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REPORT ON GOVERNMENT ONLINE VIDEO MEETING – 17th September 2020

AFRICA SPECIAL

SKILLS & INNOVATION FOR JOBS OF THE FUTURE

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GOLA Report

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SECTION 1. Format & Participants

1.1 Introduction

The purpose of this private video meeting for government and civil society officials in Africa, organised in partnership with Intel, was to 21st century competencies and how to better embed skills and innovation into K12 education without the need to change or disrupt existing curricula. Participants were encouraged to discuss the actions of their governments and institutions, and to make policy recommendations where appropriate.

Many countries in Africa have already implemented curriculum reforms to better prepare their young people to have the right real-world skills for the 21st century. With a young population across the continent and the need to create jobs and develop entrepreneurship then the starting place is critical thinking and problem solving in schools. Recent discussions have emphasised how COVID-19 is accelerating change and the position of policy makers in education from assessment to teacher continuous professional development. This meeting of African education officials was centred around how they can integrate skills and innovation without the need to disrupt curricula or existing education infrastructures.

This event followed a natural progression of previous meetings that have highlighted the challenges and interventions in response to COVID-19, the delivery of content and necessary upgrading of ICT infrastructures, the reform of assessment and the implementation of blended learning, which the pandemic has certainly quickened. Uncertainty over the types of jobs of the future has been a part of any digital transformation discussion, yet now we are witnessing greater uncertainty and with the greater need to focus the minds of educators and policy makers to ensure we have both the appropriate technologies and the right policies for skills and innovation.

During the private break sessions of the meeting, officials were encouraged to address the following questions:

How has COVID-19 created more uncertainty of what types of jobs and skills are going to be needed in the future and accordingly what are the priorities for ensuring resilience is built into African education systems?

COVID-19 has focused minds on the certainty of blended learning in the future, but before rushing into new technologies is there a need for a rethink of what technology we are buying for education?

Can blended learning technology improve outcomes and enable higher order thinking amongst students? How are you choosing technology that can address online and have capability to address skills for jobs of the future?

Skills for jobs of the future can be ingested into current curriculums. How are you addressing this?

Given the economic pressure COVID-19 is putting on every government worldwide is the best way forward for African countries to stop being just users of technology but developers, with all the proprietary benefits. How are you addressing this in your respective countries?

For young Africans to be the next generation of developers is it necessary to start learning the skills pre-K12. So, is this in opportunity to invest more in such skills development rather than just technology without a holistic approach?

COVID -19 has created immense pressure on current education systems but how are you taking advantage of what COVID has forced you to do to get students ready for the 4th Industrial revolution?

Can you give examples of how educators are blending skills for jobs of the future with the current curriculum?

A lot of focus has been given to STEM students however how are you addressing skills for jobs of the future to students that will follow the TVET route?

1.2 Executive Summary & Key Findings of the Meeting

Developing the requisite skills in readiness for jobs of the future is a key concern of African countries. The opening statement from Hon Reginah Mhaule emphasised how the Government of South Africa has committed to skills development and made their own policy innovations such as introducing coding and robotics at the foundation grade of primary school education. The key is to invest more in innovation and to produce learners with the relevant future skills for the African continent. Veerappan Swaminathan especially emphasised the need to integrate skills without disrupting existing systems and to ensure our education systems can self-correct for future changes as we build capacity. The following are not exhaustive, but 11 important issues drawn from this meeting are:

Education policy makers have adjusted to the impact of COVID-19 with a variety of interventions by redirecting existing resources in response to the new challenges

There have been positive outcomes from the pandemic, notably greater collaboration between education stakeholders and more 'joined-up government'.

Africa's ICT infrastructure still needs considerably more investment and that includes upgrading to 4G and 5G mobile networks, necessary to cover sparsely populated land masses.

A phased approach to equipping students with the right technology and devices, appropriate to their age, experience and learning needs is essential

The often-cited resistance to ICTs for education from the teaching community is now starting to wane as we see an inevitable future of blended learning

The role of the teaching will change in the future and professional development needs to reflect the changes impacted by blended learning; though concerns remain that when budgets get cut it is training and development that feels the pinch first.

We are seeing a growing emphasis on social and emotional learning, but how does that relate to online learning when there is a loss of pedagogical connection, a lessening of the human interaction between teacher and student?

Competency-based curricula are spreading across Africa and with that necessary reforms to assessment.

Greater uncertainty of the type of jobs that will exist in the future make the integrating of skills and innovation in early education essential. Problem-solving and critical thinking are now far more important than memory and knowledge attainment.

Industry and the private sector should also have a voice in skills development

Right now, there are many new innovations and technological developments being done by young Africans. Now they need opportunity, access to markets and for barriers to entry to brought down.

1.3 Format of Video Conference & this Report

In section 1.4 we list the ninety-three participants of this video conference on skills and innovation. The most immediate lesson of online video conferencing is to ensure that every participant has a voice. Small groups are essential. So, after opening statements the event was broken into small groups each with a moderator to take notes and provide a summary.

Prior to the break-out rooms there were opening statements from: Hon Reginah Mhaule MP, Deputy Minister of Basic Education, South Africa; and Veerappan Swaminathan, advisor to the Government of Singapore and content developer for Intel's skills and innovation program. Although all discussions were recorded and transcribed for the purpose of this report, none of the quotes or what was said during the private break-out rooms is made attributable to any one person.

The following was the video conference format

Part A: Opening statements Hon Reginah Mhaule MP, Deputy Minister of Basic Education, South Africa, and Veerappan Swaminathan, skills and innovation advisor to the Government of Singapore.

Part B: Thirteen break-out groups were formed, each with a moderator to record discussions and take note of the key points raised.

Part C: All participants returned from their break-out groups. Summary and synthesis of key issues was given by Norberto Carrascal, Bienvenu Soglo and Susan Mbogo of Intel. Norberto Carrascal, Intel's Education & Public Sector Director of the EMEA region for Intel gave a closing presentation of how to empower the next generation of African innovators

The total time of the video conference was 100 minutes

After introducing the participants in 1.4, the format of this report is structured around the policy issues and non-attributable quotations. The participants hold senior positions in education from multiple countries and expressed what they are experiencing as well as their own policy recommendations.

