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Artificial Intelligence for Sustainable Development: Synthesis Report, Mobile Learning Week 2019

Borhene Chakroun

Fengchun Miao

Valencir Mendes

Anett Domiter

Huhua Fan

See next page for additional authors

Authors

Borhene Chakroun, Fengchun Miao, Valencir Mendes, Anett Domiter, Huhua Fan, Iaroslava Kharkova, Wayne Holmes, Dominic Orr, Mitja Jermol, Kim Issroff, Jongwi Park, Keith Holmes, Helen Crompton, Paz Portales, Davor Orlic, and Sandra Rodriguez

Artificial Intelligence for Sustainable Development

Synthesis Report

Mobile Learning Week 2019

UNESCO Education Sector

Education is UNESCO's top priority because it is a basic human right and the foundation on which to build peace and drive sustainable development. UNESCO is the United Nations' specialized agency for education and the Education Sector provides global and regional leadership in education, strengthens national education systems and responds to contemporary global challenges through education with a special focus on gender equality and Africa.
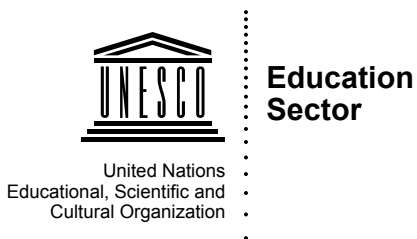
The Global Education 2030 Agenda

UNESCO, as the United Nations' specialized agency for education, is entrusted to lead and coordinate the Education 2030 Agenda, which is part of a global movement to eradicate poverty through 17 Sustainable Development Goals by 2030. Education, essential to achieve all of these goals, has its own dedicated Goal 4, which aims to *"ensure inclusive and equitable quality education and promote lifelong learning opportunities for all."* The Education 2030 Framework for Action provides guidance for the implementation of this ambitious goal and commitments.

Acknowledgements

During the five-day event for Mobile Learning Week 2019, UNESCO gathered participants from around the world to share experiences, initiatives and plan joint actions with a view to harnessing artificial intelligence (AI) to achieve Sustainable Development Goal (SDG) 4. The report stems from the work that the speakers presented and the insights that all the participants shared at the event.

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Acronyms and abbreviations

AGI	Artificial general intelligence
AI	Artificial intelligence
AIGG4E	Artificial intelligence global goods for education
GDPR	General Data Protection Regulation
ICT	Information and communications technology
IoT	Internet of Things
ITU	International Telecommunication Union
MLW	Mobile Learning Week
NGO	Non-governmental organization
OECD	Organisation for Economic Co-operation and Development
OER	Open Educational Resources
ROAM	Rights, Openness, Accessibility and Multi-stakeholder governance
SDG	Sustainable Development Goal
UIS	UNESCO Institute for Statistics
UNESCO	United Nations Educational, Scientific and Cultural Organization
VR	Virtual reality

Executive Summary

2019's Mobile Learning Week (MLW), UNESCO's flagship event for information and communication technology (ICT) in education, focused on the theme 'Artificial Intelligence for Sustainable Development'. Held over five days in Paris, it comprised a sequence of high-profile events (a global conference, a policy forum and workshops, a symposium and strategy labs), and involved more than **1,500 participants** from **140 countries** (including Ministers of Education and ICT, other representatives from Member States, the private sector, academia and international organizations).

The week's events built on a sequence of premises. First, it is widely recognized that the world is facing a learning crisis (currently, more than 200 million children globally are out of school, while a further 600 million are in school but are not achieving minimum levels of competency); second, it is education that powers sustainable development (education is a key driver of all the UN Sustainable Development Goals (SDGs), as well as the focus of SDG 4); and third, sustainable development will only be achieved if we successfully leverage the digital revolution, which now increasingly includes artificial intelligence (AI).

Discussions at MLW 2019 centred on the challenges of reducing barriers to education and improving learning outcomes for all, and the possibilities afforded by AI. The conversations were both wide-ranging and in-depth, and were informed by experiences from many countries and social contexts worldwide, as well as by experts in both AI and education. Notably, at times, there appeared to be a clear divide between the experts in AI (who sometimes shared limited knowledge of pedagogy, the learning sciences and classroom practices), and the expert educators (who sometimes demonstrated a limited appreciation of the pervasive nature and transformative potential of AI). Nonetheless, although throughout the week more questions were raised than were answered, broad agreement between the participants did emerge, and is summarized in this report.

Four overarching themes structured the discussions: how to ensure inclusive and equitable use of AI in education; how to leverage AI to enhance education and learning; how to promote skills development for jobs and life in the AI era; and how to safeguard transparent and auditable use of education data.

How to ensure inclusive and equitable use of AI in education

There continues to be a problem of uneven global development of the infrastructure necessary for the application of AI in educational contexts, leading to a digital divide both between countries (with access to digital innovations concentrated in Europe, America, China and the Middle East, and very little in sub-Saharan Africa or in large areas of East Asia), but also within countries (between urban and rural communities, and according to socio-economic status). In fact, education powered by AI must be accessible for all, whatever the individual's environment, nationality, culture, gender, disability status, sexuality or age – if only to ensure that marginalized and disadvantaged groups are not excluded from AI-powered education. In addition, even where there is access, the application of AI technologies in educational contexts raises multiple concerns (issues such as ethics, fairness, accountability, privacy, security, inclusion, accessibility, equity, transparency, awareness, sustainability and human rights) which are yet to be systematically addressed.

Core issues include data and algorithmic biases, human-centred values, the relationship between humans and AI, and accountability. For example, they involve preventing the codification and reinforcement of existing human biases (especially those focused on gender, ethnicity or disabilities); ensuring that the use of AI in classrooms does not dehumanize learning, undervalue teachers or compromise fundamental human rights; and considering what happens if automated decisions turn out to be wrong (who or what is responsible and accountable?). All of these issues and more need to be critically addressed, not just to prevent intentionally malign uses of AI in education, but also to facilitate the conditions within which AI in education innovations can flourish.

One approach would be to co-create an international consensus on the application of AI in education. Another might be to apply UNESCO's ROAM[1] principles: aligning digital developments with human **R**ights (addressing freedom of expression, access to information, media pluralism and political participation), **O**penness (recognizing that some machine-learning approaches are an obstacle to transparency), **A**ccessibility (access to research, to education human

resources, data, connectivity and hardware) and **M**ulti-stakeholder governance (transparency, responsiveness, accountability and collaboration). Together these could enrich the values, norms, policies, regulations, codes and ethics that govern the development and use of AI in educational contexts.

A third complementary approach involves a widening of research (to identify evidence-based strategies, especially with a focus on developing countries, local contexts and cultural specificity) and an increase in diversity (for example, encouraging more women to become involved in the research and development of AI, as well as more people from countries that are yet to widely leverage AI technologies). Finally, there needs to be an emphasis on developing AI technologies that complement and augment human cognition, with computers and humans doing what they do best.

It is in bringing these and other approaches together that there is the potential to augment, not replace, human intelligence – especially in classrooms.

How to leverage AI to enhance the quality of education and learning

Despite the many years of research and implementation, it is striking how little is known about the effects of technology on the quality of education, and which specific uses of technology can result in better learning. This is of particular concern in resource-constrained contexts, where technology-based reforms are often touted as an easy remedy for poor economic and social conditions. Nonetheless, the application of AI in educational contexts does appear to have significant potential.

A key use of AI in classrooms is to recommend to students which learning materials they should work with and what pathways through the materials they should follow. Although robust efficacy studies are few and far between, such systems have been shown to better prepare students for their examinations (although we should not assume that something that works in one context will work as well elsewhere). But this so-called 'personalized learning' is not a magic bullet. It has implications for peer/social learning, collaboration, critical thinking and classroom management (it can be challenging for teachers if all students in their classroom are at different places in the curriculum). It also has implications for student agency and self-actualization. Although further evidence is needed, personalized learning might be better if it focused on supporting these key competencies rather than pathways to predetermined content. In any case,

these personalized or adaptive systems appear to work best when they are developing routine cognitive skills – the very skills that are easiest to automate. As an alternative, we need to go beyond using AI to reinforce existing practices. Instead, classrooms should focus on the so-called twenty-first-century skills, attitudes and values, and (given that today's world rewards you for what you can do with information, not for knowing it) should shift from teaching content to teaching how to analyse and make connections. AI is yet to offer much to support these key aspects of learning.

Another use of AI in classrooms, which has so far received much less attention, is to support teachers. For example, AI might automate certain routine and administrative tasks such as grading and record-keeping, which could free up a teacher's time, allowing them to focus on the more creative, empathetic and inspirational aspects of their profession. However, the benefits are again not straightforward. While AI technologies might take some weight off teachers' shoulders, not reading student assignments could mean the teachers would no longer gain important insights into their students' learning, leading potentially to worsening pedagogy in the classroom. In addition, as AI technologies continue to develop, they might take over so much of the teacher's responsibilities that teachers are deprofessionalized and reduced to the role of coach or classroom manager. This ignores research that stresses the importance of the creative and socio-emotional aspects of teaching and learning (e.g. Bali, 2017; Durlak et al., 2011; Hattie, 2008), which go beyond mere knowledge transmission and acquisition In any case, the application of AI in classrooms is likely to redefine teachers' roles, for which comprehensive training will be key. Nonetheless, whatever the approach, while AI might complement and amplify great teaching, there was broad agreement that it is unlikely ever to replace it.

How to promote skills development for jobs and life in the AI era

It is well known that there is increasing jobs volatility around the world, as automation impacts on almost every sector. In fact, AI and automation are having the effect of polarizing the labour market into jobs requiring high and low skills, while the middle-skills labour market (such as jobs in accountancy) is slowly disappearing. Multiple questions arise, which could not yet be answered. How will AI continue to impact the labour market – will there be fewer jobs in the future, or just different jobs? What AI-related skills will be needed now and in the future by the different sectors? How can

educational institutions and training providers from both public and private spheres address any existing or emerging skill gaps? One AI-driven approach is to monitor automatically government priorities, funding opportunities and employment advertisements, to ensure educational institutions offer appropriate training, while job-seekers can focus their efforts in areas where the demands of employers are increasing. Whatever the impact of AI on jobs, it seems inevitable that most adults will need to retrain for different job opportunities throughout their career, necessitating a focus on lifelong learning which might be supported by AI technologies. In addition, our education systems need to teach important skills such as how to imagine, think, construct, collaborate and share – in other words, how to be human – and need to equip students and their teachers with the competencies that everyone will need to live in an increasingly AI-rich world.

How to safeguard transparent and auditable use of education data

Machine learning, the AI that has driven much of the dramatic advances in recent years, depends on large quantities of data, which for the AI to function well must be complete, reliable and timely. For AI to support education, this means that there is a need for substantial amounts of educational data, which many countries struggle to collect. In any case, efforts need to be made to ensure that the educational data is accurate and not biased, while we also need to clarify who owns the data, who can amend it, and what happens if it is incorrect. Finally, issues around informed consent need to be addressed – particularly in the context of young learners, who cannot in legal terms provide informed consent for the collection and use of their personal data. The point is that children and young people can be vulnerable. They often do not fully understand the implications, and can unknowingly provide information and data that can later be used against them. Similarly, the digital learning traces left behind by children engaging in online AI-driven tutoring systems must be kept private and protected from intrusion and misuse. In fact, whether AI can ever be compatible with data privacy is yet to be answered. In key ways, the European Union's General Data Protection Regulation (GDPR), for example, which was designed to make the collectors of data legally accountable, is in direct conflict with the needs of AI – suggesting that new approaches will be required.

The issue of data ownership and exploitation is further complicated by the fact that much educational data is now being collected by the private sector, with its focus on profit over societal needs. In the past, the educational technology industry has often promoted new ways of organizing teaching that have collided with mainstream traditional practices, and that fail to understand how teachers work and the culture of schools. In particular, as we have noted, many current tools for AI in education appear to reduce teachers to a supportive or management role. In addition, we need to consider what will happen if AI in education consolidates to just a few global players. The personal data of teachers and students might be held only by the big tech companies, which will potentially exacerbate ethical issues of importance to many educators and policy-makers.

Moving forwards

International cooperation and stakeholders' involvement

Governments need to recognize that no single country has all the answers. Instead, there need to be a global response, multidisciplinary collaborations, and more cooperation between international agencies including UNESCO, to ensure that the commercial deployment of AI does not exacerbate digital divides or deepen existing inequalities. In particular, AI should not be left to the AI 'experts'. Instead, all stakeholders (educators, students, families, schools and universities, industry and policy-makers) need to be involved in the conversations.

Standards

We also need to draw on existing standards, norms and regulations, which have evolved over time and are well understood. In fact, globally there are already multiple sets of principles for the ethical use of AI or robotics (COMEST, 2017). However, at present there are no globally agreed ethical frameworks, principles or guidelines to address the impact of AI on education [2] (that address the AI and education silos of expertise and interest, and that go beyond the ethics of data and algorithms to consider as well the ethics of education and pedagogical choices). Outstanding questions include: what does it mean for AI to provide a 'better' learning experience, to improve learning outcomes; how can it improve educational decision-making, and what in an increasingly AI-rich world should children

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2   The UNESCO Beijing Consensus on Artificial Intelligence (AI) and Education was published in May 2019.

be learning (for instance, twenty-first-century skills, digital skills and computational thinking)? Further, appropriate policy cannot be reactive. Instead, it needs to be developed as a precursor to facilitate meaningful change.

National policies

Finally, state agencies also need to finance, support and incubate research into AI in local educational contexts (which recognizes teachers as actors and not mere beneficiaries of technological 'solutions'); to develop partnerships with the private sector; to identify and address the ethical issues and develop appropriate guidance; to create new funding opportunities for academic and research facilities for training AI in education specialists; to fill the gaps (for example, the discriminatory gender gap); to set standards and ensure transparency; to share collective intelligence in order to identify and mitigate the risks; and to enhance public understanding and public debate centred on the application of AI in educational contexts.

1. Introduction to Mobile Learning Week 2019: Artificial Intelligence for Sustainable Development

AI has risen to the forefront of public discourse in recent years. The breakthrough in AI is on an accelerated development path, and has been further propelled by innovations in other frontier technologies, including cloud computing, big data, the Internet of Things (IoT), and virtual reality (VR). As a convergence of a widening spectrum of frontier technologies, AI has garnered the potential to bring new possibilities for global development and societal change.

The transformative power of AI impacts on all economic and social sectors, including the education sector. In particular, AI has the potential to accelerate the process of achieving Sustainable Development Goal (SDG) 4. It promises to reduce barriers to access education, automate management processes, analyse learning patterns and optimize learning processes with a view to improving learning outcomes. However, the penetration of AI in education comes with concerns about ethics, security and human rights. Without policy intervention, the commercial deployment of AI is likely also to exacerbate digital divides and deepen existing income and learning inequalities, as marginalized and disadvantaged groups are more likely to be excluded from AI-powered education.

