United Nations
Educational, Scientific and
Cultural Organization

Education
Sector

International Forum on AI and the Futures of Education

Developing Competencies for the AI Era

7-8 December 2020

Synthesis Report

Education 2030

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.

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United Nations Educational, Scientific and Cultural Organization

Education Sector

Education 2030

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Executive Summary

The '*International Forum on AI and the Futures of Education: Developing Competencies for the AI Era*'[1] was co-organized by UNESCO, the Ministry of Education of the People's Republic of China, and the National Commission of the People's Republic of China for UNESCO. Building on the Beijing Consensus, the Forum shared policies and practices regarding the role of AI in education, with a specific focus on defining the competencies required in the AI era, and strategies to prepare all people to live and work with AI effectively. Forum participants included government ministers and other high-level ministry officials from Member States, together with representatives of international organizations, NGOs and academic institutions.

Internationally recognized ethical principles to regulate AI for the common good

With Artificial Intelligence (AI) becoming increasingly pervasive and transcending national boundaries, all countries must work together to ensure that AI remains under human control and is designed and applied for the common good. In particular, it is essential that humans are protected from becoming victims of AI tools, and that AI is used to augment and amplify human capacities, not to replace them. This begins in education. Once the key human and technical AI competencies have been identified, school systems need to ensure that all students are well prepared for a world in which AI is ubiquitous.

The multiple and complex challenges associated with AI need to be properly considered. For example, AI is known to be sometimes biased; however, the cause is not always obvious. AI decisions might be biased because the human data on which it is based are biased, and/or because the algorithms applied by humans are biased. In other words, AI reflects and instantiates human decision-making, reinforcing the need for humans to step up and take responsibility and control. This is self-evidently important when AI is weaponized, or explicitly threatens human rights. However, it is also important when AI is used in everyday contexts: for example, to automate low-skill tasks which might have a negative impact on jobs, or in education which might compromise student cognitive development. Nonetheless, it is also important to recognize that, when understood fully and ethical by design, AI can also be used to uphold human rights – by, for example, protecting data privacy and security.

For many technologies, the comprehensive rules that we now take for granted took decades to develop, lagging far behind the development of technologies themselves. This is currently happening with AI. In fact, AI is developing so rapidly and has such potential to impact so widely that the development and enactment of regulatory frameworks localized for national contexts are becoming more urgent. However, AI by its nature transcends borders such that effective regulation will itself have to be transnational by design. Accordingly, we need international standards for data and algorithms, together with ethical governance and stewardship, all focused on protecting human rights. We need to ensure that the design of AI is accountable, transparent, and explainable – so that we know who has responsibility, what informed the decision making, and how the decisions were

[1] Detailed information about the Forum can be found at: https://en.unesco.org/news/international-forum-artificial-intelligence-and-futures-education-2020; and https://aiedforum.org

reached, so that society might judge effectively whether the AI and its use is both ethical and for the common good.

In particular, AI developers need to be regulated, especially those working in the public domain of education, because of the as-yet unknown impact of the AI on young developing minds. However, none of this is to suggest that AI should not be used in education or beyond. Rather, society needs to have a robust say in how and what AI is developed and applied, especially when this involves children and classrooms. To begin with, like all regulations, the proposed regulation of AI needs to be firmly grounded in robust ethics, such as that provided by UNESCO's *Recommendation on the Ethics of Artificial Intelligence*, due for consideration by UNESCO's General Conference at its 41st session at the end of 2021.[2] However, AI must also be considered in terms of the context in which it is being applied, be that automotive, health, entertainment, or other sectors. When AI is applied in educational contexts, this means that ethical principles specific to the field of education – around, for example, pedagogy, consent and agency – also need to be elaborated and addressed.

Developing AI literacy for all

Yet, regulations on their own are insufficient. The world's citizens also need to understand what the impact of AI might be, what AI can do and what it cannot do, when AI is useful and when its use should be questioned, and how AI might be steered for the public good. This requires everyone to achieve some level of competency with regard to AI. This includes the knowledge, understanding, skills, and value orientation, that together, might be called *AI Literacy*. AI Literacy comprises both *Data Literacy*, or the ability to understand how AI collects, cleans, manipulates, and analyses data, as well as *Algorithm Literacy*, or the ability to understand how the AI algorithms find patterns and connections in the data, which might be used for human-machine interactions. While there is growing attention to Data Literacy, *Algorithm Literacy* remains largely overlooked.

Countries are increasingly realizing the importance of developing AI Literacy among school students. For this, AI needs to be included in school curricula as an integral component of digital literacies, and alongside existing core competencies such as language and mathematics. AI Literacy also needs to be developed by all young people and citizens through lifelong learning programmes.

Preparing competencies for the AI era

AI Literacy involves a balance of human-oriented and technology-oriented competencies. The human-oriented competencies centre on the past, present, and possible futures of AI, the uniqueness of humans, the ethics of AI and its social impact, together with data justice and regulation. Technology-oriented competencies, on the other hand, centre on AI techniques, technologies and applications, and include the advanced AI knowledge and skills needed to create, manipulate, implement, and interpret AI. Accordingly, the teaching of AI Literacy needs to adopt both a subject-specific and an interdisciplinary approach. Specific curricula and courses in AI need to be established, covering both the human and technology aspects of AI, building upon existing ICT curricula and courses. In addition, the potential and impact of AI need to be considered in all school subject areas whether the sciences, humanities, or the arts.

[2] https://en.unesco.org/artificial-intelligence/ethics

These subject-specific and interdisciplinary curricula should draw on the AI school curricula developed by pioneering countries, and must be flexible, open, inclusive and continuously evolving. Multiple stakeholders need to be involved in the design of learning materials, such as AI-driven interactive textbooks, and teachers need to be appropriately trained. AI competencies could also be developed in extracurricular activities such as coding clubs and hackathons, as well as in lifelong learning programmes such as job-, career- and entrepreneurship-related training. Such integration would equip more children, young people and working adults to fully understand how to interact with AI systems, how to take informed decisions, and how to prepare for the social impact of the widespread use of AI on jobs, health, democracy and education.

Implications of the use of AI tools in schools

In addition to being an area of study, AI is increasingly being applied in education to support management, learning and assessment. Examples include AI to automate routine administrative tasks, to diagnose student competencies, and to offer learning content and feedback adapted to individual progress and miscomprehensions. However, current AI-driven education tools, although effective in some contexts, remain narrow. Most are constrained by the range of subjects that they cover, usually limited to mathematics and some sciences; by the pedagogical approach that they take, often at odds with approaches inspired by the learning sciences; and by their prioritization of machine-based interactions over human-human interactions. Both the potential and the limitations have yet to be fully identified, elaborated or addressed. Nonetheless, it is clear and widely agreed that AI should not replace schools or teachers. Instead, social interactions – between students and teachers, and between students and their peers – need to remain at the heart of learning. In addition, some existing AI tools may reduce student agency. It is important that students be supported to be active participants in the learning process and to take more responsibility for their own learning. Moreover, AI developers need to move beyond developing tools that aim or claim to teach better than teachers, to develop instead AI tools that augment teacher capacity helping them to become the best teachers that they can be.

Equitable and inclusive use of AI

Developments in AI and AI regulations have to be achieved without compromising human values, without undermining diversity, and without creating new inequities. In particular, an AI divide between countries must be avoided. For this, issues of infrastructure, especially internet connectivity, still need to be addressed, while all countries should work to become less dependent on the big technology companies. Accordingly, many of the least developed countries are calling on international organizations and developed countries to help enhance local infrastructure, to provide open-source AI tools and resources, and to ensure the local ownership of data generated in national contexts. Exemplar initiatives that demonstrate AI's potential to be inclusive include applications to support students who have disabilities or speak indigenous languages, as well as strategic and operational partnerships in Africa which are designed to address the digital divide and promote the equitable development and use of AI across the continent.

AI and gender equity

National authorities also need to ensure that AI contributes to achieving gender equity instead of widening the existing gender gap. In particular, this means ensuring that human rights, safety and

the integrity of girls and women are not compromised in the design of algorithms, data analytics and data-based decision making, nor at any stage of the application of AI in education. In most countries, structural factors, including the way in which societies are organised, laws are set, and economies function, constrain the participation of women in AI development. This must be redressed early in schooling. There should also be more emphasis on encouraging women to become AI researchers in universities and to train in AI skills, to help ensure that more women are represented among AI engineers of the future. Only if women are properly represented in the AI workforce can AI begin to be genuinely fair, inclusive and better reflect society. This is also true for other disadvantaged groups such as persons with disabilities and young people from the Global South.