In this report we have done our best to identify the main subjects taken from what participants said to provide a disseminated report that flows as follows:

Interventions & The Impact of COVID-19

Technology, Devices & The ICT Infrastructure

Pedagogy & Teaching

Skills, Jobs & The Economy

1.4 Participants

We would like to thank all those for participating and providing such outstanding contributions. The opportunity for them to openly converse in small break-out groups provides us with a discerning judgement on the key issues, immediate policy recommendations and their own insights into future sustainability. It is an honour for the organisers to host such a distinguished gathering. Everyone committing their time during COVID-19 is a true testament to their desire to ensure strong decision making and reform of educational practices where appropriate. Participants are listed by country, alphabetically:

ANGOLA: Aldo Sambo, Director of International Relations, Ministry of Education

BOTSWANA: Dorcas Phirie, Deputy Director for Teacher Training and Technical Education, Ministry of Tertiary Education, Research, Science and Technology

BOTSWANA: Dr Fernando Siamisang, Director, Human Resource Development Planning (Demand), Human Resource Development Council

BOTSWANA: Ravi Srinivasan, Pro Vice Chancellor (Internationalisation), Botho University

BOTSWANA: Lucky Moahi, Deputy Pro Vice Chancellor (Internationalisation), Botho University

CAMEROON: Dr Lucas Agwe, Regional Coordinating Inspector, Southwest, Ministry of Secondary Education

CAMEROON: Chief Celestine Fozao, Regional Pedagogic Inspector, Buea, Ministry of Secondary Education

CAMEROON: Dr William Shu, Public & Alumni Relations Officer, Buea University

CAMEROON: Dr Alain Vilard Ndi Isoh, Dean of the Faculty of Business Management Studies, ICT University

COTE D'IVOIRE: Sylvie Tanflotien, Consultant at the Ministry Integrating Technology in Education, Ministry of National Education, Technical Education and Vocational Training

COTE D'IVOIRE: Aboubacar Coulibaly, Director of Information Technologies and Systems (DTSI), Ministry of National Education, Technical Education and Vocational Training

EGYPT: Ingy Abass, Business Consumption Egypt, Intel Corporation. *Moderator*

ETHIOPIA: Solomon Shiferaw, Adviser to the Minister, Ministry of Education

ETHIOPIA: Dr Zelalem Assefa, Director General, Ministry of Science and Higher Education: Ethiopian Education and Research Network

ETHIOPIA: Dr Diriba Eticha, Directorate Director, Transformation and Good Governance, Adama Science and Technology University

FRANCE: Annemijn Perrin, CEO, Digital Skills Foundation. *Moderator*

GHANA: Akwasi Addae-Boahene, Chief Technical Advisor, Ministry of Education

HUNGARY: Adam Collis, Cofounder & Director of Innovation, Catalyst & GOLA Founding Partner. *Moderator*

INDIA: Krishen Sanjay, IT@Intel - Regional Director, Asia Pacific & Japan, Intel Corporation. *Moderator*

KENYA: John Kimotho, Director Educational Media, Kenya Institute of Curriculum Development. *Opening Speaker*

KENYA: Dr Katherine Getao, CEO, ICT Authority

KENYA: Suraj Shah, Lead, Regional Centre for Innovative Teaching and Learning, MasterCard Foundation

KENYA: Susan Mbogo, Public Sector Director, Intel Corporation. *Moderator*

MOROCCO: Elarbi Imad, President, Moroccan Centre for Civic Education

MOROCCO: Halima Benramadane, Community Manager in charge of Information Monitoring at GENIE Program, Ministry of National Education, Vocational Training, Higher Education & Scientific Research

NAMIBIA: Dr Elizabeth Ndjendja, Member of Council of Namibia Qualifications Authority, Ministry of Education, Arts & Culture

NAMIBIA: Rauna Ndinoshiho, Deputy Director National Examinations and Assessment, Ministry of Education, Arts & Culture

NAMIBIA: Maurice Nkusi, Acting Director Teaching and Learning Unit, Namibia University of Science & Technology

NIGERIA: Prof Yakubu Ochefu, Secretary General, Association of Vice Chancellors of Nigerian Universities

NIGERIA: Prof Edward Omudu, Deputy Vice-Chancellor, Benue State University

NIGERIA: Peter Aroge, Director, Entrepreneurship Development Centre, Bingham University

NIGERIA: Vivienne Bamgboye, Principal Consultant, Oye Centre for Learning & Development

NIGERIA, LAGOS STATE: Iyabo M. Seriki-Bello, Director, Ministry of Wealth Creation & Employment

NIGERIA, OSUN STATE: Gbadebo Adenle, Special Assistant on ICT and Innovation to the Commissioner, Ministry of Education

RWANDA: Emmanuel Mucangando, Advisor to the Minister of State in charge of Primary and Secondary Education, Ministry of Education

RWANDA: Dr Christine Niyizamwiyitira, Head of ICT in Education Department, Rwanda Education Board

SENEGAL: Aminata Lo, Teacher Trainer - SIMEN, Ministry of National Education

SENEGAL: Maïmouna Soudé Souare, Elementary School Inspector, Education Planning and Reform Direction, Monitoring and Evaluation Division, Ministry of National Education

SOUTH AFRICA: Seliki Tlhabane, Chief Director for Curriculum & Quality Enhancements Programmes, Ministry of Basic Education

SEYCHELLES: Xavier Estico, Chief Executive Officer, National Institute for Science, Technology & Innovation

SEYCHELLES: Manfred Laporte, Principal Research Officer, Knowledge Management and Education, National Institute for Science, Technology & Innovation

SIERRA LEONE: Denzil Crowther, Chief Technology Officer, Ministry of Basic and Senior Secondary Education

SIERRA LEONE: Victor Abu Sesay, Director of Technology and Innovation, Ministry of Tertiary and Higher Education

SIERRA LEONE: Abass S Kamara, Deputy Secretary, Ministry of Information and Communications

SIERRA LEONE: Nyakeh B Yormah, Chief Technology Officer, Ministry of Information and Communications

SIERRA LEONE: Mohamed M Jalloh, Ag Director of Communications, Ministry of Information and Communications

SINGAPORE: Veerappan Swaminathan, Advisor to Government of Singapore & Founder of Edm8ker

SOMALIA: Dr Abdullahi A Omar, Senior Advisor Ministry of Education, Culture and Higher Education

SOMALIA: Abdiqani Ahmed Wayel, Permanent Delegation to UNESCO, Ministry of Education, Culture and Higher Education

SOUTH AFRICA: Hon Reginah Mhaule, MP, Deputy Minister, Ministry of Basic Education

SOUTH AFRICA: Seliki Tlhabane, Chief Director for Curriculum & Quality Enhancements Programmes, Ministry of Basic Education