The rapid growth in AI technologies will also significantly affect the skills required by different sectors. Already today, there is a major skills gap in the labour market when it comes to AI-related jobs and skills. Educational institutions and training providers will need to address these skills gaps to ensure that future graduates will meet the requirements of the job market and to enable an AI-literate citizenry.

As frontier technologies, AI processors and AI applications become the new norm for smartphones and other mobile devices, mobile learning is entering a new epoch. At the dawn of the next generation of mobile learning, AI-augmented mobile learning – intelligent mobile learning – has arrived, but its key potential remains to be explored and unleashed. There is a strong need for a holistic review of its implications

'Education will be profoundly transformed by AI. Teaching tools, ways of learning, access to knowledge, and teacher training will be revolutionized.'
Ms Audrey Azoulay
(Director-General of UNESCO)

for equity and inclusion in education, efficiency of education management, quality of learning, and skills development.

To maximize AI's benefits and mitigate its potential risks, system-wide planning and collective actions to reinvent the core foundation of education and learning are required. The rapid deployment of AI in education tests the readiness of stakeholders to harness AI, posing new challenges pertinent to all areas of education and learning, such as policy planning, curriculum and resources development, teacher education, and skills development.

MLW 2019: Artificial Intelligence for Sustainable Development

Mobile Learning Week (MLW) is a United Nations flagship event for ICT in education. In 2019, UNESCO with its partners – the International Telecommunication Union (ITU), the ProFuturo Foundation and Skillogs – convened a special edition of MLW at the UNESCO Headquarters building in Paris. The five-day event, under the theme 'Artificial Intelligence for Sustainable Development', began with a global conference on 'Principles for AI: Towards a humanistic approach?', followed by a one-day policy forum and workshops, a two-day symposium and a half-day of strategy labs.

Towards the close of MLW, participants were invited to join the celebration of International Women's Day,

which included a debate on Women in AI. During the week, exhibitions and demonstrations of innovative AI applications for education and more than twenty workshops were organized by international partners and all programme sectors of UNESCO.

More than 1,500 participants from around 140 countries attended the MLW events. The participants included a number of Ministers of Education and ICT from various countries, other representatives from Member States, the private sector, academia and international organizations.

2. Principles for AI: Towards a Humanistic Approach? A Global Conference (4 March 2019)

MLW 2019 began with the global conference 'Principles for AI: Towards a humanistic approach?' This comprised keynote speeches by leading thinkers, and four plenary sessions involving thirty-seven panellists from across the public, private and voluntary sectors. Participants included stakeholders from the public and private sectors, technical community, media and academia, civil society and international organizations.

The conference facilitated dialogue between stakeholder groups on the potential benefits and challenges of AI and its applications. Discussions focused on the universal aspects of AI, its ethical dimensions, and ways to ensure human-centred and ethical design of AI principles and frameworks rooted in international cooperation.

The conference was founded on the observation that international experts agree that humanity is on the threshold of a new era. Rapid technological advancements in AI – as well as other evolving technologies such as robotics, big data analytics and IoT – are changing the way we learn, work and live together. This transformation has already begun, and while it affects all aspects of our lives, collectively we are not prepared.

Research and applications in the field of AI are advancing at a very rapid pace, while the legal, policy and ethical instruments that are needed to guide and shape AI are evolving slowly. The conference considered a diverse range of issues. How far should a machine's autonomy and its decision-making power be allowed to go? How can we govern AI? Who decides what values and priorities are programmed in the algorithms of machines? If an AI miscalculation results in an accident, who is accountable? What, if anything, is off-limits to AI?

Investing in the development of an ethical and human-centred AI means that we need to address the challenges and opportunities that AI presents for today, tomorrow and beyond. We must equip current and future generations with the necessary tools to harness AI for sustainable development, and ensure that it operates based on human rights, a shared set of values and ethics for the benefit of all humanity. It is widely recognized that AI has enormous potential for developing knowledge societies, for social good and accelerating human progress. AI can help address many of humanity's most critical issues – including those related to education, the sciences, culture, media, access to information, gender equality, poverty alleviation and climate change. Yet these major opportunities that AI offers can only be unleashed if it is developed with respect to universal norms and standards, and if it is anchored in peace and humanism, focused on achieving sustainable development.

This conference was also in response to the major transformations of our societies due to AI, with the aim of facilitating international cooperation and shaping its future. UNESCO's mandate calls inherently for a human-centred approach to AI; to shift the conversation to include AI's role in addressing current inequalities regarding access to knowledge, research and the diversity of cultural expressions; and to ensure AI does not widen the technological divides within and between countries. The promise of 'AI for all' must be that everyone can take advantage of the technological revolution under way and access its fruits.

After opening speeches, led by Ms Audrey Azoulay (Director-General, UNESCO), the conference continued with four keynote presentations, the first by Mr Cédric Villani (Member of the French Parliament, Fields Medal winner 2010, and author of the influential report *For a Meaningful Artificial Intelligence: Towards a French and European Strategy* (2018)), and four plenary sessions:

- ➤ Challenges and opportunities of AI.
- ➤ The universality of AI?
- ➤ Towards a human-centred ethical AI?
- ➤ New architectures of international cooperation on AI.

Conference opening speeches

At the opening of the conference, Ms Azoulay began by comparing AI with the advances of the Neolithic Age and with the invention of printing. She acknowledged that the changes associated with AI are unprecedented in our recent history: 'It is a transformation and a revolution for humanity.' Because of the rapid developments in AI, if we do not wish to witness the end of the enlightenment, we have to make choices both technical and ethical, as the technology transfigures humanity. This is perhaps why, she continued, AI robots fascinate us, because they lead us to question who we are, and what we are capable of doing. Now, we need to ask how we can emphasize and make better use of what makes us essentially human, how we can avoid dehumanization and exploitation of humankind. In addition, while scientists define the technical pathways, it is essential for all humanity to determine how we use AI to achieve the common good.

Ms Azoulay pointed out that AI opens up unprecedented possibilities. For example we can use AI to model sites of special scientific interest to help preserve our world heritage. There is also the impact on jobs: some will go, while others will be created, but we must be aware that many people may be left behind. This is one reason that lifelong learning is becoming increasingly important – with AI being used to support teachers, to identify emotions during learning, and to improve personalization. While it may be too early to regulate AI, we must soon define the ethical principles and establish a multilateral framework, on issues such as transparency, bias and inclusion. This, she asserted, needs to be discussed before the technologies develop too far.

In fact, she explained, this is part of the role of UNESCO – to help determine what kind of AI we need, and how we can all prepare humanity to live with AI, in lives that may be transformed by it. It is for all these reasons that UNESCO is undertaking this reflection, and developing a new report on AI. This is an extension of why UNESCO was founded: knowledge-sharing for a peaceful and sustainable world. Ms Azoulay finished by saying, 'The issues raised by artificial intelligence are not technological. They concern our own humanity, raising scientific, political, philosophical and ethical questions. The time is more than ripe to define the ethical principles that must serve as a foundation and framework of this disruption; to ensure that AI serves collective choices, based on humanist values.'

This theme was continued by **Mr Angel Gurría** (Secretary-General, Organisation for Economic Co-operation and Development, OECD), who suggested that the OECD and UNESCO are key actors in the global response to critical issues raised by AI: questions such as how to bring human-centred values to AI, and how to make AI less artificial and more intelligent. Cooperation is increasingly crucial, but it comes with many challenges. Although AI technologies are still in their infancy, he continued, there have already been many successes – such as detecting health issues, and on-the-spot translations. Investment in AI reflects this optimism, with AI start-ups securing a remarkable 13 per cent of private investment in 2018. But there is much more to do, particularly in the service of people. How do we ensure responsible stewardship of AI? How do we address anxieties, ethical concerns and questions around trustworthiness? How do we prevent the codifying and reinforcement of existing human biases – as we have seen in automatized discrimination in hiring and the criminal justice system? AI systems must be both transparent and accountable.

Mr Gurría also acknowledged that no single country has all the answers. Instead, the issues require a global response. This is why, in 2018, the OECD formed an expert group to investigate adoption of and trust in AI. The group has reached agreement on core values, such as inclusive sustainable growth and well-being, critical actions by governments, policy preparations for job transformations, international cooperation, technical, ethical and legal issues, regulations and interoperability. The OECD is also planning to set up an AI Policy Observatory, with a goal of ensuring consistency and complementarity between the OECD, the G20 and G7, the Institute of Electrical and Electronic Engineers (IEEE), UNESCO, the European Union and so on. The Observatory will combine resources from all the stakeholder groups. In addition, the OECD and UNESCO are supporting a Franco-Canadian initiative to form an International Study Group on Artificial Intelligence, leveraging our mutual expertise on ethical, technical and scientific issues involving AI.

Currently, the main problem is that there are already multiple sets of principles, which is confusing for all. In fact nobody, and no one organization, has all the truth. Instead, we need to undertake common efforts in our respective fields. A time will come when we can consolidate the knowledge, and so we can create principles, norms and rules.

Mr Gurria finished by suggesting that AI must be treated as something as transformative as the internet, and that if we use AI in good spirits, it can be a partner for our future lives: better AI policies for a better life.

The final introductory talk, 'Setting the scene: demystifying AI', was given by **Mr Tapiwa Chiwewe** (Research Manager, IBM Research Africa). He began by suggesting that we are now in the 'cognitive age', or what others have called the 'Fourth Industrial Revolution'

(Schwab, 2017), in which AI is the new information technology (IT). It is, he explained, about machines performing cognitive functions that we normally associate with the human mind. While humans are good at self-directed learning, common sense and value judgements, AI is good at large-scale mathematics, pattern discovery and statistical reasoning. In bringing these capabilities together we can augment human intelligence.

AI, Mr Chiwewe continued, depends on algorithms, power, storage and expert practitioners, but mostly on data. It is expected that the world will have 165 zettabytes of data by 2025, which has both enabled the explosion in AI and requires the power of AI to analyse. Interestingly, he pointed out, the key AI techniques that are currently having such an impact (machine learning, neural networks and deep learning) have been with us for decades. But the explosion in impact is due to the recent massive increases in data and computing power. For example, in 2015 AI became 'better' than humans at image recognition. Similar advances have happened in language translation, speech transcription, object detection and face recognition, to name just a few. However, Mr Chiwewe pointed out, these are all examples of what we call narrow AI, which involves deep learning in specific domains, and requires large amounts of data. What we call broad AI is becoming increasingly possible, based on learning and reasoning, multi-task and multi-modal operations, across multiple domains. The key thing is that these approaches learn with much less data.

Mr Chiwewe concluded by asserting that, for the application of AI in education, the social and ethical questions must be addressed, so that people feel able to trust artificial intelligent systems. This is why, at IBM, they have established Five Areas of Ethical Focus: Accountability, Value Alignment, Explainability, Fairness and User Data Rights (IBM, 2019).

Conference keynotes

The main conference keynote was given by **Mr Cédric Villani**. He began his talk by describing how, when he was a mathematics student, AI was not a recommended field of research: he was told 'it won't have a future'. In those days, AI had a reputation for not leading to any successful applications. But in recent years, everything has changed. Now, AI is all about statistics and data. For years AI was in the hands of a few specialists, whose aim was to understand and reproduce human intelligence. Now, the focus is on specific tasks rather than on understanding – which is why AI has become of interest to so many and the algorithm has become all-powerful. But while algorithms can beat humans in many complex but bounded games, such as Chess and Go, they are still incapable of doing what we humans do naturally. AI algorithms currently 'understand' less than a small child. This is why we need to let machines do what they do best, while humans do what they do best.

Mr Villani continued by proposing that we should consider three closely related issues: experimentation, sharing and sovereignty. Although AI has achieved many breakthroughs, along with its many setbacks, it is still in an early stage of development. The problem is that we don't know in advance which approaches are going to be successful, which is why 'experimentation' is the first key word and funding research institutions are so important. The second key word is 'sharing'. Governments need to develop legal frameworks and international collaborations that prioritize sharing ideas and developing trust. Third is 'sovereignty'. We need to avoid a new cold war, based on AI and robots, and ensure that the European Union is not squeezed between two powerful players.

Mr Villani continued by explaining that ethics cuts across each of these key issues. How do we ensure we do not leave anyone by the wayside? How do we organize the sharing of the data that enables AI without endangering personal safety and privacy? And how do we ensure AI serves the aims of humans, rather than humans having to adapt to the needs of AI? He concluded by pointing out an opposite perspective, 'The danger is not AI. It is us. If we do not rise to the challenge. If we are too cautious, we will be delaying the benefits. Spectacular benefits.'

A joint keynote was given by **Ms Nanjira Sambuli** (Senior Policy Manager, World Wide Web Foundation) and **Mr Philip Dawson** (Lead Public Policy, Element AI). They began by questioning whether the conversation should be about 'inclusivity in AI' or about 'developing a society of inclusiveness'. Currently, they pointed out, around 50 per cent of people around the world are still without internet access, vast numbers of those being women. With this in mind, the speakers moved on to the data that are used by AI systems and how those data are managed. They discussed data governance, making the suggestion that perhaps we should establish boards of data trustees, whose role it is to help develop, then follow and apply ethical practices determined by consent. They then highlighted some key ethical issues for AI, such as human rights in general, access to AI, management of data, and who makes the choices. They concluded with three observations. Collectively, we need to consider data governance and how this is a vehicle to enable people to have access to data. We need to have more conversations about AI ethics, thinking about

human rights and technology, and we should not think of AI as the moral actor – instead, humans must retain moral agency.

The conference's final keynote was given by **Mr Marcus Goddard** (Partner, Netexplo), who began by describing Netexplo's global network of nineteen leading universities through which it captures and reviews more than 2,000 innovations per year. Netexplo experts examine and score the innovations, to produce forward-looking scenarios and to identify underlying trends. From this starting point, Mr Goddard focused on two key characteristics of digital innovations. The first was 'Zero Interface', where the technology is pervasive and immersive, becoming almost invisible. He gave the example of a system that monitors the voice cadences, typing patterns and other characteristics of investment traders, to predict whether they are on the verge of burnout. A second system continuously captures biometric data via cameras and sensors to measure and monitor, for example, heart rates, perspiration and muscular activities, to predict health issues before they become manifest. The second key characteristic of digital innovations identified by Mr Goddard is known as 'Decision 0', which refers to technologies making decisions autonomously. These technologies use AI to speed up and continuously improve decision-making. An example is a prosthetic hand that includes a built-in camera, the input of which is constantly monitored by AI to ensure the actions of the prosthetic hand are optimized. In both 'Zero Interface' and 'Decision 0', the AI has the potential to make improvements to the world – but only if the technology is contextualized. This can only be achieved, he asserted, if we accept a more holistic view of intelligence, where AI is understood not as 'artificial intelligence' but as 'augmented intelligence'.