AI and the futures of education

The Forum underlined the importance of reviewing the very purpose of education, together with the opportunity for real transformation, and the role that AI might play. It is widely acknowledged that current educational practices and educational environment are very rigid, and that the future of education should be more flexible and responsive to changing circumstances and innovation. National education authorities should identify what skills young people need to enable them to live and thrive in the new realities of a constantly changing world, and what digital transformation makes possible in the national and international context. In short, new education models are needed to put students at the centre, to move away from a focus on memorizing content, to integrate the digital and the analogue, and to foster human cognitive, socioemotional and critical skills, all of which might – with foresight and careful attention – be enabled by AI and other digital technologies.

Introduction to the Forum

One and a half years after the adoption of the *Beijing Consensus*[3] at the first *International Conference on AI and Education* held in Beijing in May 2019[4] and in the aftermath of the first COVID-19 education disruption, UNESCO together with the Ministry of Education of the People's Republic of China and the National Commission of the People's Republic of China for UNESCO co-organized the *International Forum on Artificial Intelligence and the Futures of Education* under the theme *Developing Competencies for the AI Era*.

Held over two days on the 7th and 8th of December 2020, the Forum successfully merged virtual sessions and physical meetings in Beijing to engage participants in dialogue about the pervasive use of AI in the future, and addressed the challenges associated with developing competencies for the AI era. It involved 80 speakers, including government ministers and other representatives from twelve Member States, together with participants from NGOs, the private sector, and international organizations, as well as leading experts. More than 2,000 participants from 33 Member States took part. The Forum was also livestreamed on YouTube (in English, French and Chinese) where it received more than 3,500 views.

The Forum opened with Ministers, Vice-Ministers, and State Secretaries from China, Croatia, Ethiopia, Slovenia, South Sudan, and the United Arab Emirates sharing their national experiences and programmes on AI and education. The second day included presentations by high-level representatives from the Ministries of Education and ICT of Cambodia, Kenya, Morocco, Qatar and Saudi Arabia, as well as Directors of regional and international organizations for education such as the Southeast Asian Ministers of Education Organization (SEAMEO) Secretariat, the Information for All Programme, and UNESCO.

A plenary session explored how AI competencies could be defined and developed in the context of the futures of education. Prominent AI experts discussed AI in schools, public policy and IT systems. A core focus was the importance for all countries to strengthen AI literacy among young citizens in order to ensure that AI serves the common good.

The Forum also included a session on AI and education in the context of China convening Chinese scholars, policy-makers and educators to share their perspectives on the Futures of Education, as well as three parallel sessions devoted to: (1) the integration of AI in curriculum and textbooks; (2) the application of AI in learning and teaching and how to regulate its effective and ethical use; and (3) supporting education development in African countries for the coming AI Era.

The Beijing Consensus

The Forum built on the *Beijing Consensus* which recommended that UNESCO explore the role of AI in education and mobilize the organization's institutes and networks to consider issues such as the integration of AI skills into ICT competency frameworks. The Beijing Consensus provides guiding principles and concrete recommendations in response to three fundamental questions:

[3] https://unesdoc.unesco.org/ark:/48223/pf0000368303
[4] https://en.unesco.org/themes/ict-education/ai-education-conference-2019

- How can education systems ensure the ethical, inclusive and equitable use of AI in education?
- How can education prepare humans to live and work with AI?
- How can AI be leveraged to enhance or reinvent education?

The Beijing Consensus also recognizes the distinctive features of human intelligence. It reaffirms UNESCO's humanistic and ethical approach to the use of AI with a view to protecting human rights and preparing all people with the appropriate knowledge, skills and values needed for effective human-machine collaboration in life, learning and work in the service of sustainable development. The Consensus also affirms that while AI provides opportunities to support teachers in their educational and pedagogical responsibilities, human interaction and collaboration between teachers and learners must remain at the core of the educational process. In particular, it reaffirms that teachers cannot be displaced by machines. The Consensus affirms that the deployment of AI in classrooms and beyond should be in the service of people and seek to enhance human capabilities.

While recognizing the potential of AI to support and transform learning and learning assessment, it is important to note that evidence on the impact of AI in improving learning outcomes of subject-specific learning and the development of interdisciplinary competencies remains scarce. It is therefore important to carefully review efforts to integrate AI in school curricula, whether by teaching *about* AI techniques, teaching *with* AI tools, or by preparing young people for life in a world increasingly influenced by AI,

The Consensus also recommends that governments and other stakeholders among UNESCO's Member States consider implementing system-wide actions in response to the education-related opportunities and challenges presented by AI. In particular, it highlights the emergence of a set of AI literacy skills required for effective human-machine collaboration in the AI era.

COVID-19

The economic and social disruption caused by the COVID-19 pandemic has further heightened the complexity, uncertainty, and fragility of the world in which we live with its persistent inequities, social fragmentation, and political extremism. The disruption resulting from the pandemic has exposed the vulnerabilities of our societies and our education systems, and is further exacerbating the pre-existing learning crisis. Although all countries adopted some modality of remote learning in their national education response in the form of online platforms, TV and radio programmes and take-home packages, the coverage was extremely uneven and millions of learners were left without any access to formal education.[5]

Recent survey data clearly indicates that learning loss has been more acute in low- and lower middle-income countries, than in high-income countries.[6] Disengagement and the risk of drop out is highest for the most vulnerable with the number of children out of school likely to increase by at least 24 million as a result of the pandemic.[7] In response, UNESCO has taken a holistic approach to strengthening international cooperation to support Member States to enhance distance learning

[5] https://en.unesco.org/covid19/educationresponse
[6] https://data.unicef.org/resources/national-education-responses-to-covid19
[7] https://www.unicef.org/press-releases/children-cannot-afford-another-year-school-disruption

solutions, support the safe reopening of schools, and to reimagine more resilient learning systems for the future.

The Futures of Education initiative

The current crisis also highlights the urgency of charting possible futures of education. Recognizing that knowledge and learning are humanity's greatest renewable resources for responding to challenges and inventing alternatives, UNESCO launched the *'Futures of Education'* initiative[8] in late 2019 before the outbreak of the COVID-19 pandemic. The initiative aims to rethink the role of education, learning and knowledge in light of the tremendous challenges and opportunities of multiple possible futures. Such re-visioning of knowledge, education and learning is more relevant than ever. Indeed, accelerated technological transformations over recent years, in particular in the field of AI, and their rapid deployment in work, life and education have profound implications for the future. AI is largely believed to hold transformative powers in reshaping human society and life, and will likely bring human history to a new era where we need to live and work together with AI. These transformations represent both challenges and opportunities that need to be carefully examined. The *'Futures of Education'* initiative aims to generate discussion and action on the role of education, knowledge and learning in view of the predicted, possible and preferred futures. The Forum provided an opportunity to discuss these implications and the transformative potential of AI on education.

[8] https://en.unesco.org/futuresofeducation

Ensuring inclusive, equitable, and ethical use of AI: A global challenge

MODERATOR

H.E. Mr Xuejun Tian
Vice Minister of Education and Chair of the National Commission of the People's Republic of China for UNESCO, People's Republic of China

SPEAKERS

H.E. Mr Baosheng Chen
Minister of Education, People's Republic of China

H.E. Mr Agapito Mba Mokuy
Chairperson of the Executive Board, UNESCO

Ms Stefania Giannini
Assistant Director-General for Education, UNESCO

The *'International Forum on Artificial Intelligence and the Futures of Education'* began with keynote speeches by **H.E. Mr Baosheng Chen**, Minister of Education of the People's Republic of China, **H.E. Mr Agapito Mba Mokuy**, Chairperson of the UNESCO Executive Board, and **Ms Stefania Giannini**, UNESCO Assistant Director-General for Education. Each of these speakers spoke about the global challenges of ensuring the inclusive, equitable, and ethical use of AI in education.

H.E. Mr Baosheng Chen started by mentioning how in the past year the world had experienced the enormous impact of COVID-19, which has been rarely seen in human history and is still raging across the world. He further acknowledged that the pandemic has dealt a heavy blow to education worldwide, and governments and the education sectors of various countries have responded with all-out efforts by introducing online education on an unprecedented massive scale. New technologies such as AI have shown tremendous potential to transform education. The pandemic will end one day, but the world will be a different place. Education will not be the same either. Education bears on the future of humanity. It is our shared responsibility to plan the development of education with a vision for the future.

The new round of scientific and technological revolution and industrial revolution is happening right now, characterized by the extensive application of new technologies such as AI, cloud computing, blockchain, 5G and so on. The intelligent age is dawning on us with changes that are about to transform human society. In this context, it is the mission of education to help equip each and every one with the skills and abilities to capitalize on the new technologies for better lives.

Accordingly, we need to accelerate the development of higher-quality education. The content, methods, assessment, teaching platforms and qualities of teachers all need to be reformed to ensure that every learner can access quality education and achieve the well-rounded development they need to get themselves ready for the new era.