SOUTH AFRICA: Dr Mark Chetty, Director – National Assessment, Ministry of Basic Education

SOUTH AFRICA: Veronica Hofmeester, Director: Continuing Professional Teacher Development, Ministry of Basic Education

SOUTH AFRICA: Elspeth Khembo, Director: Mathematics, Science and Technology, E-Learning and Research, Ministry of Basic Education

SOUTH AFRICA: Dr Neo Mothobi, Chief Education Specialist, Ministry of Basic Education

SOUTH AFRICA: Phozisa Nqadolo, Deputy Director: International Relations and Multilateral Affairs, Ministry of Basic Education

SOUTH AFRICA: Dr Nokulunga Ndlovu, EDIET Division, School of Education, University of the Witwatersrand

SOUTH AFRICA: Sven Beckmann, Emerging Markets Director, Government & Education, Intel Corporation. *Moderator*

SOUTH AFRICA: Bienvenu Soglo, Government & Policy Director Africa, Intel Corporation. *Moderator*

SOUTH AFRICA Joao Fidalgo, AE Business Consumption SADC, Intel Corporation. *Moderator*

SOUTH AFRICA: Hannes Steyn Business Consumption South Africa, Intel Corporation. *Moderator*

SOUTH AFRICA: Nitesh Doolabh, Consumer Sales Manager, Intel Corporation. *Moderator*

SOUTH AFRICA: Nathan Reddy, IT Consumption Africa, Intel Corporation. *Moderator*

SOUTH AFRICA, GAUTENG: Handson Mlotshwa, Director: Teacher Development & ICT Programmes, Department of Education

SOUTH AFRICA, MPUMALANGA PROVINCE: Michelle Tebeila, Director: Management Information and Technology, Department of Education

SOUTH AFRICA, MPUMALANGA PROVINCE: Joyce Strydom, Deputy Chief Education Specialist: Business Studies, Department of Education

SOUTH AFRICA, MPUMALANGA PROVINCE: Thandiwe Thwala, Deputy Chief Education Specialist: Quality Assurance, Department of Education

SOUTH AFRICA, MPUMALANGA PROVINCE: Nancy Mahlalela, Deputy Chief Education Specialist: Inclusive Education and Career Guidance, Department of Education

SOUTH AFRICA, MPUMALANGA PROVINCE: Deon van Vuuren, Curriculum Branch Coordinator, Department of Education

SOUTH AFRICA, MPUMALANGA PROVINCE: Bongani Mabena, IT Specialist, Department of Education

SOUTH AFRICA, MPUMALANGA PROVINCE: Kate Groch, CEO, Good Work Foundation

SOUTH AFRICA, NORTH WEST PROVINCE: Dr Jacob Tholo, Chief Education Specialist: Quality Promotion, Department of Education

SOUTH AFRICA, NORTH WEST PROVINCE: Nomusa Keninda, Senior Education Specialist: eLearning in Education, Department of Education

SOUTH AFRICA, NORTH WEST PROVINCE: Justice Tyobeka, Senior Education Specialist: Teacher Development, Department of Education

SOUTH AFRICA WESTERN CAPE: Christelle Barkhuizen, Chief Education Specialist Capacity Building and Implementation, Department of Education

SOUTH AFRICA WESTERN CAPE: Gail Ahrends, Senior Education Specialist, Assessment Management, Department of Education

SOUTH AFRICA WESTERN CAPE: Chasfrend Ahrends, Deputy Chief Education Special Schools, Department of Education

SOUTH AFRICA WESTERN CAPE: Ismail Teladia, Senior Curriculum Planner: Life Orientation/Life Skills, Department of Education

SPAIN: Norberto Carrascal, Education & Public Sector Director, EMEA Territory, Intel Corporation. *Moderator*

TANZANIA, ZANZIBAR: Omar S Ali, Director of ICT in Education, Ministry of Education and Vocational Training

TANZANIA, ZANZIBAR: Khalid M Wazir, Director of Policy Planning and Research, Ministry of Education and Vocational Training

TANZANIA, ZANZIBAR: Khamis Said, Director of Madrasa Early Childhood Program, Ministry of Education and Vocational Training

UGANDA: Bernadette Nambi, Deputy Director, National Curriculum Development Centre

UGANDA: Angela Kyagaba, Senior Curriculum Specialist, National Curriculum Development Centre

UK: John Glassey, CEO, Brains Global. *Host*

UK: Claire Urie, Head of Government & International Relations, Brains Global

UK: Victoria Tate, Head of Education Partnerships, Brains Global

ZAMBIA: Milner Makuni, Director - Policy and Planning, Smart Zambia, Office of the President

ZAMBIA: Moses Phiri, Assistant Director - Policy, Ministry of General Education

ZAMBIA: Delice Chishinga, ICT Officer, Smart Zambia, Office of the President

ZIMBABWE: Peter Muzawazi, Chief Director, Junior, Secondary & Non-Formal Education, Ministry of Primary & Secondary Education

ZIMBABWE: John Dewah, Chief Director, Curriculum Development and Technical Services Department, Ministry of Primary & Secondary Education

DISCUSSIONS

SECTION 2. Discussion

2.1 Opening Statements

The opening statements were provided by Hon Reginah Mhaule MP, Deputy Minister of Basic Education, South Africa; and Veerappan Swaminathan, advisor to the Government of Singapore and content developer for Intel's skills and innovation program.

Hon Reginah Mhaule MP

The Deputy Minister passed on her greetings of the Government of the Republic of South Africa, headed by President Cyril Ramaphosa, and the Minister of Basic Education, Hon Matsie Angelina Motshekga. The government wishes to learn from their peers on how to navigate public schooling in the context of the global pandemic and recognises how COVID-19 can be a catalyst and accelerator of changes in the education sector. The new social compact must be anchored in the universal roll out of e-learning. Furthermore, the pandemic has truly highlighted the need to bridge the digital divide once and for all. This means the re-imagination of the whole delivery of basic education, its management, and its monitoring. And in South Africa they have developed a phased approach to the re-opening of schools.

The government is mindful of the reality, as confirmed by research, that the longer marginalised children are out of school, the greater the learning loss. Accordingly, schools are also sites of health, hygiene, nutrition, and public advocacy around public emergencies like COVID-19. The includes psycho-social support and the resuming of key health-related programs including nutrition and hygiene that were in place prior to lockdown. It remains a calculated risk of educators to not just rescue the 2020 academic year, but to also save the education of a whole generation.