Plenary sessions

Challenges and opportunities of AI

The development of AI offers both opportunities and challenges, particularly in reference to the global SDGs. This plenary considered multiple questions. What are some of the main challenges and opportunities in ensuring the development of AI that serves humanity? How can AI contribute concretely to sustainable development? How can AI potentially both increase and fight biases, notably in the domain of gender equality, discrimination, and narrowing the digital divides? From this basis, the first plenary session, 'Challenges and opportunities of AI', included discussions on trust

and transparency, diversity and biases, experts versus citizens, and AI to help prevent violence against children.

We are at a unique point in history, and we owe it to the future to consider carefully now what it all means. There are more than 111 domains across which AI is being developed, covering the corporate, civil and academic sectors. There are also a range of initiatives, including the launch of a network in Africa to create an AI research roadmap, and a European project exploring 'Humane AI'. A key problem is that technology changes much more quickly than regulations, and we do not currently have clear roadmaps. This is just one reason why education is essential, including both research into AI and helping everyone to understand what AI means (what it is and what it is not). In fact, AI might help us solve some of the world's biggest problems.

We do know that AI has issues of bias (for example, automatizing discrimination against people of colour, or because of their gender). This is especially acute in contexts outside of the United States, Europe and China, such as in Africa and large parts of Asia. To give one interesting example, when AI-driven image recognition is used to identify photographs of weddings, it only recognizes typical Western-style weddings, which feature white bridal dresses. It ignores, and thus discriminates against, practices in countries elsewhere. In other words, existing biases can be exaggerated by AI and perpetuated. If only for this reason, we need more software developers and engineers from more diverse contexts. Having said that, it is also important to recognize that AI is neutral. It is how we choose the data, design the algorithms and use the technology that determines the outcomes.

In the United Arab Emirates (UAE), many of the issues raised by AI have been addressed in the UAE Strategy for Artificial Intelligence report. The report focuses in particular on ethics, security and inclusiveness. It is currently being applied across all key sectors, with the aim of ensuring that there is an AI ecosystem in UAE.[3]

3   www.uaeai.ae/en

We must also avoid the 'efficiency trap' where increased efficiencies result only in greater consumption. There is also the potential negative impact of AI on jobs: while the industrial revolution created the working class, the AI revolution might create the un-working class. If we want to reap the benefits of AI for sustainable development, we also need to cherish our democratic institutions, especially the rule of law, and we should challenge when AI is used to make high-level legal decisions without proper human oversight (for instance in some places, AI is being used to determine how long people should spend in gaol, and when to take children away from their families). This may be efficient but it fundamentally undermines the function of the law, and offends the values of justice.

An important example of where AI might have a critical role in the future is helping prevent violence against children. Although the statistics vary between sources,[4] as many as one in every two people across the world has been a victim of violence as a child. This can mean anything from corporal punishment to child refugees being sold into slavery or for sexual exploitation. It is known that violence against children spreads and clusters like any epidemic, which means that it can be tracked using mobility data and possibly AI in order to help identify who is being abused, so that they might receive effective support. One such AI tool has been developed by the Global Partnership to End Violence Against Children to enable the police to identify much more quickly children who are subject to violence. This tool has already been used effectively in thirty countries. Other possible AI-driven approaches include using blockchain to identify the money that is involved in child exploitation.

Participants

Ms Cathy Mulligan
(Visiting Research Fellow, Centre for Cryptocurrency, Imperial College, United Kingdom) (moderator)

Ms Bunmi Banjo
(Managing Director, Kuvora Inc.)

H.E. Omar Bin Sultan Al Olama
(Minister of State for Artificial Intelligence, United Arab Emirates)

Mr Seng Yee Lau
(Senior Executive Vice President, Tencent)

Mr Nicolas Economou
(Founder and CEO, H5)

Ms Marija Manojlovic
(Strategy, Data and Innovation Advisor, Global Partnership to End Violence Against Children)

Mr Luis Enrique Sucar
(Senior Research Scientist, Instituto Nacional de Astrofísica, Óptica y Electrónica, Mexico)

The universality of AI? Ensuring a global approach

The conference's second plenary session, 'The universality of AI? Ensuring a global approach', included discussions on inclusion and infrastructure, standards and ethics, the potential of AI for both good and harm (as an 'emancipatory force' or a 'crushing force'), and delegating decision-making to AI.

The development of AI directly impacts all domains of UNESCO's mandate. AI is changing the way we think about heritage reconstruction, and contemporary creative production. Environmental programmes and underwater research are being transformed by AI-driven technologies, and the ethical dimensions of AI are at the heart of the preoccupations of governments and everyday citizens. Teaching tools, ways of learning, access to knowledge, and teacher training are all likely to be revolutionized. The question of what

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4   Know Violence in Childhood (2017); Child Trends (n.d.); UNICEF (2015).

skills to develop in order to evolve in an increasingly automated world will become more and more central. Communication and information are being directly impacted by advances in AI, through the development of algorithms and evolutions in access to information and media production.

AI ought to be available for everyone. However, there is already a major gap between developed and developing countries. Inclusion requires strong technology foundations first, which for many developing countries are still not yet in place. We also need to give the AI industry appropriate standards, so that ethical design can be embedded in AI products from the beginning. In fact, we should consider at the same time the potential of AI for both good and harm, to ensure that AI is an emancipatory, not a crushing force. In particular, we should not assume that

something that is incredibly powerful in one context works as well in all situations (with people of different cultures, genders, socio-economic status and so on). For example, AI is beginning to reveal how much our society is already biased (in terms of gender, age and socio-economic status). Now we need to use AI to address this unacceptable situation, which in turn needs both universal and contextual expertise. In addition, while we should embrace AI, we should not do so at the expense of the fundamentals (including education, equity and human rights). We need to think about issues as wide-ranging as data governance, competition, accountability, human rights, business models and ethics. We need to draw on existing standards, norms and regulations, which have been evolved over time and are well understood. We should also aim to use AI to level the playing field.

Participants

Mr Andrés Roemer
(UNESCO Goodwill Ambassador for Social Change and the Free Flow of Knowledge, writer, philanthropist, human rights activist) (moderator)

Mr Abdoulaye Baniré Diallo
(Professor, Université du Québec à Montréal, Chief Scientist and Co-founder, My Intelligent Machine, Canada)

Mr Raja Chatila
(Professor of Artificial Intelligence, Robotics and Ethics, Sorbonne University, France)

Ms Anriette Esterhuysen
(Director of Global Policy and Strategy, Association for Progressive Communications)

Mr Miguel Luengo-Oroz
(Chief Data Scientist, UN Global Pulse)

Mr Nicolas Miailhe
(Co-Founder and President, The Future Society)

The universality of AI? Ensuring a multi-stakeholder approach

'The universality of AI?' plenary session continued with a discussion entitled 'Ensuring a multi-stakeholder approach'. This included contributions about the alignment of private interests and societal needs, building bridges between the multiple stakeholders, especially between industry and the public sector, the fact that AI is itself neutral and that outcomes depend on how it is designed and used, and AI's potential for good and its many challenges.

AI is already being used widely. To ensure that AI is used for good, international agencies need to work together. This is why the OECD has launched the AI Policy Observatory, and is working with many other agencies, including some of the best institutions in the world (public, private and academic), learning from each other, towards developing trustworthy AI, and to create a set of AI principles (around equality, transparency, accountability and fairness).

A key issue is that some stakeholders – in both the private and public sectors – have more voice because they effectively own the data. The problem is that these private interests are not always aligned with societal

needs. Instead, we need to think of AI as a possible social good that belongs to everybody. We need to think about all of society, to reflect the many different walks of life and areas of activity. A core question is how we can build bridges between designers, developers and users, to ensure that the AI allows feedback to maximize its potential while minimizing its risks. We need to create conditions that allow us to define and test standards, to consider how AI can help solve social justice issues. Perhaps most importantly, we need to figure out a way to ensure that all people, including women and other disadvantaged people, have ownership of AI, to ensure a more humanist approach.

In particular, we need to go beyond small numbers of people to discuss issues around AI with all stakeholders, to foster a common vision of the future – not only engineers and mathematicians, but also psychologists, teachers and policy-makers, people of all ages and from multiple cultures. In short, we need to bridge the divide between the AI experts and most citizens. The

Slovenia has a network of research labs, involving more than 300 researchers, which is working with UNESCO to create global tools for AI, and to enable stakeholders to understand what AI can do.

current lack of regulations means that there is a need for in-depth and wide-ranging discussions. In fact, many nations are undertaking critical reviews of AI, and are thinking about how humanity can find ways of living with AI, especially with the possibility of AGI (artificial general intelligence).We also need to avoid hierarchical approaches, and instead draw on the example of Wikipedia's collective intelligence.

Participants

Mr Andrés Roemer
(UNESCO Goodwill Ambassador for Social Change and the Free Flow of Knowledge, writer, philanthropist, human rights activist) (moderator)

Ms Hawa Ba
(Head of the Senegal Country Office, OSIWA)

Mr Katsumi Emura
(Chief Technology Officer, NEC)

H.E. Mr Jernej Pikalo
(Minister of Education, Science and Sport, Slovenia)

Mr François Taddei
(Director of the Center for Interdisciplinary Research, France)

Mr Ulrik Vestergaard Knudsen
(Deputy Secretary-General, OECD)

Towards a human-centred ethical AI

If we are to make the most of the possibilities offered by AI to the world, we must ensure that it serves humanity, with respect for human rights and human dignity, as well as our environment and ecosystems. Today, no globally agreed ethical framework or principles for AI developments and applications exist. UNESCO is a unique universal forum with over twenty years of experience in developing international instruments related to bioethics and the ethics of science and technology. It has the responsibility to lead an

interdisciplinary, pluralistic, universal and enlightened debate – not a technical debate, but an ethical one – in order for us all to enter this new era with our eyes wide open, without sacrificing our values, and to make it possible to establish a common global foundation of ethical principles.

What do we mean exactly by a human-centred and ethical AI? What are the immediate and potential long-term ethical challenges raised by AI in the domains of UNESCO's mandate? What are some of the challenges in establishing ethical frameworks and principles in this

field? Does this definition change in different regions of the world? What is a possible way forward and who needs to be involved in the conversation?

In response to these many questions, the 'Towards a human-centred ethical AI?' plenary considered the proliferation of AI initiatives and how UNESCO might contribute to the discussions. Panellists agreed that UNESCO can bring an ethical voice into the AI in education landscape, focusing on the humanity perspective – we need to think collectively about what it means to be human and what defines us as humans. UNESCO's potential role includes developing a publication on ethics and AI, and a call for UNESCO to think about inclusiveness, transparency, awareness, democracy and sustainability. The seven panellists engaged in discussions about the challenges of AI, the ethics of information and data, scientific impact and design processes, and the key points in the difference between humans and AI. The discussion highlighted a number of key issues that need to be further unravelled and addressed:

➤ the agency of non-actors, such as many people in developing countries, which AI initiatives and progression might disregard

➤ the power of AI to influence and change behaviours

➤ how the experiences of humans should enhance AI

➤ the alignment of AI towards the SDGs and how to empower humans while promoting human rights and privacy

➤ how we can include AI without dehumanizing learning.

PARTICIPANTS

Mr John Shawe-Taylor
(UNESCO Chair in AI, Professor of Computational Statistics and Machine Learning, University College London, UK)

Mr Sang Wook Yi
(Professor of Philosophy, Hanyang University, Republic of Korea; member, World Commission on the Ethics of Scientific Knowledge and Technology, UNESCO) (moderator)

Mr Bernd Carsten Stahl
(Professor of Critical Research in Technology, Director of the Centre for Computing and Social Responsibility, De Montfort University, United Kingdom)

Ms Dorothy Gordon
(Chair, Information For All Programme, UNESCO)

Mr Edson Prestes
(Institute of Informatics, Federal University of Rio Grande do Sul, Brazil)

Ms Emma Ruttkamp-Bloem
(Professor in Philosophy of Science, University of Pretoria; Leader of Ethics of AI research group, Centre for Artificial Intelligence Research (CAIR), South Africa)

Mr Osamu Sudo
(Professor, University of Tokyo; Chair, Council for Social Principles of Human-Centric AI, Japan)

Mr Sang Wook Yi
(Professor of Philosophy, Hanyang University, Republic of Korea; member, World Commission on the Ethics of Scientific Knowledge and Technology, UNESCO)

Mr Lan Xue
(Dean of Schwarzman College, Tsinghua University, People's Republic of China)

New architectures of international cooperation on AI

This final conference plenary session involved discussions on the role of international organizations and the importance of global and cross-sector cooperation. Participants agreed that UNESCO, as a standard-setter and laboratory of ideas, has a role to play in shaping the international debate on the future of AI and its governance. UNESCO's multidisciplinary mandate positions it to address the ethical and social implications of AI while promoting its development around human-centred values. How can multilateral cooperation on AI be assured between relevant international, regional and national bodies so that we are not reinventing the wheel as it concerns the development of norms and standards in this domain? What strategies, frameworks and principles have been developed at the national or regional level in relation to AI and human-centred values? What remains to be done, and what is the role of UNESCO?

The audience were asked how optimistic they were about UNESCO's and other international organizations'

chances of coordinating developments in AI. Using the conference app, more than 200 people responded, revealing that they were on average 'relatively optimistic'. However, it is important to recognize that this discussion might differ according to the type of AI and the application of AI being discussed. So at this stage it is more important to organize discussions and mutual exchanges. In fact, the private sector and international organizations can provide added value, because they can help organize and coordinate the market. For example, ITU already organizes an event called 'AI for Good',[5] in response to approaches from industry.

This also relates to regulations, because in the AI era existing laws are fast becoming not fit for purpose. Here there is an increasingly urgent need for a coordinated and multi-stakeholder approach, which goes beyond a focus on policy-makers, to take in industry and civil society – although most private-sector organizations have a preference for non-binding regulations or soft governance. In any case, whatever regulations do emerge, they must be able to keep pace with developments.

PARTICIPANTS

Students from Sciences Po Paris School of International Affairs class 'Governing the Rise of AI: A Global Perspective' (moderators)

Mr Houlin Zhao
(Secretary-General, ITU)

Mr Amandeep Singh Gill
(Executive Director, Secretariat of the High-level Panel on Digital Cooperation, *ex officio*)

Ms Gabriella Battaini-Dragoni
(Deputy Secretary-General, Council of Europe)

Mr Fabrizio Hochschild Drummond (Assistant Secretary-General for Strategic Coordination, Executive Office of the Secretary-General of the United Nations)

Mr Roberto Viola
(Director-General of the EU Directorate-General for Communications Networks, Content and Technology, European Commission)

Mr Moez Chakchouk
(Deputy Secretary-General, UNESCO)

Ms Boutheina Guermazi
(Director of Digital Development, Infrastructure Practice Group, World Bank Group)

5   https://aiforgood.itu.int

3. Policy Forum and Workshops
(5 March 2019)

Introduction

The second part of the activities to celebrate Mobile Learning Week 2019 comprised an 'Artificial Intelligence for Sustainable Development' policy forum and workshops. These were organized by UNESCO with support from ITU,[6] the ProFuturo Foundation[7] and Skillogs.[8]

The policy forum offered a platform to discuss the different pathways that governments are using to harness AI and to ensure that AI does not deepen the existing inequalities in education. The forum comprised an introductory session and four plenary sessions, and involved more than thirty speakers.