We need to accelerate the development of more equitable and more inclusive education. While technological advancement may be good for humanity, it may also widen the gap between different groups. The negative impact of the digital divide has been made evident by global online teaching during this pandemic.

We also need to accelerate the development of personalized education. Over 2,500 years ago, the ancient Chinese educator Confucius put forward the concept of education based on the personal traits of each individual. Progress in AI has provided the possibility to promote personalized development. We should apply the new technologies to create new smarter learning environments better suited to each individual's needs. We also need to accelerate the development of more open

and flexible education. Human society is developing faster and faster. More breath-taking changes will take place as we enter the intelligent age. To keep up with the times, education needs to be more open and flexible.

In the past five years, the Government of China has been actively implementing the UN's Education 2030 Agenda for Sustainable Development.[9] Priority has been given to education as part of economic and social development. China's Education Modernization 2035 and the Five-Year Implementation Plan have been released and enacted.

At the Fifth Plenary Session of the 19th CPC Central Committee convened at November 2020 overall arrangements were made for the next five years[10] and for the modernization of China by 2035.[11] Such goals as building a high-quality education system and a country strong in education have been clearly set. Facing the new era and driven by reform, China will spare no effort to implement the *'Education 2030 Agenda'* and accelerate the modernization of education. First, we will put more emphasis on improving education quality. Centring on the core competencies, we need to set the standards of education quality that cover all the stages, levels and types of education, and put in place sound standards for all subjects, disciplines and the standard for physical health as well. Second, we will strive to promote equity and inclusiveness. We will improve the mechanism to realize more coordinated education development between urban and rural areas and across regions. Third, we will focus on the application of new technology. We will keep deepening our understanding of how learning should be done, use new technologies such as AI to create new teaching methods, and support differentiated teaching and personalized learning with such technologies as educational data mining, learning analytics and deep learning. Fourth, we will further open up our education. We are firmly committed to the opening up of education and we keep strengthening exchanges and cooperation with various countries and international organizations including UNESCO.

COVID-19 has made it evident that humanity is a community with a shared future. To embrace the age of intelligence, we need to join our hands and pool our efforts. China stands ready to continue to organize international meetings on AI and education, and work together with all sides to follow through on the *'Beijing Consensus'* adopted at last year's conference.

H.E. Mr Agapito Mba Mokuy began by highlighting that the world of tomorrow will depend highly on AI. Ignoring this reality will be a grave mistake and will imply a total disconnect from the reality of the 21st century. With the advancement of technology, new technical and social systems, organizational structures, managerial practices, and competencies and skills are needed. He then acknowledged that the multiple steps undertaken by the Government of China in cooperation with international bodies such as UNESCO to lead the way in research, training and advancement in AI as well as the inclusion of developing countries, are of extreme significance and should be applauded. To enable all nations to remain competitive in tomorrow's world, one important action that could be recommended is to ensure universal access to the internet. UNESCO should lead an international campaign to ensure that this becomes a right – otherwise the gap between the haves and the have-nots will continue to widen.

UNICEF and ITU have recently prepared a report entitled *'How many children and young people have internet at home?'*. This report looks at digital connectivity during the COVID-19 pandemic, and

[9] https://www.fmprc.gov.cn/mfa_eng/topics_665678/2030kcxfzyc/P020190924780823323749.pdf
[10] https://en.ndrc.gov.cn/newsrelease_8232/201612/P020191101481868235378.pdf
[11] http://www.gov.cn/xinwen/2019-02/23/content_5367987.htm

estimates that two thirds of children and young people aged 25 years or less do not have an internet connection in their family home.[12] In fact, while 87% of children have internet connectivity at home in high-income countries, the figure is only 6% in low-income countries. This means that 2.2 billion children and young people worldwide below 25 have no internet at home, of whom 1 billion live in Asia or Africa. H.E. Mr Mba Mokuy reflected that one cannot emphasize the gravity of this reality, particularly in the era of technological advancement and AI. The COVID-19 pandemic has shown that multilateralism is the way forward.

The *'Beijing Consensus'* recommends that UNESCO take a leading role in AI and education, mobilizing the organization's Institutes to the specific purpose of integrating AI skills into ICT competency frameworks. It also recommends that UNESCO further expand its cooperation in the field of AI with relevant partners. Currently, no organization is solely responsible for this sector. This is the reason for the proposal for China to establish a Category 1 Institute in the field of AI and education. This will focus on South-South cooperation and will aim to assist developing nations that desperately need connectivity to the internet, curriculum reform for the AI era and training. These objectives should not be secondary to the mission of the Institute.

Ms Stefania Giannini reminded participants that this Forum built on the great success of the first International Conference on AI and Education, co-organized by UNESCO and the Chinese Government in Beijing in 2019, which led to the adoption of the *'Beijing Consensus'* – the first international consensus on AI and Education. The *Beijing Consensus* reaffirms UNESCO's humanistic and ethical approach to the design and use of AI, including in education. AI should be designed in the service of humanity; it should serve to enhance human capacities for sustainable development, and for a better society. To this end, UNESCO is leading the development of *'Recommendations on the Ethics of AI'*[13] to maximize the benefits of AI for human development and mitigate potential risks.

In the framework of the humanistic approach to AI, the *Beijing Consensus* recognizes the uniqueness of human intelligence and human competencies in the face of AI. This is in line with the lessons we have learned from our response to the COVID-19 crisis. Accordingly, the core aim of the Forum was to define human AI competencies – the knowledge, skills and values needed for effective human-machine collaboration in life, learning and work. In dedicating the Forum to the theme of *'Developing AI Competencies'*, UNESCO called on Member States to recognize the increasing importance of developing AI literacy and AI competencies for all citizens. The aim of the discussions was to facilitate knowledge sharing on how AI competencies can be developed in schools and universities, and through lifelong learning opportunities with particular attention to the empowerment of women and young people.

According to our scoping studies, many Member States are progressing in developing curricula on AI competencies at different education levels, with China being one of the leading countries. However, while AI transcends domain boundaries, our curricula have not. We note that a technology-oriented approach has been typically taken towards AI skills training, and AI is usually only taught as part of the computing curriculum. Human and in-depth ethical questions are too often ignored. In fact, when teaching art or music, perhaps we should also consider the works of art created by AI systems?

[12] https://www.unicef.org/media/88381/file/How-many-children-and-young-people-have-internet-access-at-home-2020.pdf
[13] https://unesdoc.unesco.org/ark:/48223/pf0000373434

UNESCO is drafting a framework for AI competency development to guide a more human-centred curriculum paradigm. The development of forward-looking AI competencies should be anchored under the framework of the futures of education and learning. Future learning systems should integrate these competencies as core sets of skills for all learners.

The UNESCO *'Futures of Education'* initiative aims to rethink the role of education, learning, and knowledge in light of the challenges and opportunities of the possible futures. With the National Commission of the People's Republic of China for UNESCO, we are co-organizing a special Consultation Session on the Futures of Education.

Among other areas, accelerating technology advancements, particularly in the field of AI, have profound implications for the future of education. If we are to secure a safe and inclusive digital future for all, as stated by UN Secretary-General Mr António Guterres, we need to reaffirm that AI must be used as a public good. The deployment and use of AI in education must be guided by the core values of UNESCO: inclusion and equity.

UNESCO has published two editions of a compendium featuring more than 80 projects on using AI tools to advance inclusion and equity in education. In our case studies, we showcase AI applications designed for children with autism and other disabilities; the use of AI to detect and prevent school dropout; AI applications that can support self-paced literacy; and the use of AI to empower teachers and teacher training instead of replacing or displacing teachers. Meanwhile, the 2019 edition of the UNESCO *'Prize for ICT in Education'* recognized AI tools for diagnosing children with reading disabilities.[14] During the Forum, we also heard about scalable AI applications promoting inclusive learning in Africa, and AI tools supporting the learning through indigenous languages.

Having said that, it is alarming that almost no regulations have been enacted to address the ethical issues raised by the use of AI in education. Without regulations, AI is likely to exacerbate the marginalization of vulnerable groups and amplify discrimination. There are also growing cases of the misuse of students' personal data by AI companies and of the introduction of AI in classrooms intruding on students' natural behaviours and teachers' human rights. Critically, the use of AI in education will only benefit all if – by design – it enhances human-centred pedagogical principles, and respects ethical norms and standards.

The deployment of AI in classrooms and other learning settings should be centred on the genuine needs of teachers and students, rather than on commercial imperatives. Accordingly, although increasing numbers of tools appear to offer solutions to improving educational attainment, it is important to note that evidence for the positive impact of AI on learning remains scarce. This is why Member States should encourage more research to determine how AI might best be used to improve the quality of learning. Furthermore, the international education community should do more to review the profound impact of AI on education provision and management, teaching, learning, and assessment – including a charting of the potential risks.