Research from Stellenbosch University suggests that without a rigorous catching up of the skills of students then we will witness a significant lowering of grades and performance that could take up to a decade to recover from. In contrast, if done right then learning loss can be recovered far more quickly. Hence, the government resolving to gradually re-open schools by grades. Of course, this is a public policy decision that is not without risk. COVID-19 in South Africa, and in general worldwide, shows that school levels of infection reflect the infection rate of the country as a whole and in South Africa there has been a high rate of infection amongst teachers.

The Deputy Minister was happy to report that all indications in South Africa are that the worst is over; they have faced the storm and are now beyond peak COVID-19. However, the country still carries the highest rate amongst SADC [Southern African Development Community], yet thankfully a fatality rate much lower than the global average. The government still calls upon the people to observe the necessary hygiene, sanitation, and social distancing protocols.

Prior to the pandemic the President, HE Cyril Ramaphosa had announced the government's policy to tackle the digital divide and in the next 6 years will provide every school child in the country with devices (tablets and laptops) containing the core curriculum materials. In the early stages of implementation, the government made it a priority to roll-out digital workbooks for multi-grade schools, rural schools, and those with special educational needs. They further committed themselves to ensure that the interests of learners with the "Disabilities Act" to effectively mainstream across all schools – in line with their mission to ensure that no child is left behind.

Instead of COVID-19 delaying plans to develop skills within education, ready for the 4th industrial revolution, it has brought haste to the government's activities, including bringing in new learning materials with the endorsement of UNESCO and implementing the innovative Teacher Connect Platform that integrates with the health checks of the South African Department for Health. Teacher Connect is a one stop digital solution for teachers and students to accelerate the delivery of blended learning in the country, by providing content, support resource, mentoring and as a communication platform between the learners and their teachers – with tracking through a real-time dashboard.

The government has also launched a free-to-air TV initiative to support the class of 2020 during these uncertain times. It is free on DSTV and a catch-up app is available to every South African via the public broadcaster SABC.

Most school have now adopted ICT for education to assist learners. This includes the provision of tablets, laptops, and access to teaching resources. For example, in the Northern Cape they have developed support packages for all subjects in all grades by providing parents or caregivers the necessary learning materials. This includes utilising local radio that plays a vital role and ensuring over the next 5 years further investment is made into the ICT infrastructure. The Government of South Africa intends to eliminate the digital divide by ensuring that all schools and education officers have access to the internet and free data. They are working hard to ensure that all learners are provided with digital learning materials on devices and especially focussing on the most disadvantaged schools in the most impoverished communities. In the medium term they plan to introduce ten new types of focus schools, incrementally throughout the country to offer new subjects and new skills relevant for the real world. These will include IT skills, high tech, coding, and robotics – supported by the implementation of a curricula that focuses on skills and competencies for a rapidly changing world.

The Department of Basic Education has finalised the curriculum for coding and robotics for higher grades and is also working with stakeholders to ensure that the education system is improved to reflect the necessary skills required for the future. At the heart of skills and innovation for jobs of the future is the commitment to digital literacy and entrepreneurship, with the latter being included as a subject for students. The framework on entrepreneurship in education was launched in January 2018 and subsequently they developed the requisite teacher training program which began in 2019. In conclusion, South Africa is committed to continued investment in basic education as a catalyst for economic growth, which is integral to the sustainability of their democracy and economic development. Equally, they wish for all African countries to do more and invest more in innovation and to produce learners with the relevant future skills for the continent. This commitment to skills and innovation will take Africa to greater heights.

Veerappan Swaminathan

The opening statement of Veerappan Swaminathan is in conjunction with the presentation as per appendix A.

Veerappan used this opportunity to share some of the key findings with respect to the practical integration of skills development within the national education system of Singapore. COVID-19 is fundamentally accelerating change in education, and this means digital transformation whereby new skills are going to be needed in the future. The key question is how we can we ensure that our young people currently in education, become the next generation of technology developers rather than just being users. Of course, this requires reform and a focus on skills development, but when it comes to implementation the devil is in the detail. There are three questions to address:

What kind of skills?

How to integrate skills without disrupting existing systems, especially in the context of stakeholders, from teachers to parents

How we live in a place or system that can self-correct for future changes and accordingly how we build capacity to regenerate and re-orientate for the future.

As show in the World Economic Forum's 2022 Skills Outlook [slide 5], it is clear the top growing skills are essentially innovation and higher order thinking and we are seeing increasing emphasis on social emotional learning as well as technological skills. Declining skills such as manual dexterity and memory are still key components of existing primary and secondary education.

A useful way of thinking about skills for the future is to segment them into three areas: social emotional; mindsets; and technology skillsets. In the case of the Singapore Ministry of Education they have used the concentric circle approach [slide 6] with core values at the heart surrounded by self-management, self-awareness, relationship management, responsible decision-making, and social awareness. These become central to the foundation of the

skills development framework. Elements such as technology, critical and inventive thinking, communication and collaboration, civic literacy and cross-cultural skills form the outer circle. Hence, it is important to consider social emotional learning as the starting point for skills development rather than something that is added on as an extra to the curriculum framework.

The next question is how to integrate skills without causing disruption or pushback. From the mapping of skills to curriculum activities [slide 8] we can see that the path of least resistance is to integrate within existing curriculum, in terms of teacher workload; but we have to choose activities that have students performing self-analysis, evaluation and creativity. The higher order thinking skills are as Bloom's taxonomy. This means we must create new activities and leverage the role of technologies to create the ideal learning environment. For example, in India they followed the Singaporean model. The computational thinking skill [slide 9] is something that was deemed as quite important from the whole of government standpoint and the original concept was that it would want to deliver this combination of thinking skills outside the curriculum. So, what the government did was to provide a whole variety of afterschool options for schools to opt into. Now, while there was some interest and take up by schools, many schools declined to take up this approach, and only had a special group or small group students in a school undertake computational thinking skills. Teachers were feeling like they had to compete for precious instructional time with what they deemed as non-core activities, non-examinable activities. So, the approach has been modified into integrating computational thinking within subjects, and in particular, the mass syllabus. Now, the other thing that happened was that with introduction of computational thinking within the mathematics syllabus, you'll also find that this subject, which many students, obviously seems to be very abstract and boring, has suddenly become much more exciting as soon as a much more engaged in the process.