The workshops showcased demonstrations of innovative policies, research, projects and solutions that use AI tools and frontier technologies for education and learning. There were eighteen workshops, which together involved more than eighty speakers. Workshop presenters were chosen from a wide range of international organizations, non-governmental organizations (NGOs), governmental agencies and academic institutions.

The policy forum

The policy forum began with welcome speeches led by **Ms Stefania Giannini** (Assistant Director-General for Education, UNESCO). Subsequently, there were four plenary sessions:

➤ What policies are needed to harness AI to accelerate progress towards SDG 4?

➤ What policies are needed to ensure frontier technologies and AI can support digital transformation, e-learning and digital skills development?

➤ What policies are needed to ensure inclusiveness in the use of accessible ICTs and AI in education?

➤ What policies are needed to empower and prepare teachers for AI-powered learning environments?

Policy forum opening speeches

In the opening speech of the Artificial Intelligence for Sustainable Development policy forum, **Ms Giannini** introduced the day's theme: 'how to harness AI and improve digital learning policy environments in the context of Education 2030 and the wider Sustainable Development Agenda'. She continued by asserting that it is education that powers sustainable development, and that this will only succeed if it leverages the digital revolution and in particular AI. This has two dimensions. First, AI tools might help bridge the gaps in access in education and learning outcomes, to help ensure that no one is left behind – which is the overarching goal of the UN 2030 Agenda. Second, education needs to equip students, and their teachers, with the competencies that they will need to live in an increasingly AI-rich world.

Ms Giannini emphasized a range of key issues that need to be addressed. These include the risks of AI deepening digital and social divides within and between countries, the importance of addressing the ethical consequences of AI (around data use, privacy and transparency), and the current scarcity of evidence for the positive impact of AI on learning.

She continued by acknowledging that the application of AI in education involves a complex ecosystem of knowledge, innovation, regulations, tech giants and tech start-ups. Meanwhile, public policies, which are still in their infancy, find it difficult to keep up. In fact, if AI is to be put at the service of sustainable development, a whole new policy landscape has to emerge. UNESCO's role is to help navigate this complex environment, by facilitating discussions and developing a set of policy

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6   www.itu.int
7   https://profuturo.education
8   www.skillogs.com

guidelines which have equity and inclusion at their core. This will require global cooperation and partnerships, between the public and private sectors (including government, NGOs, universities and research institutes), striking the right balance between competition and collaboration. It will also require the development of shared open knowledge, for universal access to learning throughout life, for individual and social empowerment, and for sustainable development.

The policy forum's second speech was given by **Mr Kemal Huseinovic** (Chief of the Infrastructure, Enabling Environment and E-Applications Department/ BDT for ITU, one of the policy forum sponsors). He began his contribution by noting that, while IT has always been a driver for change, its effect is moderate when compared with the potential impact of AI on all sectors of society. For this reason, it is essential that everyone becomes aware of AI, its possibilities and the social consequences. Policy-makers in particular need to have a good understanding, so that they are able to develop and deploy appropriate and effective policies. He noted that several key issues were raised at the 2018 'AI for Good' summit, organized by ITU in Geneva. For example, how will AI affect labour, education and market structures? What is AI's role and how can we ensure it helps rather than harms society? And how do we ensure that AI does not replicate or increase the existing IT divide? To address these issues will require cooperation and partnership, everyone having access to education and appropriate technologies, and the technologies serving people – not the other way around.

The opening session was concluded by **Ms Sofia Fernández de Mesa** (Managing Director, ProFuturo Foundation, the second policy forum sponsor). She began by briefly introducing the ProFuturo Foundation, which was established to 'improve education around the world, guided by the absolute conviction that digital education has the power to narrow the education gap, reduce poverty and improve people's lives'. Ms Fernández asserted the importance of empowering global leaders to understand the potential of AI in education, of working to ensure that results are sustainable at scale, and of preparing teachers, developers and learners for the possibilities and the risks. She concluded by referencing a key working paper recently prepared by UNESCO in partnership with ProFuturo, entitled *Artificial Intelligence in Education: Challenges and opportunities for sustainable development* (Pedro et al., 2019), which was then used to structure the policy forum discussions.

Policy forum sessions centred on the 'Artificial intelligence in education: challenges and opportunities for sustainable development' working paper

'AI is a field that spurs innovation and, by doing so, increases countries' competitiveness. Yet, at least when it comes to education, there is also room for cooperation, whose basis is knowledge sharing' (Pedro et al., 2019).

Mr Francesc Pedro (Chief, Section of Education Policy, UNESCO) and **Ms Paula Valverde** (Head of Product and Innovation, ProFuturo Foundation) introduced the working paper *on Artificial Intelligence in Education: Challenges and opportunities for sustainable development*, which sets out 'to bring the discussion [about AI in education] to the least developed and developing countries, recognising the multiple limitations these countries face while uncovering the need for structural innovation to leapfrog education as a human right using technological opportunities to advance at a large scale in new learning scenarios'.

While many countries have developed policies and plans for AI, few have yet to fully consider the impact of AI on education. For example, how can AI provide a better learning experience and improve learning outcomes, how can it improve educational decision-making, and what in an increasingly AI-rich world should children be learning (for instance, twenty-first-century skills, digital skills and computational thinking)? The way forward requires international cooperation on AI in education – possibly involving a common policy framework, a forum for stakeholder discussions, or (building on the OECD's AI Policy Observatory) an AI in Education Observatory. This is in a context where the application of AI in education has been led principally by non-state actors, particularly the private sector, with the rapid expansion of the EdTech industry together with the tech giants leading the increased use of AI-enabled learning technologies in educational settings.

The working paper also highlights the responsibilities of UNESCO, which:

> *"Given its leadership role in the SDG 4 – Education 2030 Agenda, has the mandate to coordinate with national governments and mobilise non-state actors, including NGOs and private enterprises. Furthermore, UNESCO's extensive network of businesses, policymakers and practitioners working within the education sector, allows the Organisation to broker partnerships between learning solution*

providers. Moreover, the Organisation's normative function allows it to define fundamental criteria and standards for the selection of appropriate AI technologies, in light of SDG 4 objectives."

In summary, the working paper comprises a definition of AI, a comparison of knowledge-based and data-driven AI, a conceptual map of AI and policy interventions, how AI might improve learning outcomes (with examples from developed and developing countries), and the role of learning management systems and the emerging discipline of learning analytics. The main section of the paper focuses on six key challenges and policy implications for AI in education:

Challenge 1: developing a comprehensive public policy on AI for sustainable development

Challenge 2: ensuring inclusion and equity in AI in education

Challenge 3: preparing teachers for AI-powered education and preparing AI to understand education

Challenge 4: developing quality and inclusive data systems

Challenge 5: making research on AI in education significant

Challenge 6: ethics and transparency in data collection, use and dissemination.

These six challenges served as the foundation and structure of the policy forum.

Challenge 1: A comprehensive public policy on AI for sustainable development

Source: Profuturo Foundation

AI is widely thought to have great potential for improving education but it also impacts on what is taught. How can AI help learners, teachers, administrators and policy-makers? And what do learners need to learn to enable them to thrive in a society surrounded by AI? Accordingly, the first challenge is ensuring that there are comprehensive public policies for AI to support the SDGs, particularly SDG 4.

Many countries have developed national AI strategies, although most often the application of AI in education is not prioritized. In fact, currently, most AI developments in education have emerged from the private sector, while most governments are struggling to manage this rapidly developing engagement. The role of the state in this context remains underexplored.

AI works within complex ecosystems of knowledge, innovation, business and new regulations, while the development of public policies regarding AI in education is still in its infancy. However, some key requirements are starting to emerge. These include the need for state agencies to address the speed of innovation in the field of AI and the disconnect with traditional institutions, to incubate and research AI in educational contexts, to develop partnerships with the

The UAE government is working hard to create an AI ecosystem supported by a comprehensive regulative framework, to increase the efficiency of all government services. In fact, the government has recognized the critical importance of AI – it is the first country to appoint a minister of state for artificial intelligence – which is also enabling the country to become the region's AI hub.

private sector, to identify and address the ethical issues and develop appropriate regulations, to create new funding opportunities for academic and research facilities for training AI specialists, and to enhance the public understanding and public debate.

The policy forums explored this challenge from multiple perspectives, addressing questions such as where policies should start, what the priorities are, and what the key pillars should be. In fact, policy frameworks are needed to empower all citizens for the AI-powered digital world; and to achieve this, we need to develop an intelligent ecosystem built on effective infrastructure, partnerships and governance models. However, this key work is currently being hampered by the common view that AI is only something 'in the future', which is why it is not being given the urgent attention that it needs. In fact, policy should not be reactive; instead it needs to be developed as a precursor to facilitate meaningful change.

> Argentina has worked to develop an ecosystem of educational innovation, providing teachers and schools with training so that they can make best use of the available tools. The government sees its role as being to empower both the private and public education sectors, which has led to the development of an adaptive mathematics programme that is being delivered to students across the country.

AI policies are particularly needed to address the AI and education silos of expertise and interest. This will require a horizontal strategy that brings together all of the important areas, including legal, financial and educational, in both the private and public sectors. In addition, policies also need to go beyond protection and safety in a digital world, as addressed by Europe's General Data Protection Regulation (GDPR), to ensure that it facilitates and encourages innovation and experimentation in formal education.

Policies also need to focus on both human intelligence and AI, the point being that we cannot automate all aspects of human intelligence (such as social, emotional and contextual intelligence), so we should be investigating how we can use AI to make humans smarter while increasing well-being.

Challenge 2: Ensuring inclusion and equity in AI in education
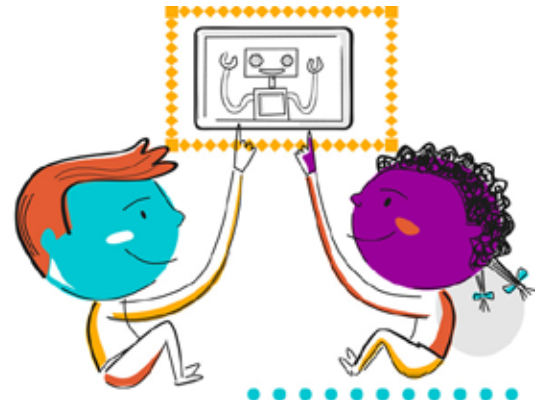
Source: Profuturo Foundation

The authors of *Artificial Intelligence in Education: Challenges and opportunities for sustainable development* note that while AI can open numerous possibilities, it may also deepen existing inequalities – as the marginalized and disadvantaged are more likely to be excluded from AI-powered education. The result will be a new digital divide between those who do and those who do not have access to AI technologies.

For this reason, equity and inclusion must be core values of any policies being designed to address the application of AI in education. There are many initial questions. What infrastructure conditions are necessary to make AI in education possible? What can we learn from previous experiences that will enable us to ensure equitable digital access? How can AI enhance education for disadvantaged groups and populations? How can AI help close the educational gap between the rich and poor students of the world?

The reality is that for many developing countries there are already foundational obstacles. These include the availability and reliability of electricity and internet access, the cost of hardware, software and data, the availability of computer hardware, student ICT skills, language and the lack of culturally appropriate content (Nye, 2015). The introduction of Big Data in developing countries has already shown that a lack of basic infrastructure can lead to a new digital divide (Hilbert, 2016).

To prevent the replication or exacerbation of inequities and divides, it will be key to define access to the internet and AI technologies as twenty-first-century fundamental human rights. In particular, it is critical to have a broad understanding of accessibility, one that captures the needs of vulnerable groups both within and between developed and developing countries. If AI creates a bigger divide, it is not being that intelligent.

'Education for all' means that education powered by AI should be accessible for all, whatever their environment, nationality, culture, gender, disability status, sexuality or age. Almost half of the world's population need accessibility approaches. As well as children from challenging backgrounds, this includes older adults who are already in careers and those with age-related disabilities. In fact, it is essential to ensure that policies for AI in education focus on the whole population and not just the young.

Accessible ICT has accessibility built into its very design – it cannot be a bolt-on. Meanwhile, without developers making a conscious choice to ensure that hardware, software and content are accessible, it simply will not happen. This is the approach recently taken by Microsoft. Each part of the company now has to plan how they will address accessibility, which has already led to significant changes in how core software is developed. For example, features to support people with dyslexia (such as the ability to easily change font sizes and colours, and page layouts) have been incorporated into Word and other software.

However, even if educational ICT is accessible by design, accessibility problems still exist if teachers are not aware of the accessibility features or how to use them. In other words, not only the designers and engineers of AI tools for education, but also teachers and school leaders need training and support.

A final question is when should governments use the carrot, stimulating the private sector with funding and awards, and when the stick. There are European rules coming in that aim to embed accessibility in design, while the use of legislation in the United States has worked well: as the US government is one of the world's biggest purchasers of educational products, insisting on accessibility has forced companies to build in accessibility from the ground up.

Challenge 3: Preparing teachers for AI-powered education and preparing AI to understand education

Source: Profuturo Foundation

The authors of *Artificial Intelligence in Education: Challenges and opportunities for sustainable development* note that, rather than addressing the existing problems and issues that teachers face, the educational technology industry often promotes new ways of organizing teaching that collide with mainstream traditional practices. Yet the history of innovations in education is full of lost promises that fail to understand how teachers work and the culture of schools. In fact, many current AI in education tools reduce teachers to a supportive or coaching role, ignoring the research that stresses the importance of the creative and socio-emotional aspects of teaching and learning, which go beyond mere knowledge transmission (e.g. Bali, 2017; Durlak et al., 2011; Hattie, 2008). Not surprisingly, although teachers hear what vendors have to say, they do not necessarily buy into it.

However, AI-enabled technologies do provide opportunities to enhance classroom practices (Holmes et al., 2019). For example, they might automate certain routine and administrative tasks such as grading and record-keeping. This could free up a teacher's time, effectively allowing them to focus on the more creative, empathetic and inspirational aspects of their profession. Yet teachers are typically unaware of the potential of AI for teaching or of the social and ethical implications, such that teacher training is critical. Teachers need to assimilate new competencies, including an understanding of how AI-enabled systems can facilitate learning, research and data analytics skills, skills to effectively manage both human and AI resources, and a critical perspective on the ways AI and digital technologies affect human lives.