[14] https://unesdoc.unesco.org/ark:/48223/pf0000373477

National strategies on AI and education

MODERATOR

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Ms Ivana Franić

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H.E. Mr Hussain bin Ibrahim Al Hammadi, Minister of Education, United Arab Emirates, began with a reflection on the impacts of COVID-19 on education. He reminded participants that no one had predicted a pandemic that would lead to the worldwide closure of schools. In fact, the pandemic had also exacerbated many problems that already existed. As **H.E. Ms Ivana Franić**, State Secretary, Ministry of Science and Education, Croatia, explained, that even when schools were open, millions of children still could not read, write, or do basic mathematics even after several years in school. This learning crisis is widening social gaps instead of narrowing them. Around the world, too many young students who are already disadvantaged by poverty, conflict, gender, and disability reach young adulthood without even the most basic life skills.

H.E. Mr Gabriel Changson Chang, Minister of Higher Education, Science and Technology, South Sudan, added another level of complexity. Traditionally, education has been seen as a social, cultural phenomenon, and a conduit through which a community's values, norms and identity are passed from one generation to the next. However, now that educational resources are becoming increasingly global, and students are virtually identifying more than physically identifying themselves, how can community norms and culture be preserved? Put another way, can Sustainable Development Goal 4, which requires quality and equity in education, be achieved in such an imbalanced situation where many developing countries are without the necessary technology or infrastructure?

Nonetheless, many people have predicted that a new education will emerge gradually as a result of the fourth Industrial Revolution and AI. This new way of learning will require a more open learning environment and a 'learning society' in which everyone can learn whatever, whenever and wherever they want. For this, the COVID-19 pandemic has been an accelerator because it has shown the world in a very short time what can be done using technology.

In fact, AI has become increasingly important and more noticeable even in low-income countries, even if multiple infrastructure issues remain a major barrier. Nonetheless, AI has the potential to benefit many sectors, including education and training, and to contribute to the way we build shared futures based on our common values. It is essential that AI should always be in the service of humanity, yet it brings with it multiple issues and risks that need to be critically examined and addressed. For example, as **H.E. Mr Fuzhi Zheng**, Vice Minister of Education, People's Republic of China, explained, our way of life is likely to change. The AI era will bring about closer people-to-people connections and people-to-things connections making the whole world a community with a shared future. Yet, as **H.E. Ms Simona Kustec**, Minister of Education, Science and Sport, Slovenia,

pointed out, a flipside is that it is also possible around half of all existing jobs will disappear over the next 10 to 12 years, bringing massive changes to society.

The potential of AI in education has been researched, debated and discussed for nearly 20 years within the academic community. What everybody agrees on is that AI has changed drastically in the last few years and will likely continue to do so, bringing risks as well as opportunities for education – especially now in the context of the COVID-19 crisis. We therefore need to proceed vigilantly and prudently into a new educational environment where AI is used to support the learners and teachers and where we also prepare learners for a future where AI plays an increasing prominent role.

AI is also shifting the theories, focus, priorities, and practices of education. One area experiencing change is the role of teachers. The traditional view of teachers as controllers, transmitters and processors of knowledge seems to be fading away. Robots and some computer programs are increasingly taking over this role and have proven to be effective tutors and mentors to learners to some degree. AI technologies are becoming the brains driving the future of education processes and progress. For example, the role of teachers in higher education is being increasingly limited to supporting learners in seeking, finding, and integrating information, and supervising their collaborative work as independent learners and thinkers. However, as the role of AI increases, we still need human teachers, whether at universities or at lower levels, to work in unison with AI. The focus should be on how we assist teachers to help learners to develop their full potential.

We must also ensure that AI in education does not result in a growing achievement gap. This can only be achieved if the human role continues to be central, if all stakeholders are involved in the design of this future of learning, and if the process is transparent. For example, to judge whether a student is ready for a more challenging task, it will still be necessary to have teachers of high professional and moral standards. Speakers also acknowledged that, while the potential benefits of using AI to tackle the entrenched injustices faced by learners across the globe are profound, the risks posed by AI in education are significant. Accordingly, learners, educators and societies as a whole should without question be cautious about introducing AI into any form of learning environment.

The growing impact of AI on society also means that all citizens need to be taught about AI. **H.E. Dr Engineer Getahun Mekuria**, Minister of Education, Ethiopia, suggested that ministers of education and UNESCO should commit to a total overhaul of the curriculum, starting from elementary school up to university. AI is fundamentally changing the skills needed in society, while human life-skills need to be closely related to the economic goals and human well-being of a future knowledge society. This implies three skill sets:

- skills to develop AI which requires highly skilled individuals with solid computer science backgrounds;
- skills to work with AI which requires problem solving and innovation; and
- skills for people to live with AI.

Participants agreed that we should redesign curricula to highlight the development of core competencies. The curriculum is not just an education and teaching system, but it also reflects the goal of talent cultivation and so should be designed to reflect that goal. At the same time, attention should be given to big concepts, big ideas, and comprehensive issues in order to reconstruct the content of curriculum and to improve the presentation of the concepts. In particular, it is essential to help teachers shift from focusing on imparting knowledge to focusing on supporting student self-development.

A renewed emphasis should also be placed on the cultivation of proper values, essential characteristics and core competencies that can enable lifelong personal development.

- First, attention should be paid to empowering students with information awareness, computational thinking and digital learning abilities, so they can survive and thrive in the digital world.
- Second, attention should be paid to the cultivation of higher-order competencies such as critical thinking, the courage to explore and innovate, and the ability to reflect and introspect. This can help students cope with the uncertainties of the future world.
- Third, attention should be paid to reinforcing a sense of social responsibility. We should stress the importance of a self-disciplined, interdependent, and teamwork sense of responsibility, and we should equip students with attitudes founded on ethical standards so as to help them understand the concept of a community with a shared future that is open and inclusive.

However, the main competencies that need to be built are now not for the *development* of AI but for the *use* of AI. So, how can governments build an 'AI ready' workforce, and how can we support citizens with educational systems and services as new Artificial Intelligence technologies emerge in the future? This is why Artificial Intelligence needs to be part of both formal and nonformal education in the same way that digital competencies were in the 1990s, but cutting across disciplines.

In order to cultivate talent for the AI era, it is important to start building new course and textbook systems, undertaking remote teaching reforms, and changing the approaches of talent cultivation pursued by educational institutions. Teaching materials should be chosen based on the need to develop the core competencies of students based on their life experience and situational social developments. Materials from real life should be chosen, so as to allow students to learn and innovate as they try to identify and analyse actual problems in real life. In addition, focus should be given to improving teaching methods to foster core competencies in students. Research in the Learning Sciences should be strengthened to explore new teaching methods based on the laws of learning to make learning more effective.

Finally, all Member States have to cooperate and share ideas because these are not local issues but global ones. There are already some examples of effective international collaboration. For example, Slovenia has established the first *'International Research Centre on Artificial Intelligence'* (*IRCAI*)[15] under the auspices of UNESCO, which aims to explore how education systems can ensure the ethical inclusion and equitable use of Artificial Intelligence in education, and to help Member States address the recommendations of UNESCO's *'Beijing Consensus'*. A key focus for IRCAI is to develop global collaboration in research on AI and education.

[15] https://ircai.org

National Strategies on AI and Education: Key Messages

- AI has the potential to benefit many sectors, including education and training, and to contribute to the way we build the future of our common values.
- Transformation cannot happen without proper physical infrastructure.
- AI should be in the service of humanity, but it brings risks as well as opportunities so we need to proceed prudently.
- AI is shifting the theories, priorities and practices of education.
- Students need skills to develop AI, skills to work with AI, and skills to live with AI.
- AI-powered learning should address, not increase, inequities.
- The traditional view of teachers as transmitters of knowledge is changing. However, we still need human teachers. The focus should be on assisting teachers not replacing them.
- Ministers of education should overhaul the curriculum from elementary school up to university.
- All stakeholders should be involved in the design of futures of learning.
- The curriculum should empower students with information awareness, computational thinking and digital learning abilities, higher-order competencies such as critical thinking, the courage to explore and innovate, and the ability to reflect and introspect, and ethical standards.

AI and the futures of education

UNESCO's flagship programme on Futures of Education[16] in the context of forthcoming AI era was explored by Chinese scholars. To begin with, it was suggested, it is necessary to review the very purpose of education and its organization in terms of SDG 4 and the Education 2030 Agenda, and in the context of today's digital transformation – especially as education is a key pillar for social and economic sustainable development. This need to rethink education has been reaffirmed by the COVID-19 pandemic. However, most efforts worldwide over the past months have focused on addressing the disruption to face-to-face education. Instead, we must do more than that. We must seize this opportunity for real transformation to ensure that the future of education involves lifelong learning for all, is accessible to and adapted for the needs of everyone, and responds to society's real needs.