Now touching on the final question of how to ensure the system has self-correction for the future built within it. We cannot be overhauling policy all the time, so must find a way to ensure adaptability and resilience into the education system. One way this can be done is to introduce a culture of lifelong learning which in Singapore has been a crucial element in the country's national human resource development. The mathematics learning policy is now very comprehensive and coordinated through several ministries including education and manpower as well as the largest trade union in Singapore. Such a cultural shift will not happen overnight, and the policy was put in place five years ago with expectations that it would take about a decade for the policy to manifest itself in tangible outputs.

Regarding the lifelong learning framework, there are two elements viewed as key enablers [slide 11]. The circular diagram on the left-hand side shows technologies for learning and the capability of learning to learn. Such a lifelong learning policy is not just something that happens at the school level, it also needs to translate into workforce level, or at the later workforce, or even, semi-retirement or middle working life situation. So, in fact, a lifelong learning policy can even look like this, that somebody continuously comes back to school repeatedly, every couple of years, until they retire.

So, to put it all together, the tricky questions, are something useful to consider. We must think about how to integrate skills within education system, we must involve the whole of system in the process. This means policymakers, school leaders, teachers, and many other stakeholders who have a very important role to play. When it comes to change, as experienced in Singapore was to supplement first. The idea of supplementing first is to figure out where the opportunity is and to introduce new changes in a way that supports some of the activities that are already ongoing, and then over time, supplanted with something better. If we try to change all things overnight, it will tend to create a lot of resistance, a lot of pushback by different parties along the process. These approaches are embedded in an overall skills and innovation program.

2.2 Interventions & The Impact of COVID-19

COVID-19 has certainly exposed the preparedness of educational systems in Africa and policy makers are now saying, of course they knew of how technology is disrupting education but the speed in which the pandemic has demanded change has taken everyone by surprise. So how do we make adjustments, what subjects are going to need to be refined, how much course content should be reduced and how much capacity is in the teaching profession? For example, in Nigeria, the Federal Ministry of Education determined a policy that all schools should go online. Yet, because of basic technology challenges, infrastructure challenges, and the capacity of the teachers, were not able to do so. So, adjusting is proving difficult and they have not yet decided what they want to prioritise in terms of subject matter and what will be the way they are going to teach in this new environment.

COVID has seemingly brought with it a realisation to have better 'joined up government' – to think as a

system across departments from education to health to commerce and ensuring a more multi-stakeholder approach. In developing entrepreneurship and innovation then the curricula also need to have social emotional and behavioural considerations at the core and not just an afterthought. This brings education policy makers in greater connection with national socioeconomic needs.

The critical challenge experienced during the time of COVID-19 is also the issue of learners in remote areas. In deep rural areas, or in remote areas, there is an issue of connectivity and the availability of content. This has meant building partnerships with TV broadcasters whereby learners can access scheduled educational TV programs. This ensures that the governments are as inclusive as possible and do not exclude those learners in remote areas.

In Ethiopia, the Ministry of Education and Ministry of Science & Technology have been working aggressively on their COVID-19 response, in harmony with the Ministry of Health, several innovation and research activities have been carried out and they still are conducted by the universities. Such responsiveness has been based on research and to provide technology and innovative products to the public. Resources have been extensively used for COVID mitigation. For examples, universities are being used as treatment or testing centres. This is an important contribution made by the higher education institutes. Ethiopia has over 46 public universities and over 200 higher education institutes. The ministry is mainly engaged in such COVID response and to utilizing their intellectual experience that includes establishing a national COVID mitigation task force.

In Botswana, when COVID-19 struck, they were in the process of upgrading their local area networks; meaning the system is still underdeveloped in terms of utilising technology and best practices. As well as the infrastructure issues, there remains concern of the social and emotional condition of those within education. The teachers, the lecturers have a lot of anxiety, the learners themselves have a lot of anxiety and the home environment itself may not be very stable. So, as we move forward to embrace technology and ask how technology can improve accessibility, we need to make sure that everyone is a part of this picture. The big issue is how do we maintain the mindset to remain focused in a positive way on what people can still do with their existing tools? It is the new skills that we must really strengthen now.

In Sierra Leone, even before COVID, they have been trying to push their universities and technical institutions to go digital. The ministry for tertiary and higher education is now looking at the implementation of campus management systems. What COVID has done now is to emphasise the need for greater technical applications and to make sure the administrators utilise technology to better manage and communicate. Away from the campuses, they found there are a whole range of challenges, such as bringing some lecturers up to speed technology. In Sierra Leone they have zero-rated online academic resources. The problem is how do you retain all of these academic materials? In addition to the fundamental problem of content creation and digitising the content for students. They are building learning management systems for TVET, yet the main challenge remains ensuring lecturers are aligned with new technologies. The students are doing very well. They are quick to catch up with changes. One idea is to fit very sensitive inconspicuous microphones for a lecturer who may not be too comfortable at creating their own content, so when delivering a lecture, it will be captured and automatically live streamed.

The ICT authority in Kenya has deployed technology in just under 22,000 primary school across the

country and manages over 9,000 km of fibre optic networks. The Good Work Foundation in South Africa works closely with the government and spends a lot time in bridging the gap between education and work which involves looking at the journey of a young person in school all the way through to job readiness. Under the principle that one only knows what they do and do not like once they have experienced it, means reaching out to as many students as possible and hence having over 10,000 children participating in programs.

In Zanzibar they have been using technology to specifically prepare educational TV and radio programs, along with establishing an entire radio station specifically for education. They have also established a new e-learning platform and developing assessment whereby the students can complete assignments at home. In collaboration with the World Bank the ministry of education is also planning the framework for a virtual learning environment to enable students and teacher to better integrate with technology.

In Zimbabwe, their education reforms have already embedded a competency-based curriculum, which comes with the realisation that such curricula must be supported by a competency-based assessment framework. Digital skills are already part of the menu, yet there is a sense they will be even more pronounced post-COVID, because of children having to learn from home and because parents need to be more engaged in their education.

The impact of COVID-19 has seen some very positive outcomes, especially in terms of collaboration amongst education stakeholders. Initial resistance to the use of ICTs in education has given way to greater acceptance and allowed for ministries of education to incrementally implement changes and encourage teacher collaboration through shared experiences of how to apply the new technologies. Equally, it is important for the policy makers to demonstrate the benefits of leveraging the platforms for better communication as well as the feedback mechanisms that much of e-learning can provide. This is helpful to the learners who, for example in assessment, can get instant feedback which then encourages them to want to learn more in a way that allows further adoption of skills for their future employment.