Together, this suggests that the development of AI-enabled tools and their integration into the delivery of educational programmes must be a participatory process, designed to 'deliver the support that educators need – not the support that technologists or designers think they need' (Luckin et al., 2016). AI developers have to participate in new dialogues with educators, content designers and cross-disciplinary specialists, while teachers have to become more aware of how AI is permeating all aspects of society. The challenge is to create new pedagogical dialogues at micro- and macro-levels of understanding education. For instance, we should analyse systems thinking, critical thinking, self-regulation and active listening. Data analysis should move across individual tutoring systems and evaluate student skills for the twenty-first century (Woolf et al., 2013).

AI and AI developers should not be leading the debate; instead, the focus should be on learning and how AI can contribute. Similarly, the common tendency for developers is to push the boundaries of technology, rather than seeing how existing technologies might be repurposed effectively for particular local contexts. For example, ordinary mobile phones and text-based formative assessments are being used to help teachers in sub-Saharan Africa improve their pedagogy. Reforms such as one-laptop-per-child were broadly ineffective because they neglected issues of pedagogy and teacher support. They were also highly dependent on large-scale provision of equipment and infrastructure. Instead, more frugal reforms, which start small, are likely to be more successful – even those that involve AI.

While AI technologies might take some weight off teachers' shoulders, perhaps by automating the marking of assignments, this could also mean that important insights into student learning would no longer be gained by the teacher, leading potentially to a worsening pedagogy in the classroom. So the benefits are not always clear-cut. In any case, as AI continues to improve, and takes more and more weight off teachers' shoulders, eventually there might not be anything left for the teachers to do – losing everything that teachers bring to teaching. But the use of AI to support teaching gets more complicated still. While AI replacing teachers would have negative consequences for educational systems that have good numbers of teachers, in places where teachers are few and far between, learners might find AI tutors especially beneficial.

Nonetheless, AI is unlikely to replace teachers, because education is a complex ecosystem, involving teachers who understand the possibilities of AI, as well as schools that have the necessary equipment, and an agreement that AI can be a good thing. The media is contributing to an unhealthy anxiety about AI. Accordingly, training should be put in place to demystify AI, to help teachers understand what AI is and to feel comfortable using it. When educational reforms are implemented, there are often complaints that teachers do not keep up, but often they are not given enough time and space to do so. Teachers need to be supported in the transition.

> Palestine has a major initiative to rebuild its entire education sector from scratch. This radical approach is based on smart teaching and learning, pedagogical innovations, moving from memorizing to engagement, and involving creative subjects along with technologies such as AI.

There is little point using AI simply to replicate or automate existing educational practices. For example, if the teaching changes, because some of it is undertaken by AI and some by human teachers, perhaps so should the way in which students are assessed – otherwise we might be assessing the wrong things. Perhaps examinations might be replaced with AI-driven continuous assessment, which could provide more nuanced understandings of individual student competences. Digital learning systems already capture thousands of data-points along each student's individual learning journey, which could be used to represent learning and competencies more accurately than examinations ever could. However, it is important to note that although digital continuous assessment may be more accurate and useful, it raises challenging ethical issues around the digital surveillance of students that have yet to be properly considered.

Challenge 4: Developing quality and inclusive data systems

Source: Profuturo Foundation

Machine learning, the type of AI that has seen such dramatic advances in recent years, depends on large quantities of data; and for the AI to function well, the data must be complete, reliable and timely. For AI to support education, this means that there is a need for substantial amounts of educational data, which many countries struggle to collect. The UNESCO Institute for Statistics (UIS) cites many hindrances that prevent the efficient and effective collection and use of educational data (UNESCO-UIS, 2018) – a key issue being the associated costs, which can make it especially challenging for low and middle-income countries.

In addition to recording progress and outcomes, education data should also account for inequities – which means that they must provide insights disaggregated according to demographic factors such as age, gender and socio-economic background (UNESCO, 2018). This allows educators and policy-makers to better understand educational disadvantages experienced by marginalized or vulnerable populations. However, data on disadvantaged groups still currently tend to be incomplete or even absent.

For instance, a 2016 study by UNICEF showed that, out of forty countries surveyed, nineteen had no data at all on children with disabilities – and often, when they were available, the data were insufficiently granular to be useful (UNICEF, 2016). Similarly, data on refugees and internally displaced populations can be lacking. For example, refugees studying in schools are frequently not identified as refugees in national education statistics, thus making it more difficult to monitor and evaluate their learning outcomes.

Another issue is the ownership and control of the data. Governments are mostly unaware of many of the new

possibilities and implications of Big Data, while the large private platforms that host most of the world's data think globally. This is why policy needs to be set at an international level, and needs to take into account much longer timescales than is usual for politicians (who are limited by election cycles).

Although the availability of data is necessary for AI, data are not on their own sufficient. Appropriate algorithms are needed to analyse the data, identify patterns and make predictions. In particular, they can provide real-time insights about students' individual progress and their most effective learning pathways, thus allowing teachers to make real-time adjustments to their teaching, or enabling adaptive and personalized AI-powered tutoring.

A key related issue discussed in the policy forum centred on data protection, as addressed by the European Union's GDPR. Because machine learning AI relies so heavily on data, it is critical that the databases and their sources, the digital learning traces left behind by children engaging in online tutoring systems, are protected from intrusion and misuse. As highlighted by the Cambridge Analytica scandal, we also need to ensure that algorithmic models are transparent and open to inspection.

Challenge 5: making research on AI in education significant

Source: Profuturo Foundation

While the potential of technology to transform education is frequently claimed, this potential has yet to be realized as expected in developed countries (Conlon and Simpson, 2003; Cuban, 2001; OECD, 2015; Sandholtz, 2001) or developing countries (Power et al., 2014). Experience also suggests that there is no such thing as universal technology-based solutions for current challenges in education, and AI-driven

educational technologies are likely to be no different (Holmes et al., 2019).

In fact, when reviewing how decisions are made, it is striking how little is known about the effects of technology on the quality of school education, and which specific uses of technology can result in better learning (Holmes et al., 2018a). There have been many years of research into the use of technology in education but few robust actionable outcomes. This is of particular concern in poorer, resource-constrained developing country contexts, where technology-based reforms are often touted as an easy remedy for poor economic and social conditions. In fact, the emphasis of many national initiatives is usually on granting access to the technology, all too often with poor results (Newcome, 2015; Warschauer and Ames, 2010), while relatively little robust research has been conducted on the actual effects on learning.

To better prepare schools and other educational institutions for the impact of AI – both on society in general, and on learners, teachers and educational systems in particular – monitoring and assessing what works, and disseminating results in ways that are meaningful for teachers and suitable for scaling up, is essential. But these assessments have to go beyond standard randomized controlled trials, to investigate the implementation of the technology from a comprehensive array of perspectives. For example, it is well known that the adoption of an innovation essentially depends on the end users' perceptions of its advantages, as much as on the capabilities of the particular technology itself (Rogers Everett, 1995).

Contextual conditions and the sheer number of variables in classrooms and other learning settings (variables such as student baseline skills, teacher skills, socio-economic status, student motivation, classroom design, local policies, school leadership values – as well as the myriad interactions between them) make it challenging for education research to isolate the influence of the teaching approach and any educational technology, or to provide results from which generalizations can be drawn (Lederman, 2003).

With respect to AI technologies designed to support teaching and learning, well-oriented local research, that recognizes teachers as actors and not mere beneficiaries of technological 'solutions', is needed to address a wide range of questions, few of which have yet to be addressed in any robust way. For example, what is the effectiveness of AI-powered technologies to help learners learn in more effective ways and to achieve better outcomes? What are the strategies at a system level that will help make this possible? And, what are

the conditions that make the AI-powered approach capable of being applied effectively at scale?

In particular, while AI might have achieved some impressive outcomes, unless it is embedded properly into sound teacher practices its sustainable effects on learners are likely to be disappointing. Moreover, although good research is necessary, it is not sufficient. We need an AI in education ecosystem, supported by long-term investments, involving all stakeholders, which has an ethical framework at its core.

Challenge 6: ethics and transparency in data collection, use and dissemination

Source: Profuturo Foundation

While AI has been shown to have many positive applications, there are also societal and ethical concerns that should be addressed. Many people have read something about AI systems discriminating unfairly (Angwin et al., 2016; Dastin, 2018; Smith, 2016), taking life-impacting decisions in a non-transparent way (O'Neil, 2017), being ready to take all our jobs (Manyika et al., 2017) and set to wrest control from humans (Quach, 2018). With AI fast permeating every corner of our societies, all of these concerns should be considered very carefully. In fact, across the world, there is much work being undertaken that is investigating the ethics of AI (for example, Cihon, 2019; European Union, 2019; Nuffield, 2019; Reisman et al., 2018). Nonetheless, of particular importance here, and despite the potential critical impact of AI technologies on the developing minds of children and other learners, little work has been conducted into the ethics of AI applied to education (Holmes et al., 2018b).

Scholars have sought to define the ethics of ICT for more than 30 years. However, the emergence of data as the core of AI-driven technologies has shifted the discourse from computer ethics to data ethics: 'it is not the hardware that causes ethical problems … [I]t is what the hardware does with the software and the data that

represents the source of our new difficulties' (Floridi and Taddeo, 2016, p. 3). The growing public distrust in systems that use and collect personal data, with people often uncertain about how their data will be used after they have given their consent (UNCTAD, 2016), suggests a need for legal frameworks that not only ensure privacy and protection against cyber-attacks, but also tightly regulate the use of individual data for surveillance. However, at present, fewer than 30 per cent of countries, across all regions excluding Europe, have comprehensive data protection laws in place (UNCTAD, 2016); while those that do exist rarely account for the particular ethical issues centred on the application of AI in education.

The use of data and algorithms in AI for education raises multiple issues. Who owns the data, who can amend it, and what happens if it is incorrect? And what about informed consent – particularly in the context of young learners, who cannot in legal terms provide informed consent for the collection and use of their personal data (which often includes aggregating and sharing data)? Also, what happens if AI in education consolidates, as has happened with digital platforms more generally, to just a few global players? The personal data of teachers and students might be held only by the big tech companies, which might exacerbate issues of privacy, transparency, equity, fairness, security, monopolization and balance of power.

A key use of AI in education is to make recommendations to students, about which learning materials they should work with, and what pathways through the materials they should follow. However, when these recommendations are based on certain machine learning algorithms, it will not be possible for human teachers to find out why a particular recommendation was given, in order to confirm that it is the best choice. In the extreme, this raises questions about liability. What happens if the automated decisions turn out to be wrong? Who or what is responsible and accountable – the platform owner or the teacher?

Similarly, increasing numbers of educational institutions are using machine learning algorithms to accept or reject students – yet because the outcomes are based on prior data, this might lead to unintended biases (for example, if the system was trained on students from developed countries, it might be biased against applicants from developing countries). Finally, as has been noted earlier, if AI systems automate increasingly more tasks that are normally performed by teachers, what happens to the teachers' jobs?

All of these ethical concerns and more need to be addressed, not just to prevent intentionally malign uses of AI in education, but also to facilitate the conditions within which AI in education innovations can flourish.

The impact of AI on accessibility and data security are key ethical issues that need to be addressed. To begin with, ethics is about more than data protection. AI potentially offers the possibility of bringing high-quality education to everybody worldwide, which is a clear ethical plus. However, before rushing forward with implementing the newest AI technologies, understanding the complete consequences of the application of AI in educational settings and beyond is critical. Finally, it is important to ensure that all school and university students are taught about the ethics of AI (which is happening in the UAE's new curriculum), as well as about AI's multiple possibilities and its social implications (many of which are still to reveal themselves).

Moderators

Mr Borhene Chakroun
(Director, Division for Policies and Lifelong Learning Systems, UNESCO)

Ms Diane Lalancette
(Senior Project Officer, UNESCO)

Ms Claire Scharwatt
Director of Advocacy, (GSMA)

Ms Roxana Widmer-Iliescu
(Senior Programme Officer, Digital Inclusion Division, ITU/BDT)

Participants

H.E. Ms Wanda Buk
(Undersecretary of State, Ministry of Digital Affairs, Poland)

Ms Tracey Burns
(Senior Analyst, CERI-OECD)

H.E. Ms Maria-Manuela Catrina
(Secretary of State, Ministry of Communications and Information Society, Romania)

Mr Claudio Cimelli
(Director of Digital Education, Ministry of National Education and Youth, France)

Mr Anantha Kumar Duraiappah
(Director, UNESCO Mahatma Gandhi Institute of Education for Peace and Sustainable Development)

Mr Nathanael Gossaye
(Co-Founder/CEO LangBot, Ethiopia)

Mr Wayne Holmes
(Assistant Professor of Learning Sciences and Innovation, Institute of Educational Technology, Open University, UK)

Ms Alexa Joyce
(Director, Education System Leaders, Microsoft)

Mr Andrew Smith Lewis
(Co-founder of CEREGO, United States)

Mr Mick Levy
(Director of Innovation, Business and Decision Services, Orange Group)

Mr Adrian Lim
(Director, Digital Participation and Foresight Division, Digital Readiness Cluster, IMDA, Singapore)

Mr Pierre-Jean Loiret
(Director, Partnerships, University Agency of the Francophonie, France)

Ms Rose Luckin
(Professor, Learner Centred Design, UCL Knowledge Lab, United Kingdom)

H.E. Mr Omar Sultan Al Olama
(Minister of State for Artificial Intelligence, United Arab Emirates)

Mr Ivan Ostrowicz
(CEO, Domoscio, France)

Ms Jonghwi Park
(Programme Specialist, UNESCO Bangkok)

Ms Placencia Porrero
(Senior Expert, Disability and Inclusion Unit, European Commission)

Mr Axel Rivas
(Director, School of Education, University of San Andrés, Argentina)

H.E. Mr Sabri Saidam
(Minister of Education and Higher Education, Palestine)

Mr Rupert Schlegelmilch
(on behalf of the European Commissioner for Digital Economy and Society, European Commission)

Mr Miguel Ángel Valero
(Director of Ceapat Imserso, Spain)

Workshops

The MLW 2019 policy forum workshops were organized by UNESCO's Communication and Information Sector (CI), Science Sector (SC), Culture Sector (CL) and Social and Human Sciences Sector (SHS). Presentations were selected through a call for proposals which addressed the implications of AI in the key areas of UNESCO. The aim was to facilitate demonstrations of innovative policies, research, projects and solutions that use AI tools and frontier technologies for education and learning. There was a total of eighteen workshops, organized under four themes: 'Learning and Skills', 'Freedom of Expression and Access to Information', 'Science and Society' and 'Creativity and Heritage'. Workshop presenters were chosen from a wide range of international organizations, NGOs, governmental agencies and academic institutions. Here, to illustrate the breadth of discussions, we summarize some examples.