Rather than relying on first industrial revolution models, students should be at the centre of education. Indeed, we need to leverage the advances made possible by digital technologies, so that education is no longer be about memorizing content but instead focuses on 21st century skills like creativity, helping prepare students for the future that this transformation makes possible.

However, education is moving further and further away from the reality that

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[16] https://en.unesco.org/futuresofeducation

surrounds it. The current educational environment is very rigid and not in line with a constantly changing world. In addition, whenever curricula are reviewed, new content and themes are added, overloading teachers and students with more content to cover. Instead, it is important to lighten the curricula and to focus on what is really important and necessary for our students to learn. The curriculum should be adapted to current needs, and should involve new approaches that apply different strategies rather than being standardized. It should be flexible to enable students to both acquire and produce new knowledge. We need to understand what skills our young people will need to enable them to adapt to the new realities. We need to know how to prepare appropriate responses; and we have to design education to meet these complex challenges. In short, if we are to move forward successfully, it is necessary to redefine 'with whom' to learn, 'where' to learn, 'what' to learn and 'how' to learn.

Yet, all of this is taking place in an increasingly complex and uncertain world transformed by new technologies, which are posing serious challenges to education. Because of these new technologies, new jobs will emerge, and there will be young entrepreneurs and business innovations. The challenge will be to respond to these developments in our education systems to develop new educational offers based on emerging technologies. Accordingly, new education models are needed, possibly enabled by AI, IoT, Virtual Reality (VR)/Augmented Reality (AR), blockchain and big data analytics.

In particular, many have identified the potential of AI for sustainable development, and have highlighted the possibility of connecting education to AI in order to best serve the learners' learning interests. AI is essentially a tool for increasing human capabilities. We now need to think how AI might be developed for the common good, and how it might best be introduced to educational contexts. The AI has to be embedded in order to promote the development of each individual student, for instance their critical thinking skills, and might provide students with several pathways to learning. Achieving this will require partnerships with different stakeholders in order to build a consensus together with programmes for training teachers to help them address the many challenges. In this AI era, we need to analyse the skills that will be key to our changing contexts, redirect learning so that students acquire the knowledge that they need, make digital resources and new ways of learning accessible in remote areas, modernize teacher training so that they are able to interact effectively with these systems, and ensure that the focus remains on the student.

We also have to recognize that in some limited respects, AI is more capable than humans. It will replace humans in repetitive tasks, so it is likely to replace humans in some professions. However, the likelihood that AI will replace teachers is low due to the characteristics of the role. Even with such a revolution, schools will not disappear. Instead, AI could enable teachers and schools to solve core problems such as the difficulties of access to education in remote areas by connecting online teachers in one place and students in another. It could also help change current approaches and improve teachers' skills, which all too often fail to meet the needs of students, focusing it on areas such as creativity and involving social interactions and collaborative learning. AI will also help teachers in routine tasks, for example in the context of marking and assessment, freeing them for the really important tasks such as monitoring pupils' learning. AI could also be central to supporting students who have disabilities such as those who have sight or hearing problems.

Although we are still in the time of weak AI, AI already makes individualized learning possible by means of intelligent systems and helps decision-making by means of data. But the analogue world of

education will remain, so we need to integrate both the digital and the analogue in future education provision. Also, very importantly, we need to ensure digital inclusion for everyone, and effect a balance between the human and technological aspects of technology-driven education. Schools also need to consider what skills will be needed by our students, as AI increases its impact on the world.

AI and the Futures of Education: Key Messages

- We should investigate how to best integrate AI in education.
- We should use AI to empower and enhance education.
- We should discuss the future of education and redefine it in the context of the digital transformation
- We should define the core competences and skills that our students will need in the future.
- We should ensure that AI is developed to assist teachers and not to replace them.
- We should provide every student with an AI Companion and every teacher with an AI Assistant.
- We should make bridges between the digital and the analogical worlds.
- We should develop platforms that support both online and onsite (face to face) educational approaches.
- We should address the ethical and privacy questions raised by the use of AI.

Defining and developing AI competencies

A key question that now needs to be addressed is how AI will shape the future of humanity and education. Answering this involves reviewing the implications of AI to reimagine knowledge and education, guided by the principles of inclusion and equity in access to quality learning opportunities.

Humans have an innate ability to develop a 'theory of mind' – the ability to attribute mental states to others, which we develop through interactions with other humans. It is an extraordinarily sophisticated ability which, if it fails to develop, can lead to severe difficulties in adjusting and working in society. Given the growing impact of AI, we now need to work towards teaching young people how to develop a theory of the artificial mind. In particular, we need to teach the difference between the human and the artificial mind. Such skills will require an understanding of computational thinking but also an understanding of how AI ticks, gaining insights into what it can offer and what it cannot, all from a human perspective. The point is that humanity is more than intelligence. Accordingly, it is vital to develop an appreciation of our humanity that goes beyond mere intelligence, and the societies that educate the next generation to take control of AI and be creative will be those that will prosper the most.

We need to understand what AI can and cannot do because it is increasingly being used on a daily basis and is impacting our decision making throughout our lives. For example, online platforms that use AI, such as YouTube, are affecting schools and young people in secondary and primary education, having an increasingly significant impact on them. In fact, these platforms in some ways are actually increasing a new digital divide – between those who understand and those who do not understand AI. Working towards the AI curriculum means focusing on those human skills like self-regulation, which is a skill that allows us to monitor and guide our own behaviour. From the 'human-in-control' perspective as promoted by

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the European Union, humans should take the decisions while they use and monitor the data provided by the machines. The human ability to control and monitor AI is therefore essential, and humans need to understand how AI functions in order to do that.

Accordingly, AI has to be included in the curriculum, so that all citizens can understand how we interact with AI systems and can therefore take informed decisions. While AI can be a tool for good helping improve health, education and culture, there are also many risks and many issues. Risks include those around biases, manipulation and fragmentation, while the issues centre on transparency, data ownership, privacy and human rights. In fact, there are many challenges when considering using AI in educational contexts. For example, the use of AI to monitor who has submitted their work raises issues of surveillance. Other issues centre on who is going to govern the AI algorithms, whether teaching is going to focus on data, and whether AI is really equal in terms of gender. Clearly, AI can be a useful tool. For example, AI is used in Shanghai to support teaching, learning, assessment and evaluation. The experience from Shanghai shows that when the technology is secure, reliable and controlled, AI can be very helpful. In particular, learning is personalized, while AI has been used to track learning behaviours, to record and analyse the processes, and to recognize the obstacles that different students might face. AI can also improve the efficiency of teachers and to detect the competencies of students. Other examples include: TAL Education Group developed an AI and education solution for China's Ministry of Education which catered for thousands of students and teachers during COVID-19; a technology that integrated voice recognition and voice evaluation technologies to help students from ethnic minorities to learn Mandarin; and a massive database of student profiles. This solution recorded what the students learned, what they had not learned, and their motivations. Analysing the data generated digital student profiles that accurately identify and evaluate the precise learning trajectories and potential of individual students.

Nonetheless, there are also privacy issues, and problems around ethics, bias and inclusion. For these reasons and more, we need to establish rule-based governance just as we did following the arrival of the first motor cars. Most importantly, it is necessary to enable all citizens to understand the interaction with our AI systems, and to take properly informed decisions in our lives. But this will only work if we ensure that AI is accessible and inclusive, that it uses properly representative data and avoids biases, and that it is designed for the global common good.

For all of this, the roles of education, schools and universities, teachers and teaching, are paramount. UNESCO presented a project on developing AI competencies with a focus on teaching AI at schools.[17] Three interlinked action lines were proposed:

- an AI Skills Framework for K-12 students, involving learning objectives, teaching methodologies, and teacher training;
- resources for teachers to use to teach their students about AI, for which UNESCO is developing the *'Teaching AI for K-12'* portal; and
- support for countries to develop their own curricula, including workshops and support for curriculum development.

Four categories of AI competencies were proposed:

- human-oriented competencies, such as the uniqueness of human intelligence, the social and

[17] Teaching Artificial Intelligence for k-12: http://teachingaifork12.org

ethical impact of AI, and data justice and regulation;

- computational thinking AI competencies, including representation and reasoning, algorithms and coding, and engineering and design thinking;
- technology-oriented competencies, including AI techniques, AI technologies and AI applications; and
- maker-oriented competencies, designing AI applications and contextual data/algorithm-based problem solving.

These competencies can be developed at three levels: national inter-sectoral, including identifying the appropriate AI competencies, and developing a funded master plan; the education sector, including developing curriculum, textbooks and assessment, and training teachers; and AI literacy under lifelong learning involving non-formal and informal initiatives such as coding clubs and hackathons.

