-Pacific. Bangkok, UNESCO Bangkok Office. https://bangkok.unesco.org/sites/default/files/assets/article/ICT%20in%20Education/TVET/TVET%20pub.PDF
- UNESCO. 2019. The Beijing Consensus on Artificial Intelligence in Education. Paris, UNESCO. https://unesdoc.unesco.org/ark:/48223/pf0000368303

Interesting initiatives/companies/videos mentioned in the conference:

- Burning Glass. https://www.burning-glass.com/
- Nasscom Future Skills Portal. http://futureskills.nasscom.in/
- Pymetrics. https://www.pymetrics.com/
- Tetsubin: Japanese Cast Iron Kettle. https://hojotea.com/categ_e/tetsubin.htm
- Teach AI: Prepare our students for the future. https://www.youtube.com/watch?v=ympzqGzfl0U&feature=youtu.be
- Transforming Rural India Using AI and Digital Technology. https://www.youtube.com/watch?v=IdBemHBN7xQ
- UNESCO-UNEVOC i-hubs Balanced Scorecard. https://unevoc.unesco.org/i-hubs/i-hubs+-+Innovation+Toolbox
- UNESCO-UNEVOC Bridging Innovation in Learning in TVET (BILT) Project. https://unevoc.unesco.org/bilt

About the moderators

Dr James Keevy is the Chief Executive Officer at JET Education Services, an independent public benefit organisation located in Johannesburg, South Africa. Dr Keevy is a policy researcher working in the education and training sector, and particularly in the post-school and technical and vocation education and training areas. He has conducted and overseen various initiatives related to national, regional and international qualifications frameworks in Africa and further afield. His research into qualifications, the recognition of learning, and the professionalization and migration of teachers has been widely published and presented. He has represented JET in various international fora, for example at the 2019 TVET Sub-Regional Forum for Eastern Africa on 'Skills for Youth Employment and Entrepreneurship' held in the Seychelles. Dr Keevy was part of the external peer review panel for the Guidelines for the Quality Assurance of TVET Qualifications in the Asia-Pacific Region developed and published by UNESCO Bangkok, working with Member States in the Asia-Pacific region. He contributed a chapter to the recently published Workforce Readiness and the Future of Work, edited by Fred Oswald, Tara S. Behrend, and Lori Foster.

Kelly Shiohira has worked internationally in the fields of language and literacy acquisition, teacher development and technology for educational improvement, and has applied these areas of expertise to curriculum and policy design, research design and implementation, strategic planning and monitoring and evaluation in the education sector. Ms Shiohira's recent work includes contributions to the UNESCO publication *Artificial Intelligence in Education Compendium of Promising Initiatives* and lead authorship of *Interoperable Data Ecosystems: An International Review to inform a South African Innovation*, published by JET Education Services. Ms Shiohira has widely presented at conferences on topics including curriculum design, integrating ICT into the classroom, AI and skills development, AI for teacher development, differential education in second-language learning, cultural adaptation, materials development in indigenous languages, and evaluating the impact of ICT in the classroom. In 2019, Ms Shiohira represented JET Education Services at UNESCO's Mobile Learning Week and the International Conference on Artificial Intelligence and Education, where she presented on the intersection of AI and intermediate skills.

Published in 2020 by the UNESCO-UNEVOC International Centre, Platz der Vereinten Nationen 1, 53113 Bonn, Germany

This publication is available in Open Access under the Attribution-ShareAlike 3.0 IGO (CC-BY-SA 3.0 IGO) license (http://creativecommons.org/licenses/by-sa/3.0/igo/). By using the content of this publication, the users accept to be bound by the terms of use of the UNESCO Open Access Repository (http://www.unesco.org/open-access/terms-use-ccbysa-en).

The designations employed and the presentation of material throughout this publication do not imply the expression of any opinion whatsoever on the part of UNESCO concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

The ideas and opinions expressed in this publication are those of the authors; they are not necessarily those of UNESCO and do not commit the Organization.

Front cover attribution CreativeCommons_Flickr_Fiat Chrysler Automobiles Corporate *Sterling Heights Assembly Plant*

Author Kelly Shiohira and James Keevy, JET Education Services, South Africa

4 QUALITY EDUCATION

Sustainable Development Goals