Learning and Skills

The 'Learning and Skills' workshops covered a diverse range of topics. One introduced UNESCO Mahatma Gandhi Institute's knowledge-sharing digital platform called 'CHI' (Collective Human Intelligence) (Saurabh, 2019). CHI promotes socio-emotional intelligence by means of discovery learning. It uses the semantic web (natural language processing) and sentiment analysis to support the real-time moderating of discussions and create a 'safe space' for conversation and exchange. It also aims to individualize learning pathways based on the users' interactions. The platform will be offered online and, so that it can also become part of classroom teaching, teachers will be trained to use it. A second workshop investigated the use of AI in higher education, including research into affective computing, the use of AI systems to manage applications and to identify students who are falling behind with their studies, the 'wheel of education' (which involves teacher training, content creation, licensing, exploitation, assessment and competences), and the importance of taking a measured approach to change.

Another workshop discussed the impact of AI on the middle labour market, and the competencies needed by workers who do have not university-level education. The discussion noted that AI and automation are having the effect of polarizing the labour market into jobs requiring high-level and low-level skills, while the middle-skills labour market is vanishing – a process that has been called the 'hollowing out of the middle' (Davidson, 2013). The same workshop also considered the usefulness of expert decision systems like the Merlynn TOM (Tacit Object Modeler) system, an AI technology designed to enable non-technical experts to work through a series of simulation steps that culminate in the creation of a virtual expert.

A fourth workshop discussed methodologies used to assess the effectiveness of learning programmes. Four areas of focus were drawn from the literature: access to technologies, computer-assisted learning, technology-based nudges (such as tips and encouragements), and online learning. One case study was reported by ProFuturo: an online learning tool being used in primary schools in Latin America and Africa. To date, because of poor infrastructure and low teacher competencies, the use of the tool has been limited. Nevertheless, the programme is being evaluated by using the data generated by student interactions. The final workshop in this theme discussed OER initiatives, beginning with the Ljubljana Open Educational Resources (OER) Action Plan (Second World OER Congress, 2017), which emphasizes that OER are about sharing knowledge. The second initiative was X5GON,[9] a global OER network that exploits the possibilities of AI, which involves a global OER processing pipeline, a mechanism to join OER websites and services in one learning environment. The third initiative involves the use of blockchain technologies to track the repurposing of OER resources while crediting the original authors and their institutions (Grech et al., 2017). The final initiative discussed in this workshop was Wikidata,[10] which has become the world's largest OER repository. Wikidata uses various AI technologies to ensure that the data are constantly updated, and to support the querying of what is mostly unstructured data.

9   https://www.x5gon.org/
10   https://www.wikidata.org/wiki/Wikidata:Main_Page

Freedom of Expression and Access to Information

The first workshop on this theme introduced UNESCO's ROAM principles, which are currently being finalized (see UNESCO, n.d.). These principles aim to align digital developments with human rights, openness, accessibility and multi-stakeholder governance, and so should be applied to the development of AI. With respect to the human rights dimension, the workshop acknowledged that freedom of expression, access to information, media pluralism and political participation all risk being undermined by the increasing personalization of information and content selection by AI algorithms and micro-targeting techniques. For the openness dimension, the workshop discussed how some machine-learning algorithms have a level of complexity that represents an obstacle to the needed transparency of AI. About the accessibility dimension, many factors are needed to succeed with an AI-based solution, such as access to research, to education and human resources, to data, and to connectivity and hardware. Finally, with regard to the multi-stakeholder dimension, effective principles include transparency, responsiveness and accountability, which together can enrich the values, norms, policies, regulations, codes and ethics that govern the development and use of AI. Cross-cutting issues discussed included bias (with some AI applications, such as voice assistants, reinforcing gender norms), trust and disinformation.

A second workshop discussed issues centred on data. For example, data are being hyped as 'the new oil'. While there are a huge amount of data in the world, the problem is that not enough of it is of usable quality, not enough is meta-tagged, and not enough is shared. In addition, it was acknowledged that collecting, aggregating, analysing, conserving and disseminating data is a much bigger set of problems than many people realize. More critical questions were posed in the workshop than could be answered. For example, is there a need for data commons? What multi-stakeholder cooperation is required? Should there be a code of data ethics? How do we avoid 'techno-colonialism'? How should the asymmetry between those who have access to data and those who do not be addressed, especially given that so much data is held by private companies?

Science and Society

The first workshop on this theme discussed apps designed to support citizen science. Many examples were given, including iRain (which has been developed for areas hit by water-related disasters or general water scarcity), Spipoll (which aims to combine automatic and human intelligences to identify species of insects from photographs), and Pl@nt net (which helps identify plants that a user has photographed). On the impact of apps in general, those that people use every day, we are all feeding them with precious personal information (such as location, time, gender and religion) without being aware of the costs to us as individuals or as citizens. In particular, when apps are used in education, we have to ask whether they are educating or indoctrinating our students.

Creativity and Heritage

In this final theme, the question considered was whether AI could be creative in itself, or whether it had the potential to be a creative partner to humans. Some renowned artists gave examples of how AI had been the creative partner in their work. These included the ORLANoïd, which is a humanoid in the image of its creator that has been endowed with artificial, social and collective intelligence. A second example is Orchids, the first AI-assisted musical orchestration software and one of the next generation of AI-based tools being developed for musicians. The workshop discussed how creative works like those produced by these technologies were developed, acknowledging that they are usually derived from the inputs of humans, mediated through pre-existing artefacts and algorithms.

4. Symposium
(6–7 March 2019)

Introduction

The Artificial Intelligence for Sustainable Development Symposium was the summit event of MLW 2019. The two-day event involved participants from around the world, who exchanged knowledge and analysed together the opportunities and threats linked to the use of AI in education, shared experiences and planned joint actions with a view to harnessing AI to achieve SDG 4. It featured keynote speeches, high-level plenary addresses, demonstrations of AI applications and numerous breakout sessions.

The symposium was structured around four themes:

➤ how to ensure inclusive and equitable use of AI in education

➤ how to leverage AI to enhance education and learning

➤ how to promote skills development for jobs and life in the AI era

➤ how to safeguard transparent and auditable use of education data.

Opening speeches

In the opening speech of the Artificial Intelligence for Sustainable Development Symposium, **Ms Stefania Giannini** (Assistant Director-General for Education, UNESCO) began by reminding us that, although it is around 70 years old, AI has only recently begun to transform the world because of technology developments such as increased processing power. This is why it is has become so critical to understand the AI revolution, its potential and pitfalls.

Ms Giannini continued by acknowledging that AI in education is a topic that poses more questions than answers. Questions include, how do we achieve the best match between AI and education? How do we ensure that we teach students the things that humans do best and not the things that machines do better? And, how do we set the foundation of a humanistic,

ethical approach to AI that services humanity? In fact, she reminded us, the world is facing a global learning crisis, with more than 200 million children out of school, and a further 600 million in school but not achieving minimum competencies. So the key question is, how can AI be leveraged to improve equity and learning to develop inclusive, quality education for all?

Ms Giannini outlined three important steps towards answering this question. First, we need to transform learning, adapting it to the new AI-rich environment. But we need to be careful. While AI has the potential to diagnose and optimize learning through more personalized and collaborative approaches, we need to build platforms that are designed from the ground up to help achieve equitable and inclusive education. In short, we have a public responsibility to develop policies and partnerships that bridge divides and inequalities. Second, we must acknowledge that teachers are at the heart of education and that we need them to take the lead. Teachers are more than mere facilitators; they are human mentors who can inspire and develop creative and social-emotional characteristics in our children. To support this, it is critical that teachers are trained in the learning sciences, to understand better how learning happens and how it might be enhanced. Third, we need to focus on the learning and wider environments. Learners need to be empowered to better navigate their world, while technology developers need to develop approaches that support students in that endeavour. In particular, this means focusing on the so-called soft skills, such as communication, teamwork and creativity.

To achieve all of this, Ms Giannini concluded, we need to have policy interventions: to fill the gaps (for example, the gender gap in technology – only 20 per cent of AI professionals are women), to set standards and ensure transparency, and to share collective intelligence in order to identify and mitigate the risks.

Recent developments in AI, and how these technologies are starting to impact on all our lives, was picked up by **Mr Kemal Huseinovic** (Chief of the Infrastructure, Enabling Environment and E-Applications Department/ BDT, ITU). Thanks to the enormous quantities of data,

increased computing power, more effective algorithms and better connectivity, the promise of AI is big. However, inclusive education is only possible when everyone has access – which currently is not available to 48 per cent of the world's population. The issue of digital skills is also important, if not critical. ITU research (ITU, 2018) has found that a lack of digital skills is a significant barrier to using the internet, and that fewer than 5 per cent of the world's population can write a computer program. Most troubling, the digital skills divide is widening, and the developing world is being left behind. ITU's development bureau aims to strengthen digital skills through its academies. The challenges in capacity and skills development require a collective response from government, the private sector and other key stakeholders, and involves reskilling and upskilling for many. Mr Huseinovic concluded by arguing that we need to leverage AI to ensure inclusive and quality education for all.

Keynotes

In the Symposium's first keynote, the SDGs were the starting point. **Mr Anthony Salcito** (Vice-President of Worldwide Education, Microsoft) began his talk by asserting that education should be using AI to enable everyone, especially students, to harness technology to improve the world. To do this, the students need resources and opportunities. While his words were automatically transcribed by a Microsoft technology and shown on the screen behind him, Mr Salcito explained that embracing and thinking about these issues is core to Microsoft's mindset. Key questions include, how are teachers thinking about the role of education? Do students feel inspired and confident regardless of their place in the world? How can we empower students who use technology to drive change? He suggested that we do not need a technology transformation. Instead, we need a people transformation, and we need to build skills and nurture talent to develop creative solutions to change the world.

In fact, he continued, students need to develop the skills of creative and critical thinkers, while virtual assistants, digital assessment and adaptive learning systems are ways of helping understand students. It is also important, he asserted, to recognize the ethical foundations of fairness, reliability, safety, privacy, security, transparency, accountability and inclusiveness. AI has the potential to change the world by helping make technology more inclusive: technology-enabled inclusivity should be considered in terms of learning, visual, mobility, hearing, neurodiversity and mental health.

An example AI-powered application uses OneNote to create an immersive reader designed to help students with dyslexia. The technology reads for the student, when necessary, and can be personalized by changing the visual environment to suit the particular student. It can also help students identify types of words and grammatical features, and highlight specific words. However, Mr Salcito concluded, while this is an example of what AI can do for students, we now need to shift the focus to what students can do with AI: we need to fuel talent to change the world.

The role of the private sector in ensuring that AI is an opportunity for all was addressed by **Ms Lynn Dai** (Product Executive Director, Sensetime). AI, she explained, aims to develop machine intelligences to simulate human intelligences, which means that machines are becoming more natural, smarter, personal, adaptive, helpful and proactive. In the future, AI will be more intelligent and more proactive than current technologies. She gave three examples of the integration between AI and industry: making better transportation systems (safer, more convenient and easier to use), producing better photographs (improving the quality of an image as you take it), and supporting higher-quality health care (using better and more accurate diagnosis).

In the context of AI and education, Ms Dai described two areas, AI education and AI-powered education. AI education is concerned with what teachers should teach students about how intelligent machines work. Children need to know the fundamentals of AI, including data, application modelling, interaction and ethics. This is key because there will be more and more machines, with more and more intelligence, that humans will need to master. AI-powered education, on the other hand, includes using AI to make education more efficient and to create equal opportunities. For example, she described a robot that reads textbooks to young children when their parents are busy and working, which brings opportunities for every child to learn, and other systems that use face, emotion and gesture recognition to help teachers see and pay attention to all the children in their classroom, or virtual reality (VR) technologies to enable children to experience otherwise inaccessible times and places. To support the use of AI in education, Ms Dai's organization Sensetime is publishing textbooks for school children, and developing platforms on which students can undertake projects and teachers can curate courses on AI.

Ms Dai concluded by arguing that 'AI is making our lives better, and we hope AI will improve equality in our society. But we still have a long way to go, and fundamental questions remain.' Is AI reshaping

education? What should the next generation learn to survive in the AI era? And, how should we teach them?

Mr Andrea Moro (neuroscientist and professor of general linguistics at University School for Advanced Studies IUSS Pavia, Italy) gave a keynote presentation focused on the question, 'Can we design better languages?' He began by summarizing the history of attempts to automatically understand language, and then underlined that the biological investigation of language is paradoxical, because language is arbitrary and cultural. It is not possible to reverse-engineer language. Instead, to understand language, there is a need to focus on impossible languages. To begin with, is it possible to design a simple rule that can be applied to all languages (such as the rule to make a statement into an interrogative)? The impact of some impossible rules on the brain has been investigated, leading to the finding that possible rules generate increased blood flow, while impossible rules generate less blood flow. In other words, the absence of non-hierarchical syntactic rules is based in the brain. This raises further questions: how do we focus on one speaker, when there are two talking about different things? Is it possible to speak to yourself inside your head, if you don't use language (a question raised by Wittgenstein)? And can you 'unthink' sound?

In his keynote address, **Mr Ke Gong** (Executive President, Chinese Institute of New-Generation Artificial Intelligence Development Strategies, People's Republic of China) presented ongoing AI work in China. The Chinese strategy focuses on five key areas: data-driven AI, coordinated AI clusters, human–machine enhanced AI, cross-media sense AI (combining human senses), and autonomous AI. This work is being supported through research centres, the establishment of open innovation centres in cooperation with private businesses, and through educational programmes. Over 100 universities have already launched AI-focused programmes, which generally teach what they call 'AI+' courses, in which knowledge of AI is combined with subject-specific knowledge in domains such as law, sociology and mathematics. Mr Gong concluded his presentation by identifying four areas critical for AI, all of which he asserted require urgent interdisciplinary work and international dialogue:

➤ understanding AI's role in society

➤ ethical and legal frameworks

➤ public awareness of AI (to counter the influence of media and science fiction)

➤ principles of AI (while numerous international and national organizations are focusing on this, there is yet to be any consensus).

In the final keynote of the symposium, **Mr François Taddei** (President of the CRI Center for Research and Interdisciplinarity, France) began by raising a key question for AI: is AI equal to humanity, a partner or a slave? He continued with a focus on education, making the argument that our education systems need to evolve. At the current time, they do not empower intelligence, instead they focus on memorizing. Our education systems need to teach important skills, such as how to be human, how to imagine, think, construct, and share (often described as twenty-first-century skills). His point was that machines cannot teach those skills, yet they are exactly the skills that we need to teach our children.

Mr Taddei continued by turning to the role of AI in helping to preserve the natural world, to help us take care of it, and understand its complexity. This is an area where AI might be useful, helping us to grasp our planet's multiple complex dimensions. Mr Taddei concluded by observing that we have a Wikipedia for knowledge and a Github for coders. Now we need a similar platform – perhaps a global campus or a global laboratory, with solutions powered by AI – to help us solve the SDGs.