2.3 Technology, Devices & The ICT Infrastructure

With policy makers moving to more blended learning programs, time and resources need to be invested in digital skills and especially the ICT infrastructure. With the true state of online connectivity exposed for what it is in many parts of the world, governments must surely now be looking at far more robust partnerships with the telecommunications operators. After all, a truly equitable and well-connected education system with greater use of devices can only be of benefit to the operators and hence their collaboration and contribution is essential.

In terms of mobile connectivity, mapping across Africa, the largest networks remains 2G which simply is not good enough to access the internet and particularly use applications such as e-learning platforms. 2G remains predominant with 3G and 4G only concentrated around urban areas. Integrating technology into education is wonderful but a big problem remains if one looks at the current situation of connectivity across Africa. There is no shortage of innovation in many countries, such as mPesa in Kenya that exactly solves the problem of people not having bank accounts.

When considering technology in education, we need to think of something sustainable and it needs to be embedded into educational policies. The policies need to be strategic and any revisions must have outcomes well-defined along with encouraging creativity and innovation. Ultimately, this is about encouraging African students to embrace a culture of innovation and do so in a manner that is relevant to their local setting. Everything starts with the design of curricula and implementation then helps us decide what students can do with new technologies.

In terms of the infrastructure, many African countries may need to work harder on leveraging lo-tech, like low technology in terms of using the features on basic mobile phones. That is how in Western Cape, for example, they are trying to reach as many families and as many students as possible, by taking the content and making a summary in terms of small SMS messages that are then followed by a quiz. Students can log on using their ID and then they can choose a topic and read two to three messages that explain the topics and then further messages giving details of the specific topic. In terms of the access, like paying for the fees, the government has collaborated with the telecom companies in the country and they have zero-rated such services.

Putting aside connectivity issues, equipping students with the right kind of device, appropriate to their level, the curriculum and the desired learning outcomes is essential when keeping up to speed with the rapid changes of the 4th industrial revolution. Learning off the phone is very limited; a larger device like a tablet will be conducive at times but when implementing coding, robotics and expecting the right kind of skills for the future then considerations run much deeper into the likes of processing power,

battery and storage capacity etc. A good standard of laptop or notebook is preferable but there is a noticeable jump in unit cost when going from the tablet to the laptop and this makes it prohibitive for governments when considering large scale roll-outs to their student populations. That said, a phased approach, as seen in Kenya, and working with the manufacturers to encourage local assembly in Africa can make a real difference to pricing and project management. What we do not want is to equip the kids with the wrong type of device that simply does not deliver on the skills and innovation outcomes expected. Such projects end up becoming huge white elephants.

In Kenya, where the digital literacy program is now well-established, there remains a disconnect between the technology they are introducing and aspects of education policy. There is also an issue over how governments can quickly respond such as when introducing devices for students at school in the event of prolonged school closures as witnessed during COVID-19. can the ministry of education respond quickly enough to allow those same students to take the devices home? If not then the laptops and tablets remain sitting in cupboards at school, while kids are sitting at home with no access to technology and no ability to log into the services that provide educational content.

There is a huge debate around issue of deployment of technology in education, where one school of thought says do not deploy these technologies in schools until you have trained teachers and another school of thought that says we already have IT support inside of the classroom, because the very same learners are the ones who are going to show teachers how to use these things. The youth are born with technology as part of their DNA. So, we need to support the view that says this, give young learners the space, and then we are going to see amazing things coming out of them.

In a wider context technology is often a race and this does not sit well with the infrastructure of education systems. Education is not a race and cannot possibly be expected to keep up with technology. Yet while even the most developed countries are still trying to determine best practices and measurable outcomes of integrating technology into education, in Africa countries are lagging behind in terms of infrastructure and this results in efforts to integrate technology often being a hinderance to learning. It is important to ask the question of how we can create competencies and the kind of skills that are required to use technology in education. We need to create capacity, and competencies for teachers and for the policymakers and for everybody who works in education before integrating technology into education. COVID-19 is now impacting how policy makers are thinking about the business of running education, in a way they maybe have not before. In Ghana, they think that there is a need to reflect carefully on what they are doing in education and to make sure that they build a resilient system that can withstand future pandemic. This pandemic has exposed us, yet has given us an opportunity to lead and to challenge ourselves, to begin to look at ways in which we can address the technology gap equity issues that are associated with the use of technology.

Importantly if one looks at the devices that are available right now, they are not designed for education. They are not education specific devices. So maybe we need to look at education specific devices. We need technology that is meant for teaching and learning. Furthermore, in discussing skills development we need to look at soft skills, because COVID-19 has shown us how important this is. There is a long list of requirements for what is needed in a purpose-built device for education. That requires a very specific dialogue. Bearing in mind certain technologies have a short lifespan and then are obsolete, to be superseded by the latest innovation.

For those countries who have implemented coding into earlier years education they are now beginning to witness the possibilities within the classroom, especially changing the mindset of most of the teachers. But now one can see that everything is moving to online. The biggest challenge remains the sluggish networks, especially when needing to train teachers with online tools such that they can be user friendly in the classroom. Maybe they will have the devices in the teacher training centres but when teachers go back to their schools, they have problems connecting with their devices.

So, one of the programs introduced in Mpumalanga, South Africa, is an to bring ICT into the professional learning community specifically for teachers who want to learn ICT in their own time. Still the realisation comes that with current workloads teachers do not have time, so it requires designing change management within their school so that they can put aside time to learn more of the disrupting technologies.

In Rwanda they have noticed how COVID has drawn their attention to what kind of devices the students are using while at home and thus how this will impact on the decision of the government of exactly what they are installing in their schools. Where learners

are concerned, they have been mostly working with mobile devices rather than laptops and computers. Cost is definitely a factor behind this, but also more smartphones are available for learners in poor and vulnerable communities than laptops. These youth are also the generation of swiping; they do not want to type, they swipe.

The feedback they are getting in Nigeria is that the smartphone is something that the kids will always have access to and then is easy to charge in an environment where there are challenges with access to reliable power supply. Furthermore, the data that is from the mobile operators is also a lot more affordable than buying a desktop or a laptop to service the entire family. Thus, cost and availability are the core drivers of using mobile.

Regarding the procurement of the technologies for education, before such acquisitions it is necessary to contextualize the current education and technological environment, taking into account teachers, learners and the curriculum involved. Then secondly, we also need to review the two modes of learning: the physical one, and remote learning and accordingly what works best under which conditions. Thirdly, there is also need for consideration of the shift from academic competencies to skills competencies.