From another perspective, AI literacy involves:

- a comprehensive set of AI knowledge, including what AI can do and what it cannot do, and the critical role of humans in all AI achievements;
- AI skills, including creating and using AI; and
- values, including when AI is useful and when it should be questioned.

The aim is to provide a reference upon which Member States can build curricula that respect their national contexts. The UNESCO AI guiding framework addresses the human-oriented AI competencies that must be included in any effective curriculum. These include AI past, present and possible futures, the potential of AI, the ethics of AI and its social impact, and data justice and regulation. Meanwhile, the framework also addresses technology-oriented AI competencies. These include AI techniques, for example symbolic AI, machine learning, and Bayesian networks; AI technologies, for example perception, creation, and agents; and AI applications, for example autonomous transport, AI in education, and AI in medicine.

One approach is that taken by Kids Code Jeunesse, which has developed a wide range of resources to promote *'Algorithm Literacy'*[18] and to help students learn about AI. These resources cover traditional programming and machine learning, computational thinking and human values, and are designed to be used by teachers with their students especially as triggers for discussions. One recently developed resource is an animated video about algorithms.[19] This shows how understanding algorithms can help us to make decisions and to retain the power over AI. Key messages include that AI is not always visible, algorithms are not always right, ethical issues are always involved, and emerging literacies are needed.

Although many details are not publicly available, there currently exists only a few national curricula designed to support AI literacy, many of which are still in development. In other countries, this work has been left to the private sector. However, most AI curricula that exist appear to be almost entirely technology-oriented, although usually with a nod to ethics; whereas a robust AI curriculum must be both human-oriented and technology-oriented by design. In fact, the human aspects of AI must be threaded throughout the curriculum, and not just an after-thought. One country that has made

[18] https://algorithmliteracy.org
[19] https://youtu.be/46AcviSU9Rg

significant progress is the Republic of Korea, which emphasizes that AI competencies should include human-intrinsic competencies such as cognitive skills, as well as a deep understanding of human uniqueness. Nations need to ensure that human capabilities are augmented with intelligent machines, as AI doesn't replace humans but complements and amplifies human functions.

Defining and Developing AI Competencies: Key Messages

- Young people need to develop a theory of the artificial mind, and to understand the difference between the human and the artificial mind.
- All countries need to achieve AI literacy, comprising a comprehensive set of AI competencies.
- From one perspective, AI competencies include: AI knowledge, what AI can do, and what it cannot do; skills, creating and using AI; and values, when AI is useful and when it should be questioned.
- From another perspective, AI competencies include: human-oriented competencies, computational thinking AI competencies, technology-oriented competencies, and maker-oriented competencies.
- Only a few countries have developed national curricula to support AI literacy.
- Most AI curricula are technology-oriented, whereas a robust AI curriculum must be both human-oriented and technology-oriented by design.
- A key human competency is self-regulation. Humans should take the decisions while they use and monitor the data provided by the machines.
- The human aspects of AI must be threaded throughout the curriculum, and not just an after-thought.
- UNESCO has been working with experts to develop a guiding framework of AI competencies, to provide a reference upon which Member States can build curricula that respect their national contexts.

Promoting equitable use of AI in education and support Priority Africa

AI is both a centrepiece of the new industrial revolution, and a carrier of technological progress that is changing societies and economies throughout the globe. However, AI is experiencing uneven development in Africa because the institutional, economic, and social conditions in many areas across the continent do not always create an enabling environment to unleash its potential. Accordingly, as **Mr Firmin Matoko**, Assistant Director-General for Priority Africa and External Relations (PAX/AFR), UNESCO, reaffirmed, it is important for African countries to develop AI skills and AI strategies for education and for improving life more broadly by means of a pan-African shared vision and international cooperation.

In light of these challenges and opportunities, PAX/AFR organized the first *'High-Level Forum on Artificial Intelligence in Africa'*, held at the Mohammed VI Polytechnic University in Benguérir, Morocco, which took place in December 2018.[20] It highlighted the many challenges and opportunities related to the development and use of AI in Africa. Several ministers, more than 30 Ambassadors to UNESCO, and around 500 international experts participated in this event. Building on the achievements of the Morocco Forum, this session aimed to foster constructive discussions on how new

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[20] https://en.unesco.org/artificial-intelligence/africa-forum

technologies should be leveraged through South-South dialogue and academic cooperation to accelerate the development of education in Africa, and to ensure that the continent benefits from AI.

Education is essential for the development of humanity, while the COVID-19 pandemic has put education to the test. However, this is also an excellent opportunity to do things differently. Accordingly, we must re-focus on re-imagining or reshaping education in Africa, and on reformulating the overarching purpose of education. Even so, it still remains critical to improve mainstream education, to scale up education dramatically, to give all students the opportunity to learn broadly from science to creativity, and to support lifelong learning from kindergarten to beyond university. One key starting point is the need to improve the whole process of 'training the trainers', which in the context of COVID-19 will depend mainly on online education.

The digital transformation of education in Africa is a long-term project requiring sustainable effort, which might be effectively supported by AI. However, it is critical at the outset that AI is seen as just a tool – one that has huge potential, but one that should be at the service of teachers and not the other way round. In fact, AI has to be demystified – it is not magical, nor is it new. Equally, there is no need to panic about AI. In education, AI has two distinct applications. First, to support teaching and learning in order to help massify education. Second, to ensure that all students gain key competencies to enable more young people across the continent to develop the skills needed for the future so that AI enhances human capabilities, and to develop the future AI specialists. This is especially important in Africa to help build resilience, which can have difficulties addressing challenges such as COVID-19 and other shocks.

One possible approach is to create a pan-Africa AI hub. This could be designed to generate knowledge, to include and benefit all, to develop a common African approach involving the public and private sector, to foster a critical mass of AI expertise, to ensure that AI takes into account the specificities of African countries, and to help Africa achieve the Sustainable Development Goals. This would require increased investment in the necessary technological infrastructure, as well as the collaborative sharing of open access resources, and a robust focus on questions of ethics and privacy.

Promoting Equitable Use of AI in Education and support Priority Africa: Key Messages

- This is an excellent opportunity to do things differently: we must re-focus on re-imagining or reshaping education, and on reformulating the purpose of education.
- Improving basic education across the continent remains critical.
- AI should be seen as just a tool – one that has huge potential, but one that should be at the service of teachers and not the other way round.
- AI has to be demystified – it is not magical, nor is it new. Equally, there is no need to panic about AI.
- One possible approach is to create a pan-Africa AI hub designed to develop a common African approach, to foster a critical mass of AI expertise, and to help Africa achieve the UNESCO sustainable development goals.

Empowering women and youth

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Director, Southeast Asian Ministers of Education Organization Secretariat, Thailand

While there has been much discussion around the equitable and ethical use of Artificial Intelligence in education to achieve SDG 4, it is essential to focus on empowering women and youth.

Some claim that AI is the new electricity. However, as **H.E. Mr Saaid Amzazi**, Minister of National Education, Vocational Training, Higher Education and Scientific Research, Morocco, acknowledged, there cannot be AI without humans. AI demands new skills, which all citizens need to have in order to prevent them from being excluded. This dependency of AI on humans also underscores the importance of schools, the need for curricula to be developed, and the need for teachers to be appropriately trained.

Nonetheless, it is not yet fully clear how AI will affect education. It is possible that, as **Ms Ethel Agnes Pascua-Valenzuela**, Director, Southeast Asian Ministers of Education Organization Secretariat, Thailand, mentioned, teachers and machines could collaborate in the schools of tomorrow so that students can learn faster and more efficiently.

Ms Dorothy Gordon, Chair, Intergovernmental Council for the Information for All Programme, UNESCO, explained that many current AI tools that have been developed for use in education by international companies pose a range of issues such as cultural biases. To address such biases and reduce cultural erosion, the content needs to be localized, and we need to work towards developing our own solutions. In any case, there is currently little evidence for learning gains from these technologies – something that teachers need to be made aware of. In fact, governments and schools are spending a lot of money without always achieving the expected impact.

H.E. Mr Nasser Al-Aqeeli, Deputy Minister for Research and Innovation, Ministry of Education, Saudi Arabia, indicated that Saudi Arabia has implemented and rigorously tested personalized, adaptive learning tools such that in a few years it is expected to be the norm of Saudi Arabian education.

Other factors, explained **H.E. Mr Vincent Adul**, Communication Technology Expert, Ministry of ICT, Innovation and Youth Affairs, Kenya, include the need to ensure inclusive internet access, reliable and supportive infrastructure using broadband or mobile telephones where appropriate. We also need to undertake human capacity building, for example by training teachers how best to select and

use these tools. All of this requires effective partnerships between governments, schools and the private sector together with a regulatory framework that addresses data privacy and security and the risks of using AI.