Partnesr speeches I: Promoting open partnership for universal and equitable use of AI in education

The problem of uneven global development was introduced by **Mr Wang Guangfa** (Chairman, Fazheng Group, China). In many locations, the internet network is not good enough, and there is a poverty of education resources. However, satellite teaching and AI can help improve standards of living. The example was given of Wangfu School, which does not use paper, breaks the boundary of the campus, and is working with seven Hong Kong educational institutes. In this school both AI and leadership are crucial. Connectivity and the sharing of advanced education concepts, advanced technology and advanced quality resources will be major ways to change all aspects of human thinking.

Using AI to improve life-long learning opportunities was discussed by **Mr Raphael Moraglia** (CEO, Skillogs). His team have been developing AI tools, including learning analytics (LA), to personalize learning: teaching depends on the individual, we have to support them to discover who they are. This has led to the development of Skillogs' adaptive learning programme, which is suitable for anyone from 6 to 99 years old, up to a university degree, or for in-company training. It is based on two axes. Axis 1 is a chatbot, which aims to replicate everything that a teacher does in the

classroom. It gives each student personalized support, and uses neuro-linguistic programming (NLP) to point students to the right exercises that they need. Axis 2 is a recommendation system. Students are assessed on everything that they have done, allowing the system to identify critical trajectories and to recommend a particular pathway to a student (in the same manner as Netflix). But there are key challenges. In particular, how can we know that the students genuinely understand?

Hamdan Bin Mohammed Smart University, UAE was introduced by **Ms Serine El Salhat** (its Vice Chancellor for International Cooperation and Corporate Communication). It is the university's belief that in order to educate the innovators of tomorrow you cannot use the technology of yesterday. So smart AI is at the core of the university. There is a smart learning environment, a smart highly customizable campus, a smart advice service, personalized learning journeys, automatic analytics, a social learning platform, accessible knowledge, gamification and a strategic partnership with Starbucks, Siemens and others. Even the building uses smart concepts, for heating and power, managed by AI, using prediction to maximize efficiency and sustainability. All of this is seen as a valuable investment in the future of the country's young people, a pioneering step towards positive educational change, and a driving force of development.

Partners speeches II: Promoting open partnership for universal and equitable use of AI in education

The moderator, **Ms Shafika Isaacs** (University of Johannesburg, South Africa), opened this session by highlighting the importance of cooperation across domains, countries and regions – which, she asserted, is a key responsibility for UNESCO. The evolution of online education in China was introduced by **Mr Hao Gong** (Chairman, Huashi Education Group, China). After showing a video that explained the Huashi Education Group, he continued by introducing the AI educational cloud, which brings together several complementary services, including video, voice, language, knowledge, teaching, and an AI bot (which functions as a study assistant, emotional assistant and life assistant). He then introduced a social network for schools, being developed together with UNESCO, with real-time communications translated into sixty-two languages.

How Norway is using AI to support educational planning and implementation was introduced by **Ms Liv Marte Kristiansen Nordhaug** (Senior Advisor, Norad, Norway). AI is also used in a global books alliance (which has the aim of providing, by 2030, children everywhere with open access to all the books they might need) and a translation platform (which helps with content structuring, translation, content checking and image recognition). Ms Nordhaug suggested that an AI regulatory framework should be guided by, and should build upon, existing international agreements and principles for mainstream IT, and should draw upon existing digital development communities.

The final speaker in this session, **Ms Zohra Yermeche** (Program Director, Ericsson, Sweden), described a programme being developed at Ericsson, called 'Connect2Learn'. This adopts a human-centric approach to responsible AI, to help augment the human experience, optimize services, and ensure privacy and security. It involves Ericsson cloud services, and focuses on three components of personalization: big data, value for money and user experience. A key aim is to enable young people to learn advanced digital skills, in order to help them address the demands of the fourth industrial revolution. This involves an 'AI for Youth' initiative, being developed with UNESCO, teaching students and teachers about AI, and teaching people how to develop AI (which involves hackathons, and supporting start-ups).

Plenary 1: Ensuring inclusive and equitable use of AI in education

Across the plenary sessions, participants discussed the problem of uneven global development of AI in education. A key reason for this is that around half of the world is still offline – it has no internet access – while many countries continue to have other infrastructure challenges. In fact, there are multiple digital divides: the global divide (innovations concentrated in Europe and Middle East, with very little in sub-Saharan Africa), the skills digital divide and the gender digital divide. Participants agreed that we cannot focus solely on teaching advanced programming skills, we also need to consider basic digital skills. In fact, we need more research for evidence-based strategies, especially with a focus on developing countries. Meanwhile, much of our data and methods are driven by the developed world, and more work is needed on context and cultural specificity. In particular, participants also agreed that we also need more women in the AI industry. Awareness of gender bias (many biases in data and algorithms in AI are because of the dominance of men) is key. For this reason, there needs to be a concentration on encouraging young girls to take science, technology, engineering and maths (STEM) courses and pursue engineering careers.

In fact, without policy intervention, the deployment of AI in education can exacerbate digital divides and learning inequality, with marginalized and disadvantaged groups most at risk of being excluded from AI-powered education. To ensure equitable use of AI in education, large-scale initiatives are needed to support developing countries in boosting the development of AI technology, enabling access to AI platforms and resources, and nurturing local innovations in AI. Can AI break through barriers for vulnerable groups to access quality education? What kinds of strategies or programmes are needed to prevent gender bias in AI applications? What should be put in place to promote gender equality in AI professionals and AI skills development?

Niger was given as an example of a developing country. Niger has the youngest population in the world, with a median age of 15, which presents many challenges. Because traditional approaches have not enabled the country to change, Niger is also faced with other development problems (for instance, the literacy rate is 30 per cent). For these reasons and more, the government has decided to put the citizen at the heart of what it does. For example, with most of the country's population living in villages (only 6 per cent live in the capital), the government has set up an education-focused programme which involves developing 'smart villages'. Connecting 15,000 villages with education is at the heart of the programme. There are digital tracks to get people online and to make available knowledge and information. In addition, the smart village programme includes government quality health care and agriculture education. In addition, it has set up a 'City of Innovation Technology', which is a village that is a centre of excellence which aims to develop and adapt tools for use in smart villages. However, much of this depends on gathering enough data for AI to be adapted to the local context. This is a challenge, and carries risks which might exacerbate the gap between Niger and other countries.

From the corporate perspective, this plenary focused on Huawei, which has made a revolutionary change in its approach to technology and inclusivity. It now thinks of inclusivity in three pillars:

1. Connectivity. An example is 'RuralStar', which uses 4G technology to allow data transmission between rural villages. The base stations have no cables, which reduces the costs of installation, yet the system is enabling connection for villages when it was previously impossible.

2. Applications. An example is the 'StorySign' app, which helps deaf children learn to read. Using AI, the chips in smart phones read the words while an animated character signs them.

3. ICT skills. An example is the Huawei ICT Academy, which delivers Huawei ICT technologies' training, encourages students to get Huawei certification, and develops talents with practical skills for the ICT industry and the community.

An example of the company's use of AI was given from China, where there is inequality between schools in the metropolitan areas and those in the outer suburbs. Huawei has built a metropolitan area network to improve internet access for schools in the outer suburbs. The data being connected enables teachers to target struggling students.

A complementary approach involves the NGO War Child Holland, which has developed a series of games to help refugees learn to read and to develop their confidence. The project involved educationalists, designers, humanitarians and users. The games enable personalized learning, which can be particularly important for refugees. In war-torn countries, classes can contain children of a wide variety of ages who speak many different languages. Personalized and self-paced learning can help to address this, enabling children to learn with resources adapted to their needs. The organization has also designed games to predict when students are at risk of dropping out, although this requires a great deal of data which is still being collected.

The plenary also considered the issue of the lack of women in the AI sector, which has led to biases in AI algorithms. However, it is possible to fight the biases in several ways. The first is to ensure that the data themselves are not biased – although this is complicated by the lack of consensus on defining and correcting biases, and the lack of good data. Second, if the first step is unsuccessful, specialized AI algorithms can be used to automatically detect and correct biases. Third, and in any case a key requirement, is to have more woman involved in the development of AI systems. Policy-makers should work on removing barriers for women and girls in order to increase participation. It is particularly important to develop educational programmes for young girls, encouraging them to take up STEM subjects, especially engineering.

Teaching young people about AI is being pioneered by a UK-based organization, Teens in AI. For them, the main challenge is funding. Teenagers usually understand how AI is changing the world and how technologies work, but they need to be inspired to learn about the world and how to change it using technologies. The courses also teach the skills needed to use technologies for good, by focusing on human-centred design and ethics.

Participants

H.E. Mr Ibrahima Guimba Saidou
(Minister Special Advisor to the President of the Republic of Niger and CEO of the National Agency for Information Society (ANSI), Niger)

Ms Elena Sinel
(Founder of Teens in AI and Acorn Aspirations, UK)

Ms Hanan Salam
(Co-founder of Women in AI, France)

Ms Kate Radford
(Programme Director of 'Can't Wait to Learn', War Child Holland, the Netherlands)

Mr Andrew Williamson
(Vice President, Huawei, People's Republic of China)

Plenary 2: Leveraging AI to enhance education and learning

There is little doubt that AI is likely to revolutionize the delivery and management of education, provision of content, and analytics of learning. But how can AI solutions improve learning outcomes? Will AI help learning scientists better understand how learning happens? Most argue that teachers will not be replaced by machines in the future, but how will the use of AI in education and learning transform the role of teachers? What continuous support is needed to prepare teachers to work with AI in an AI-rich education environment? And as AI transforms all of human life, how can education prepare learners to live and work together with AI (drawing on human–machine collective intelligence) for sustainable development?

The question of how to leverage AI to enhance education and learning was explored across multiple plenary sessions. But as well as 'learning with AI' (AI powered education), participants recognized that we also need to think about 'learning about AI' (AI education: awareness-raising for all, for teachers, for children, plus training the AI engineers of the future). Currently, most existing AI in education technologies are student-facing personalized learning systems. However, participants acknowledged, although personalized learning is powerful in many ways it is not a magic bullet. It has implications for peer/social learning, collaboration, critical thinking and classroom management (for example, it can be challenging for teachers if all students in their classroom are at different places in the curriculum). Participants also posed the question, in the AI era, what is the new role for teachers? We need to support existing classroom teachers, yet few

AI in education technologies are teacher-facing, despite the fact that AI has potential to be a powerful teacher assistant. In addition, we need proper teacher training, empowering teachers, helping them use AI to collect and share best practices to shape future policy.

The session discussed three key questions. How will AI help us solve the problems of education? How will AI drive the transformation of learning? And, how should education support people to live with AI?

In a world where routine cognitive skills are easy to automate and to test, we should focus on skills (for example, being a scientist), attitudes and values (for example, being able to work with people who are different from you). We need to shift from knowing content to being able to analyse and make connections (today's world rewards you for what you can do with information, not for knowing it). For example, mathematics is not about remembering formula, but about making the links. Education is about helping people develop reliable competencies: developing first-class humans, not second-class robots. But, if children are always behind desks and computers, what will be the impact on their social skills? Assessment, which can enhance or over-burden learning, is an area where AI might have a positive impact. Traditionally, it has been difficult to assess collaborative skills and socio-emotional skills, while the kind of things that are easy to test are easy to automate. AI and learning analytics has the potential to address this, identifying misconceptions or feeding back on accuracy, bringing teaching and assessment closer together.

Another approach is consider what is uniquely human in cognition, which is an existential challenge. In this era, where we rely on machines to take the cognitive

load, what is left for humans to do? This is both a technical challenge and a human opportunity. We might think of the brain as a kind of car. Cars have an engine (representing our working memory, processing speed and learned knowledge) which determines how far and fast we can go on a straight road. But life is not a straight road. We have to learn how to negotiate traffic, obstacles and other road users. Cars also have steering, which involves imagination – imagining ourselves in a variety of scenarios. This is metaphor for our ability to adapt, develop epistemologies, switch attention, anticipate and see things from other perspectives. The point is that AI is a straight-road engine. It cannot imagine, it does not steer, it needs to be steered by humans. Machines can solve problems, but sometimes the wrong ones. Machines can reduce biases, just as they can amplify them. Machines can also reveal malign human actors. All of this is possible so long as humans remain in control. In summary, we need to teach children how to steer themselves, which will lead to improved mental health and learning.

A recent report from Stanford University (2016) (emphasizing the potential role of robots, intelligent tutoring systems, online learning, and learning analytics in education) has been the inspiration for a new ICT curriculum for Chinese middle schools. This curriculum promotes students' information consciousness, digital learning and innovation, computational thinking, and responsibilities for the information society. From this perspective, AI in education falls into ten

categories: intelligent pedagogy, AI-guided learning, compensatory teaching, the new teacher's role, AI-powered teaching, differentiated teaching, new school mode, AI literacy, new school–family relationships, and school improvement. In addition, we need to focus on collaboration between the different stakeholders, developing trustworthy AI, and the governance of AI.

Despite a bell curve of student abilities, teachers have to deliver the curriculum in a one-size-fits-all factory model of education. In addition, around 60 per cent of teachers' time is spent on administrative tasks, while around the world teachers are in increasingly short supply. As a consequence, around 30 per cent of children are not achieving properly. So the question is, how do we improve this situation. One potential answer is differentiated personalized learning, high-quality learning resources, and constant formative assessment, all grounded in neuroscience and involving AI. Such an approach may mean that teachers will change roles, becoming facilitators.

Finally, an example of an AI-assisted global virtual school was given, Tella, which has been developed in Finland in collaboration with teachers, and is always open. However, the AI in that school is the least important aspect of teaching via the cloud (raising the reflection, will AI be introduced into education as slowly as VR has been?). The session finished with a key observation, 'Just because we can collect data, it doesn't mean that we should' (Ms Koivula).

Participants

Mr Andreas Schleicher
(Director for Education and Skills, OECD)

Mr Simon Walker
(CEO, STEER, UK)

Mr Ronghuai Huang
(Director of the National Engineering Center for Cyberlearning and Intelligent Technology, Beijing Normal University, People's Republic of China)

Ms Priya Lakhani
(Founder of Century Tech, winner of the 2018 MIT Solve's Challenge Prize, and founder of the AI equitable access to education programme with the Ministry of Education and Higher Education, Lebanon)

Ms Ulla Maaria Koivula
(Founder and CEO of Thinglink, Finland)

Plenary 3: Promoting skills development for jobs and life in the AI era

Emerging technology trends related to the digital transformation, such as AI, machine learning, the Internet of Things (IoT) and big data analytics, have profound implications in terms of the skills required for the evolving digital economy. In particular, the notion of lifelong learning has emerged as one of the key strategies for job security and employment in the digital era. How will AI impact the labour market, and what AI-related skills are needed today and in the future by different sectors? How can educational institutions and training providers from both public and private spheres can address any existing or emerging skill gaps? What recent developments and concrete case studies about industry talent development programmes, academic programmes and other initiatives that have been implemented address the emerging skill gaps?