In South Africa, the provincial departments of education interpolate policy from the national level in terms of what informs the programs to be developed, based on the needs analysis carried out prior to developing programs. What they have experienced in South Africa is that the political will has been translated from a policy perspective into supporting the use of ICT in education. Gauteng Province already had a program that rolled out digital resources to about 500 schools and the teacher development was to provide some sort of intervention, so that the resources that are deployed to these particular schools do not become white elephants. With COVID-19 they discovered that there was a greater need from teachers requesting training around digital skills or on the use of productivity tools, such as Word documents, Google Classrooms, and other learning platforms. With regards to coding and robotics, they have been negotiating the teacher training schedule with the unions and in light of COVID-19, the teaching unions recommended that for this particular financial year, they should not go ahead with the coding and robotics, because it was seen as something in addition to the curriculum delivery, as something not examinable.

In terms of technological adoption, several meeting participants spoke of how, while devices were rolled out, they experienced some sort of resistance, initially. Teachers did not want device-oriented training, but rather something that will speak to their practices in the classroom, or what they are required to do in order to deliver the curriculum. This means reworking programs which are device oriented. With COVID-19 one can identify three main objectives in this regard: curriculum coverage and recovery time; enabling students to progress and addressing the psychosocial issues caused by the impact of COVID-19.

Although Rwanda has made great leaps in its digital transformation and infusing of technology in education, like all other countries, COVID exposed the ICT infrastructure and inequity of connectivity, thus requiring the use of TV and radio for the delivery of content. So, the pandemic has made the ministry of education see things differently and the need to be innovative, especially in serving those students in more remote areas. The key to this is engaging with the community and try to ensure that they are involved in helping the ministry to make sure a digital divide does not open-up.

Cameroon is another country in which the government has been implementing technology into the learning process and incentivising with prizes for young people and career progression opportunities. Still the main problem remains the ICT infrastructure and equitable access to online platforms. Greater collaboration with the telecommunications industry to increase bandwidth is called for to allow more robust implementation of e-learning technologies.

The sparsely populated Namibia is also encountering problems in overcoming the challenge of incorporating technology in education because of such a vast area with an unevenly distributed ICT infrastructure. The e-learning platforms and facilities are much stronger in the private schools in urban areas and the government is keen to bring greater equity to the system. Yet as well as thinking about technology in schools they know that the upskilling of teachers in the public schools is necessary to ensure the right pedagogical principles are applied when implementing ICT for education.

When the President took office in Sierra Leone, he immediately prioritised digital transformation and to drive the process within education. The challenge remains connectivity and the Ministry of Information and Communications has been actively engaging with contractors and operators to get schools connected to digital services.

In Nigeria they have also introduced coding and robotics, and with that have their holistic considerations have been on three levels: making sure the teachers have the required knowledge and understand how to teach it in an enjoyable way; having the access to technology; and thirdly the cost of technology itself. Pedagogically, they have found that it is about breaking down the knowledge of STEM education into steps that the students can embrace for themselves, to make it interesting in terms of taking the knowledge out pf the classroom. This may involve coding and the using of applications that can be downloaded and applied any time. The policy of government is to ensure that the technology is available. In Osun State they are proposing to have about 35,000 tablets distributed to secondary school students along with the assets and applications to develop ideas themselves.

The Western Cape Education Department in South Africa has been providing hardware to schools, computer liberties and training since 2001 Teachers were trained how to transfer skills and knowledge to learners. In the last five years they have embarked on an extensive program of installing broadband connectivity in every school in the Western Cape, ensuring all schools have access to the Internet, along with the necessary computer technology. When COVID-19 struck, they realised that although they had the technology, much more was needed in applying the technology in how to use it to transfer skills and knowledge. They learnt that the device most appropriate for the students was one in which they could transfer data seamlessly to a learner wherever they are. So, if we enable the learner with a particular device, with the necessary data, then we can start using that as a vehicle to transfer new computational thinking. In the Western Cape, they have made good progress in putting a technology and connectivity footprint down, but now must use it to transfer the skills and knowledge.

2.4 Pedagogy & Teaching

The role of the teacher has evolved from being the one in control, 'the smartest person in the room' to witnessing the uptake of technology and with that losing the attention of students in the class and losing that element of control. Now teachers are bringing the curriculum in terms of informing the students what they must master, but in terms of content and projects the work is collaborative and requires problem solving as a team. The teacher brings maturity and wisdom, the student brings energy, vitality, and the desire to learn new research skills. Teachers becoming coaches. Accordingly, the teacher training institutions have to change and even the word teacher might be deemed old fashioned.

Simultaneously we need to be very careful not to make teachers feel bad, or for teachers to feel demeaned by the technology as it is important to respect them as professionals. Teachers need to be brought along and encouraged in the benefits of technology. This means the assurance that technology is not here to replace teachers, but to complement them. Technology is only a tool, the same tool as when using a textbook, this time the tool is digital. So, it is important that we put in place strong change management programs, both for teachers, and school leaders.

All participants spoke of their expectations of how online and blended learning is going to be a permanent feature of education service delivery and thus teacher training and continuous professional development is critical. We need to adapt training and pre-service qualification such that online learning and virtual lessons are included in the curriculum of teacher training colleges. Fundamentally, teachers are trained to teach in a physical setting and so new initiatives are required to ensure professional development in online pedagogy and assessment.

In terms of adopting more blended learning, th policy makers are asking how do they want teachers to use all the different online platforms? How do you give teachers both the skills and capacity to translate content that was supposed to be for face-to-face? How do you train them with the skills to do it online? A key element of such blended learning requires also that learners become independent and adapt to managing themselves. So, ministries of education now need to train all teachers to use blended

learning without relying on face-to-face training interventions.

COVID has made the governments in Africa re-think about how they offer education and particularly the fundamental changes and disruption that blended learning will bring to the teaching profession. There must be some kind of ICT for educators which includes the development of materials for teaching through digital platforms, virtual learning environments and the preparation of video classes. All requiring a different kind of approach and pedagogy than face-to-face classroom teaching.

Importantly, the requirements of blended learning will need better evidence-based research on the types of devices. In South Africa, they appreciate this issue in that while they are looking at all the devices or platforms that are available, because one cannot say upfront that in a particular area learners only have cell phones and in other areas learners have access to more platforms. So, the intention is to provide them with the skills to use all types of platforms, ensuring that wherever the learner is they not excluded. The important part is that sometimes as teachers, we may focus only on the knowledge and not the skills and it is necessary to shift from that with a combination of knowledge and skills.