The ethics of AI and education need particular attention. **Ms Gabriela Ramos**, Assistant Director-General for Social and Human Sciences, UNESCO, introduced UNESCO's *'Recommendations on the Ethics of AI'*, which raises multiple issues such as diversity, inclusiveness, and human rights. When reflecting on how to deploy such ideas in education, things become very challenging. There is a need to consider how much such technologies should be used in the education cycle. For example, how using an AI tool to maintain children's attention is not necessarily good for their agency. We also need to focus on safety, security, social fairness and non-discrimination, especially for girls. In addition, what is fundamental for the proper application of AI in education is that it should be driven by pedagogy and learning processes, and not by the available technologies. Finally, we also need to recognize that algorithms can go wrong. They are human-made and the reality is that the AI cycle requires a lot of human oversight. The black boxes do not tell us how conclusions are made and they may reproduce existing inequities.

H.E. Dr Ibrahim Bin Saleh Al-Naimi, Undersecretary, Ministry of Education and Higher Education, Qatar, presented the National Artificial Intelligence Strategy of Qatar.[21] He also called for an AI and education forum, for the use of AI in education to address ethical issues such as data privacy, for the key AI competencies that students need to learn to be agreed, for appropriate strategies and policies for international collaboration between governments and for-profit and not-for-profit enterprises to be established, and for the world to embrace openness and transparency.

Empowering Women and Youth: Key Messages

- There cannot be AI without humans, which underscores the importance of schools.
- We need to ensure that AI serves all humanity, in particular all women and young people.
- Algorithms can go wrong. They are human-made and the AI cycle needs a lot of human oversight.
- AI should not be allowed to reproduce stereotypes, ignore social biases, or create new inequities.
- Women should be active participants in AI, more women should be trained in AI, and AI should be designed to ensure gender equality.
- We should support women now, and in the future, to learn skills that machines cannot replicate.
- We need to focus on social fairness and non-discrimination, especially for girls.
- AI might reduce cultural diversity: content needs to be localized to reduce cultural erosion, and countries should work to develop their own solutions.
- There needs to be a reliable and supportive infrastructure, human capacity building, and a regulatory framework that addresses the risks of using AI.
- AI in education should be driven by pedagogy and learning processes, and not by the available technologies.

[21] https://www.motc.gov.qa/sites/default/files/national_ai_strategy_-_english_0.pdf

Implications of the use of AI for curriculum and teaching

MODERATOR

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SPEAKERS

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The growing impact of AI in education requires careful consideration of curriculum-related issues and textbooks. This raises multiple questions. How can a curriculum be designed to unleash the potential of AI in education while addressing the challenges? What problems in education might AI solve and what is its purpose? What opportunities does AI provide for students and teachers? What needs to be understood and agreed before AI is implemented in classrooms? How can education adapt to the constant changes in AI? What are the implications of adding AI to the curriculum? What do students and teachers need to understand about how AI works, and what training do they need?

There are many possibilities for how AI might support education. For example, AI might be used to automate routine and administrative tasks, thereby giving teachers more time to spend with their students to provide differentiated and individualized learning and feedback to students, and to provide support outside the classroom such as in the time of COVID-19. AI might also be used diagnose student competencies before offering them personalized learning content and feedback tailored to their needs and localized for the school's context. Alternatively, AI might be a crosscutting tool for the transformation of education in the post-COVID era, or a method for effective data analysis for students and teachers, or a way to improve teaching quality and democratize the teaching process.

In any case, it is critical that humans not lose control to AI. In particular, AI should not replace schools or teachers. Instead, schools need to develop people who control the AI. Indeed, we need to have a general vision for the future, and to think what kind of people and what core competencies we need to cultivate. For example, digital literacy will be achieved by adjusting school curricula – not by adding a new discipline, but rather by embedding AI across all disciplines: ICT, mathematics (modelling, probability, statistics), and ethics, as well as the humanities and arts. This needs to be based on evidence and shared experience, and must be flexible, open, inclusive and continuously evolving – a process that AI might facilitate. In fact, right from the beginning of their education, young people need to be active in their use of AI. The curricula should also involve active pedagogies

in which students are active participants in the learning process and take responsibility for their learning – in other words, learning that makes sense for the learners.

We also need to involve multiple stakeholders to design learning materials and AI-driven interactive textbooks,[22] going beyond the typical reliance on PDFs, and train teachers how to use those pedagogies, materials, and textbooks. Teachers and learners also need to play an active role in the development of AI tools, which has been shown to be possible in countries like the Democratic Republic of the Congo where students are developing algorithms to solve equations. The arrival of AI underscores how important it is to look at best practices from around the world, and to plan for the future. Textbooks are still essential, which is why developments in AI and education need to engage with publishers and parents who are all too often excluded. There is also a need to scale up the training of teachers.

Implications of the Use of AI for Curriculum and Teaching: Key Messages

- AI might be used to automate routine and administrative tasks, to improve teaching quality, and to democratize the teaching process.
- AI might also be used to diagnose student competencies before offering them personalized learning content and feedback localized for the school's context.
- AI should not replace schools or teachers. Instead, schools need to develop people who control the AI.
- The cultivation of the core competencies will be achieved not by adding a new discipline but rather by embedding AI across all disciplines.
- This curricula needs to be based on evidence, must be flexible, open, inclusive and continuously evolving, and should include ICT along with mathematics, statistics and ethics.
- Students should be active participants in the learning process and take responsibility for their learning.
- Multiple stakeholders need to be involved in the design of learning materials, especially AI-driven interactive textbooks, and teachers need to be appropriately trained.

[22] http://www.ibe.unesco.org/sites/default/files/resources/report_ai_forum_parallel_session_1_en_0.pdf

Effective and ethical use of AI in learning and teaching

MODERATOR

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KEYNOTE SPEECHES

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With AI beginning to have a revolutionary impact on education, many people have concerns for the prospects of humankind. For example, AI is playing an increasing role in China, and will be fundamental for future education. AI will change the teacher's role in particular. It will take over most knowledge-based teaching and assessment so that teachers are freed from doing 'boring' teaching tasks and can focus on the social aspects of education. AI is already being used to support remote learning in different modes, with classes being *delivered* remotely, classes being *guided* remotely, and classes being *shared* remotely, each of which brings benefits and challenges.

Other ways in which AI might support education include Open Educational Resources (OER) content recommendation systems, detecting student emotions, so-called intelligent tutoring systems, AI-powered teaching assistants, automatic test scoring, automatic forum monitoring and plagiarism detection. One possibility with big potential is the use of AI-human hybrid and other approaches that require fewer resources: for example, the use of WeChat to deliver microlearning. Other possibilities are international competitions like the *'UNESCO King Hamad Bin Isa Al Khalifa Prize for the Use of ICT in Education'*, which is identifying and sharing best practices in the use of AI to ensure the continuity and quality of learning during the COVID-19 education disruption.[23]

Effort also needs to be put into developing appropriate regulations, with the European Union's General Data Protection Regulation providing a useful model, while ensuring that the regulations do not limit the development of AI. Meanwhile, students will need to develop a new range of digital competencies around issues such as information processing, computational thinking and digital learning. AI also has the potential to support this, with AI-

[23] https://en.unesco.org/themes/ict-education/ict-education-prize

powered OER, textbooks, and communities of practice.[24] However, there are many issues that need to be addressed. For example, teachers' professional development needs to be improved, as does governance, accessibility and the trustworthiness of AI. In fact, AI is becoming a catalyst for reforming education itself. For example, it will enable a greater emphasis on project based learning, flexible learning, collaborative learning, and self-regulated learning, thus improving educational quality overall.

The *'AI and the Future of Learning: Expert Panel Report'*[25] recently published by the US-based not-for-profit *'Center for Integrative Research in Computing and Learning Sciences'* makes the following recommendations. AI and education researchers should:

- investigate AI designs for an expanded range of learning scenarios;
- develop AI systems that assist teachers and improve teaching;
- intensify and expand research on AI for assessment of learning;
- accelerate development of human-centred or responsible AI;
- develop stronger policies for ethics and equity;
- inform and involve educational policy-makers and practitioners; and
- strengthen the overall AI and education ecosystem.

Effective and Ethical Use of AI in Learning and Teaching: Key Messages

- AI will change the teacher's role: it will take over most knowledge-based teaching and assessment so that teachers can focus on the social aspects of education.
- AI might support teaching in a range of ways: OER content recommendation, detecting student emotions, so-called intelligent tutoring systems, AI-powered teaching assistants, automatic test scoring, and automatic forum monitoring.
- AI is becoming a catalyst for reforming education itself: it will enable a greater emphasis on project based learning, flexible learning, collaborative learning, and self-regulated learning, thus improving educational quality overall.
- AI is already being used to support remote learning in different modes with classes being delivered remotely, classes being guided remotely, and classes being shared remotely, each of which brings benefits and challenges.
- Students will need to develop a new range of digital competencies around issues such as information processing, computational thinking and digital learning.
- Teachers' professional development needs to be improved, as does governance, accessibility and the trustworthiness of AI.
- AI and education researchers should develop AI systems that assist teachers and improve teaching, accelerate the development of responsible AI, develop stronger policies for ethics and equity, and involve educational policy makers and practitioners.
- The main obstacle to the wide adoption of AI technologies is the lack of robust evidence for its efficacy and its impact on student academic achievements.