Participants recognized that there is increasing volatility in the labour market, which means that there should be more focus on lifelong learning. However, when children are put behind desks and computers, what impact does this have on their social skills – which are much harder to develop than so-called hard sciences like maths and physics? The key thing is that we need to go beyond using AI to reinforce existing practices. For example, if the teaching changes, but assessments stay the same, there are likely to be critical consequences. Because the kind of things that are easy to test are easy to automate, we should instead focus on knowledge, skills, attitudes and values. In short, to promote skills development for jobs and life in the AI era, we should focus on the twenty-first-century skills. Participants also agreed that we also need to explore the ethical foundations of AI, around fairness, reliability and safety, privacy and security, inclusiveness, transparency and accountability.

The session began with an audience poll on the effects of AI on labour markets. The audience (n=109) was pessimistic about the effect of AI on developing countries' labour markets, but optimistic on the effect of AI in developed countries, where increases in employment were expected. The panellists agreed that it is currently difficult to know what the long-term effects are going to be, and more research is needed in this area.

The combination of opportunities and risks also requires collective work on how to ensure that developments benefit everybody. The recent ILO report, *Work for a Brighter Future. Global Commission on the Future of Work* (2019) states. 'Countless opportunities lie ahead to improve the quality of working lives, expand choice, close the gender gap, reverse the damages wreaked by global inequality. Yet none of this will happen by itself. Without decisive action we will be sleepwalking into a world that widens existing inequalities and uncertainties.' In addition, there is a need to take a 'capabilities approach' to lifelong learning, which recognizes people's competencies and helps them find new areas of work and new learning pathways in their increasingly non-linear careers.

The importance of reviewing and reforming education to enable smarter learning programmes was also noted. The problem is that technology and educational programmes are not evolving at the same pace. One example is medical training, where a doctor might need ten years to complete their training, but in the practice they are using instruments and software that they have had to learn to use on the job. This means that learning programmes need to be modularized and made more flexible.

In summary, educational programmes should place a particular emphasis on people currently with occupations requiring mid-level education, because these are the people most affected by labour market change at the moment. International research is showing that these people lose jobs, if they are not able to upskill or side-skill to other positions. It is so important to focus on this area, because training and vocational education, including further education, is not given the same type of status as general education in most countries.

It is also important to recognize that AI is not a simple technology. It can change processes, structures and power relationships in the context of its use. While it can change people's jobs, it can also change or amplify underlying norms in society. In the context of AI use, this is key to governance, regulations and ethical principles. AI is much more than a technical solution to something; accordingly it must be shaped and appraised by technologists, lawyers and anthropologists: 'People should not feel locked out of the debate, because they are not techies. We need these diverse perspectives' (Ms Bartoletti). An important question is who owns the data on which AI depends, and who owns the algorithms. These are not just questions for international organizations or policy-makers. Instead, companies using AI should also set up internal ethic committees, which discuss the consequences of data uses (including protecting data privacy) and data-led decisions.

Finally, IBM has adopted three principles for good AI: 'skills', 'purpose' and 'transparency'. AI platforms must be built with people in the industry, be they doctors, teachers or underwriters, to ensure that the AI augments their intelligence, rather than attempts to replace it. Meanwhile, companies must prepare to train human workers on how to use these tools to their advantage.

Participants

Ms Susan Teltscher
(Head, Human Capacity Building Division, ITU)

Mr Paul Comyn
(Senior Skills and Employability Specialist, Employment Policy Department, International Labour Organization, ILO)

Ms Hakima Chaouchi
(Professor, Institut Mines Telecom, Telecom Sud Paris and French Research Ministry ICT Advisor, France)

Mr Detlef Eckert
(Vice-President, Global Government Affairs, Huawei)

Ms Ivana Bartoletti
(Founder, Women Leading in AI Network and Head of Privacy and Data Protection, Gemserv, UK)

Mr Marc Fiammante (Technical Director for European Governments, IBM)

Plenary 4: Safeguarding transparent and auditable use of education data

The unconscious use of data by machine learning has intensified concerns about ethics and security in using AI for manipulating individual data across all areas. Educational institutions, students and especially children are more susceptible to the threat. How should regulatory frameworks respond to the ethical dilemma between making education data available and protecting the privacy of learners' personal data? How can technology innovations like decentralized or distributed data technologies help solve data problems caused by technology? Will the next generation of AI development enhance privacy protection of learners' data and enlighten the hidden perils in the use of AI in education?

Participants recognized that collecting data for AI is a challenge in terms of quality, quantity and bias, all of which need to be carefully addressed. For example, we need to be aware of the risks of data processing and the possible conflicts with human rights. But if AI is to help improve education, we do need to be able to aggregate data from multiple systems – which is not possible where there are data-sharing and privacy issues. In particular, we need to recognize that the question is no longer 'How do we protect data privacy?' but instead 'How do we cope with a world in which there is little data privacy?' And finally, just because we can collect data, it doesn't mean that we should!

In Malta, a task force has been established to determine a government AI strategy and to prepare citizens for the Fourth Industrial Revolution, with education being identified as one of the key channels. The strategy will by design involve a broad community of stakeholders.

In fact, the ethics of AI has been the subject of much discussion over the last few years. However, while there are many good practices of AI, and AI is likely to bring more positive than negative outcomes, we must not be naïve. The point is that children can be very vulnerable. They do not understand the implications, and unknowingly they provide information and data that can be used against them.

There are also south-–north and east–west differences in regulatory practices, partly because of the different legal systems. In any case, can AI ever be compatible with data privacy? Data is the food of AI, the basis for machine learning, and data almost always includes personal data. The EU's GDPR, which has been designed to make the collectors of data legally accountable, is in direct conflict with the needs of AI – suggesting that new approaches will be needed.

The symposium's final contributor was **Mr Amir Fehri**, a 15-year-old student and writer (Tunisia) who wondered what life would look like if he were a robot. This raises multiple questions. Is it possible for a robot powered by AI to be recognized as a true human with feelings? Would this mean that robots become a new type of citizen? Would it be possible for humans and robots to live side by side, or would it lead to more cyber harassment and bullying? AI should be the opposite of human stupidity, but how can AI help us if we do not give it consent (something that GDPR is limiting)?

Participants

Mr Edson Prestes
(Head of the Robotics Research Group, Federal University of Rio Grande do Sul, Brazil)

Ms Alexandra Bensamoun
(Professor and member of the French working group on AI's legal and regulatory challenges, France)

Mr Wayne Grixti
(CTO at Malta Digital Innovation Authority, Chairman MALTA.AI Taskforce, Malta)

Summary

Key outcomes of the symposium, drawing on all of the plenary sessions, may be summarised as follows.

➤ Individual countries and organisations cannot work independently; instead we need to leverage partnerships and work collectively.

➤ We need multidisciplinary collaborations (involving computer scientists, learning scientists, educators, philosophers, policy-makers, industry and other stakeholders), international collaborations, and more cooperation between agencies such as the OECD, ITU and UNESCO.

➤ We need standards, governance structures and policies to ensure AI is used appropriately, perhaps in the form of an AI Commons and an AI Convention.

➤ We also need a framework and principles for the ethics of AI applied in education, focusing on the education, not just on the data and algorithms, and avoiding the automation of inequality.

➤ To educate the innovators of tomorrow we can't use the technology of yesterday – but AI is much more than technology. It is also about global politics, power structures and local contexts.

➤ We need to be aware that while technology can amplify great teaching, it is never going to replace it.

Finally, UNESCO is due to publish *Artificial Intelligence in Education: Compendium of promising initiatives* which will present a selection of on AI in education initiatives in an accessible manner for a wide audience.

2. Strategy Labs
(8 March, 2019)

The Strategy labs convened interested partners to launch major initiatives and conceptualise collaborative projects that seek to harness AI's potential in accelerating the achievement of SDG 4.

Strategy Lab 1 – AI Global Goods for Education

Strategy Lab 1, organised by ITU and UNESCO, explored how AI tools might become 'global goods' for education (AIGG4E). Global goods can be regarded as digital tools and resources that are adaptable to different countries and contexts, and that are supported by a strong community, have a clear governance structure, have been deployed at scale, have demonstrated effectiveness and are designed to be interoperable. Outstanding questions that were raised included, what is the case for AIGG4E, what investments and sustainable models are needed to develop and sustain AIGG4E, and what capacity developments are required to leverage and maintain AIGG4E?

Strategy Lab 2 – AI for SDG 4: Towards a global consensus on AI in education

Strategy Lab 2 was organised by UNESCO, Weidong Group, NORAD, SEAMEO and Huawei, to provide a forum for global stakeholders to work towards a consensus on the roles of AI in accelerating progress towards SDG 4. Participants discussed a number of current projects (involving OER, global digital literacy, digital maturity of schools, sustainability, and governance models). Issues raised included the continuing importance of teachers (how teachers are constantly having to deal with imposed change), the validity of standard education models (shifting from formal education to lifelong learning), and the need for a learning society that is effective and inclusive before we can judge how AI might help.

Strategy Lab 3 – AI in a box: A free worldwide K-12 mobile and TV network

Strategy Lab 3 focused on Skillogs' proposal and plans for 'AI in a box', a free worldwide K-12 mobile and TV network, which building on ACARYA, a digital AI education platform that adapts the curriculum for each learner. Skillogs described how free STEM and AI training courses for K-12 will be offered on the Freebox system in France from November 2019, which inspired the Lab participants to discuss ways in which they might establish partnerships and networks to enable this innovative free program to be launched across the world.

Strategy Lab 4 – AI in Education Readiness Index

Strategy Lab 4 was organized by UNESCO, Microsoft, ITU, ProFuturo Foundation, Apple and Baidu. It considered the usefulness and viability of creating a 'Readiness Index' for AI applied in educational contexts. Participants agreed that any such index must reflect the complexities of AI in Education, and the global and local context; and that it must represent the voice of all stakeholders (especially those who are usually not heard). However, the key takeaway was that, rather than an index, perhaps a self-assessment maturity model, an AI in education policy innovation 'hub' (a peer learning community for people to share expertise and experiences), and policy guidelines for governments (guidelines to help them roll out solutions) might be more viable and useful.

Strategy Lab 5 – Using AI to support teachers and teacher development

Strategy Lab 5, organised by the International Task Force on Teachers for Education 2030 and UNESCO, explored how AI might be used to support teachers and teacher development. The lab was a springboard for discussion, which involved experts from the TFTE 2030 network speaking about their experiences and considering the practical role that AI might play in addressing the challenges faced by teachers.

Strategy Lab 6 – AI for youth

Strategy Lab 6 introduced 'AI for Youth', an ongoing partnership between UNESCO and Ericsson that has the aim of supporting Member States and institutions to deliver coding and AI skill development programmes for young people (particularly to address the impact of fifth-generation (5G) and AI technologies on the future labour market). Participants had the opportunity to try first-hand some of the innovative learning solutions that have been developed. They then learned about the latest developments on building a comprehensive AI curriculum for young people, and how the AI for Youth partnership can support countries in launching AI skill development programmes.

3. Conclusions

2019's Mobile Learning Week, with its focus on 'Artificial Intelligence for Sustainable Development', was in many ways a breakthrough event. Although many more questions were raised than could be answered, broad agreement was reached across multiple issues, in particular beginning the critical task of bridging the gap between the two key areas of expertise, AI and education.

Discussions began with the acknowledgement that the world is facing an education crisis, with more than 200 million children globally out of school, and that it is education that powers sustainable development, which will only be achieved if we successfully leverage digital technologies including AI. However, this is in the context of uneven global development of the infrastructure necessary for the application of AI in educational contexts. Concerns were repeatedly expressed that unless we are careful, developments in AI might lead to a digital divide both between and within countries.

Principles, guidance and potentially regulations need to be established at a global level to ensure that education powered by AI is accessible for all, whatever the individual's environment, nationality, culture, gender, disability status, sexuality or age, to ensure that marginalized and disadvantaged groups are not excluded. In addition, global efforts need to be invested in addressing the multiple concerns that arise when AI is applied in educational contexts – issues such as ethics, fairness, accountability, privacy, security, inclusion, accessibility, equity, transparency, awareness, sustainability and human rights. In short, experts in AI and in education, policy-makers, non-profit and private sector must work together to ensure that AI applied in education has human-centred values at its core. The use of AI in classrooms must not dehumanize learning, undervalue teachers or compromise fundamental human rights; while human intelligence, especially in classrooms, must be augmented by the technologies, and not replaced.

Policy-makers also need to develop the conditions in which an effective AI in education ecosystem might develop. In particular, this means providing funding, supporting and incubating innovative and participatory research. It also means using AI to address some of education's wicked challenges: not simply automating existing practices but thinking carefully about and implementing technologies that support students – young and old – to flourish in an AI-rich world within a lifelong learning perspective. Instead of developing AI technologies that focus on routine cognitive skills, the skills that are the easiest to automate with machines, we should be investigating how we develop student agency, student self-actualization and the so-called twenty-first-century skills (such as critical thinking and problem-solving, communication, collaboration, citizenship, creativity and innovation). Nonetheless, we do have to acknowledge those regions of the world where for a variety of reasons students have little access to great teaching. For these students, AI that provides automatic adaptive learning opportunities could well be transformative.

Another use of AI in classrooms that has so far received much less attention is AI to support teachers. For example, AI might automate certain routine and administrative tasks such as grading and record-keeping, which could free up a teacher's time, allowing them to focus on the more creative, empathetic and inspirational aspects of their profession, which go beyond mere knowledge transmission and acquisition. However, we also need to acknowledge that the benefits are again not straightforward, and while AI is unlikely ever to effectively replace teaching, the application of AI in classrooms is likely to redefine teachers' roles – which is why teachers need to be part of these key discussions.

Finally, governments need to recognize that in this global age, dominated by AI and other digital technologies, no single country has all the answers. Instead, it requires a global response, multidisciplinary

collaborations, and more cooperation between international agencies including UNESCO, to ensure that the commercial deployment of AI does not exacerbate digital divides or deepen existing inequalities. In particular, AI should not be left to the AI 'experts'. Instead, all stakeholders (educators, students, families, schools and universities, industry and policy-makers) need to be involved in the conversations. We also need to draw on existing standards, norms and regulations, which have been evolved over time and are well understood.

MLW 2019, in bringing together experts in AI and in education, organizations in the public sector and the private sector, international agencies and thought leaders, proved to be a seminal event – helping stakeholders across the world engage with the multiple critical issues raised. Yet this event represents only the beginning of the conversation. It has established a robust foundation for future discussions, towards enabling the world to take full and ethical advantage of AI's potential to support sustainable development and inclusive, equitable quality education and promote lifelong learning opportunities for all.

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4 QUALITY EDUCATION

Sustainable Development Goals