[24] https://en.unesco.org/news/artificial-intelligence-and-frontier-technologies-open-educational-resources
[25] https://circls.org/wp-content/uploads/2020/11/CIRCLS-AI-Report-Nov2020.pdf

Follow up actions

MODERATOR

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SPEAKERS

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Vice Minister of Education Chairperson of Chinese National Commission for UNESCO, People's Republic of China

Mr Qi Dong
President of Beijing Normal University, People's Republic of China

Ms Stefania Giannini
Assistant Director-General for Education, UNESCO

The *'International Forum on Artificial Intelligence and the Futures of Education'* concluded with keynote speeches by **H.E. Mr Xuejun Tian**, Vice Minister of Education Chairperson of Chinese National Commission for UNESCO, People's Republic of China, **Mr Qi Dong**, President of Beijing Normal University, People's Republic of China, and **Ms Stefania Giannini**, Assistant Director-General for Education, UNESCO. Each of these speakers highlighted key issues that had been introduced by the Forum's participants, and suggested some follow up actions.

H.E. Mr Xuejun Tian began by noting that the 2019 *'International Conference on Artificial Intelligence and Education'* explored the leading role of AI in education and its development in the intelligent age, and adopted the *'Beijing Consensus'*. However, in 2020, the sudden onset of COVID-19 dealt a heavy blow to global education. The intelligent age has, he suggested, come earlier than expected, presenting new challenges calling for our immediate attention.

First, in the age of AI, we need to find new ways of promoting educational development. In 2020, the world witnessed the popularization of unprecedentedly large-scale online education due to COVID-19. Intelligent technologies have been integrated with education and teaching at a faster pace, while traditional class teaching has been replaced by online study that could be carried out at any time in any place. We have come to realize that the constant changes in education delivery models, including the expansion of teaching scenarios, mark the beginning of the intelligent education revolution. Facing the historical trends of AI technology development and educational reforms, we must be forward-looking and innovative in thinking, and get a better understanding of the trends concerning education and talent development. Efforts should also be made to work out the development strategy, standards and paths for intelligent education to realize the integration and advance development of new teaching models.

Second, we need to be more people-centred and promote equity in education in the age of AI. Putting people first is the prerequisite for realizing equitable and quality education. On the one hand, AI development enables us to better cater to the demands of large-scale and individualized education. It helps provide learners with essential abilities, and helps people build values and morals in education and teaching. On the other hand, developing countries and impoverished regions are facing a widening digital divide. To achieve high-quality and inclusive education for all, we must optimize resources allocation, bridge the digital divide, and make education better quality, more efficient and sustainable, thus benefiting all people in a more equal manner.

Third, we should work together to promote common education development in the age of AI. The COVID-19 pandemic has once again proved that all countries have closely intertwined interests and

are dependent on one another. Cooperation is the only right choice for the international community to meet the challenges. We must choose solidarity over disputes and overcome prejudice with rationality. We should respect and help each other through thick and thin, and let UNESCO fully play its role in leading and coordinating intelligent education.

The *'14th Five-Year Plan'* proposal of China, involving future-oriented, all-inclusive, fundamental and targeted measures, was deliberated and adopted. China will pursue wider and deeper educational expansion, and we stand ready to work more closely with UNESCO and various countries to contribute to the international community with a shared future for humankind.

Mr Qi Dong began by highlighting the importance of linking the development and use of AI in education and learning with the research in psychology on children's development and cognitive neuroscience research of children's learning. He highlighted particularly the fundamental question on how we ensure that the combination of Artificial Intelligence and education benefits children's mental health, while improving the quality and efficiency of education and teaching. He continued by mentioning several issues that he believes are worthy of further study.

1. As Artificial Intelligence becomes more pervasive in education, it is becoming increasingly important to ensure that Artificial Intelligence promotes children's healthy development. Children of different ages have distinct features of brain development, which means that Artificial Intelligence has to adopt different ways of facilitating learning for different age groups. In particular, the application of Artificial Intelligence in education must not deprive children of the benefits that come from completing key steps in brain development, but instead should facilitate the completion of those key steps. These effects are worthy of in-depth study.

2. Experts at this meeting have discussed the core needs for literacy of the times. We all know that in this era, everyone needs the ability to learn independently, the ability to innovate, the ability to create, the ability to comprehensively understand, the ability to process emotions, and especially the ability to combine humans and machines. These abilities may not have been cultivated enough in education systems previously, but they are essential for the successful development of intelligence and education.

3. The ethical issues involved in Artificial Intelligence and education. Artificial Intelligence has profoundly affected people's thinking, values, and moral behaviour. Accordingly, a series of ethical issues raised by the application of Artificial Intelligence in education must be carefully considered.

4. Fairness in Artificial Intelligence and education involves the digital divide, and requires us to ensure that Artificial Intelligence does not distinguish between gender, status, or region. The issue of dividing national boundaries in human society is key for ensuring that everyone is able to enjoy more high-quality educational opportunities. I think these issues are also worthy of in-depth study.

Beijing Normal University, as a pioneer in the training of scientific educational research teachers in China, attaches great importance to the research of Artificial Intelligence and education. With the support of the country, we have established the National Engineering Center for Internet+

Educational Intelligent Application in cooperation with many institutions and enterprises around the world. Together, we are exploring a series of theoretical and application problems for the successful use of Artificial Intelligence in education. We believe that the successful application of Artificial Intelligence in education will depend on more extensive and in-depth cooperation in the academic, scientific, and educational circles of various countries. We are also willing to provide more support for this cooperation. Let's participate together.

Ms Stefania Giannini noted that the debates during the *'International Forum on Artificial Intelligence and the Futures of Education'* recognized that the pervasive use of Artificial Intelligence will be the distinct feature of the future. Living and working with AI will not be optional. In fact, the future of technology is now; and preparing to live and work safely and effectively with AI is a shared challenge at the global level. Having said this, countries face diverse development challenges and possible futures – the development of AI competencies and the use of AI will need to account for the diversity of local contexts. The Forum debates reaffirmed the shared vision and principles of the *'Beijing Consensus'*, and went on to chart more concrete actions moving forward.

The potential of AI – including automation of low-skill tasks, augmentation of human capacities and amplification of business models – should be used for the benefit of society and for the common good. At the same time, humans should be protected from becoming victims of AI tools. Instead, AI should be a tool at our service towards a sustainable development that is economically and socially just and inclusive. That is our shared goal as expressed in the *'Education 2030 Agenda'*.

The development and implementation of ethical and regulatory frameworks for AI applied in education is therefore absolutely necessary. In fact, keeping AI under control should, by design, enable accountability, transparency and explainability. Another challenge is that AI has the power to transcend borders, making it imperative that regulations are also cross-border. The UNESCO *'Recommendation on the Ethics of AI'* is the international ethical framework that responds to these complex needs.

Humans also need to understand how to control AI. This requires a specific AI mind-set or AI literacy. While we believe in the uniqueness of human intelligence, creativity and ethical reasoning, we should help people understand the theory and practice of Artificial Intelligence. AI literacy includes understanding how AI collects and can manipulate data. It also includes algorithm literacy that comprises knowledge of how algorithms process data and control our behaviours through personalized human-machine communication.

Many countries have already acknowledged the importance of developing AI literacy from an early age. In other words, AI has to be included in school curricula, and must ensure a balance between human- and technology-oriented approaches. All young people need to be empowered to achieve higher levels of AI competence, which can best be achieved by engaging them directly in the design and implementation of AI systems. AI literacy should also be integrated into lifelong learning programmes so that all citizens understand how to interact with AI systems and make informed decisions. To achieve all this, contextual problem-solving methodologies should be adopted to develop AI competencies that can be used to solve real problems in local contexts and to serve sustainable development.

As we have seen, AI tools have demonstrated potential to support the achievement of the SDG 4 commitments and targets - including supporting inclusive education, diagnosing learning problems, augmenting teachers' learning management, and enhancing evidence-based education policy

planning. However, ICT infrastructure, especially connectivity, is the pre-requisite for this potential to be fully leveraged. To address the long-lasting digital divide and ensure that all countries and people benefit from the potential of AI, effective international cooperation is a must. More concretely, international organizations and countries leading in the field of AI must help enhance infrastructure and provide open-source AI tools and resources in the spirit of global solidarity.

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International Forum on AI and the Futures of Education

Developing Competencies for the AI Era

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