Another issue is quality control and quality assurance. For example, where you have a blended learning format how do you record your lecture? In what environment are you recording the lecture on? What is the quality that you are uploading for the students to use? They found this in Zambia, where they had issues with teachers who did not have the proper facilities to record their lectures with a quality that is clear and appropriate for their learners. Another feedback they found is that in a blended learning environment the teachers are under much greater scrutiny from everybody than in the normal face-to-face environment. The students can applaud or make fun of the teacher, so there may be a reluctance in some circles to adopt blended learning – resulting in them waiting for the classrooms to open again. Some may not want to put themselves out there because everyone can see how good you are, or how bad you.

In terms of educators blending skills with the current curriculum, in the Western Cape they are giving teachers basic tips and tricks with software related apps that they can use to change over to remote teaching and learning. Also, this requires supporting parents who must deal with the learners at home; parents who are not teachers or have a teaching background. They have published a website for those parental skills. Equally such tips are available for the learners.

In South Africa they have the national policy framework for professional development of teachers encompassing digital learning, which highlights about 18 core competencies that teachers need to achieve in their understanding of ICT for education. Prior to COVID-19, they were conducting roadshows and workshops, to support teachers in digital learning. The private schools in South Africa are mostly well established in terms of ICT implementation in their schools, and so the government has also tried to bring the public schools on board so that they can also appreciate the use of digital tools in teaching. This includes showing teachers how to use and how to share content in an engaging format, using your ICT platforms like Moodle or Google Classroom and Microsoft Teams. An important factor is not to separate technologies, i.e. not to view technology as a separate thing, but to integrate it within teaching so as to achieve the curriculum goals.

With the advance of digital transformation and the growing role of technology in education, then the question is how much will this bring automation to the sector as we have seen elsewhere; for example, the use of technology to help teachers with repetitive tasks, giving them more time to focus on soft skills. Teachers are so much more than content delivery robots, so while digital learning technologies can teach content, we need humans to educate. Such soft skills include people skills, social skills, communication skills, character, personality, trait, social intelligence, emotional

intelligence, and all of those things to enable a young person to navigate their future environments.

Moving forward with more blended education and the necessity to vastly improve connectivity and ensure equity, especially in rural areas, it cannot go without a public private partnership, whereby the private sector can zero rate educational platforms. In the tertiary sector, in South Africa, the institutional websites are zero rated and most students have been able to submit assignments and attend classes online.

It is important to note that for every country, every district and every context, the operations will be different, because you cannot simply copy and paste from one country to another with differing circumstances. What is clear is the primacy of listening to teachers' recommendations and ensuring that equipment is available in the classrooms in an equitable manner that avoids deepening any digital divide.

With a great emphasis on social emotional learning, the problem of identifying the subtleties of student behaviour needs tackling. Regarding online learning, many teachers comment that compared to face-to-face teaching, it is a challenge see what the mood of the student is, whether they are attentive, whether they are bored, or whether they are enjoying the class. In the online system, it is virtually impossible to individualize teaching for a full class of students in a virtual setup. The body language is not clear, and it becomes much harder to identify the students' ability to learn. Thus, it is not just about the curriculum, but also the techniques and the methods of teaching, which need to be adapted to blended learning.

So over time we are seeing designers of learning management systems and learning platforms, start infusing alternatives. For example, at one school in Nigeria they recently incorporated play time into the learning, whereby they kept the cameras on when the children went to play in their homes and remained connected to all the other children – so it felt they were in the playground. This is a simple example of the kind of innovation needed in the design of the tools that we use for digital learning. Such innovations will bring results that the teachers can observe, making them more adaptable and willing to look at the e-learning technologies in a new light.

In implementing the competency-based curriculum in Kenya, one of the core competencies is learning to learn digital literacy, focussing on creativity and communication. The important question is how are such competencies delivered? The delivery is activity based. That means developing emotional intelligence. If we talk about developing every learner's potential, to better prepare them for the future. If we are building and developing competence, ensuring learners are acquiring competencies, at the same time we help ourselves in better understanding the assessment required such that one can create a check on how the competencies have been acquired. In the post-COVID environment with greater blended learning then we must be careful of the learner-teacher engagement plus learner-technology engagement. In simple terms, if we help ourselves with those core competencies of learning to learn digital literacy, at being creative, then we are more ready for those jobs of the future.

The spread of competency-based curriculum across many African countries helps ensure that learners are engaged in many different activities. Project-based learning is proving better at engaging students in the learning process whereby they learn about the challenges faced in real world situations whether it be agriculture, energy, water, and those areas relevant to the local community. As for technology it is important to demonstrate that the students are experiencing a continuous learning process, and this means not locking them into just one type of technology and to encourage them to become creators of new technology. The children should be encouraged to make their own choices and simultaneously be taught this in an African context that gives them the relevant competencies. The choices of technology should be age appropriate, experience appropriate, serve the desired learning outcomes and be useful in an ever-changing world.

Technology is one thing, knowing how to leverage that technology is another matter. Having a computer does not give you the necessary skills unless the teachers are appropriately trained with a variety of approaches on how to deliver skills and also receive continuous professional development to ensure they are constantly up to speed with the latest developments. The concern is that, during periods of financial constraint as will be experienced form the impact of COVID, it is the teacher training and development resources that have budgets cut first.

In terms of professional development, the challenge many face is having the capacity to build expertise around high quality online teaching, because currently there is a great variance in quality and furthermore it depends on the type of edtech that has been employed. All participants spoke of their expectations of how online and blended learning is going to be a permanent feature of education and

thus teacher training and continuous professional development is critical. We need to adapt training and pre-service qualification such that online learning and virtual lessons are included in the curriculum of teacher training colleges.

Many participants spoke of the need to shift the mindset of learning outcomes. Students need to be taught the ability to self-assess and curricula should have greater emphasis on critical thinking and problem solving. Education needs to go well beyond just information gathering and knowledge attainment but should be flexible and responsive enough to respond to social changes and align with 21st century needs. With a greater policy emphasis on digital literacy and ICT skills, it will be necessary for policy makers to be cognisant of the pitfalls of technology. For example, some research has already shown that artificial intelligence leads to some inherent biases especially those of varying cultural backgrounds or dual-language learners.

The ethos of inclusivity in education is a way of teaching, a conscious way that does not label certain special needs but rather the teachers realises that their class is made up of a diverse group of learners. Fostering the ethos of inclusivity is about developing the child's individual potential. In South Africa they have dedicated resources into realising such potential, for example, in coding and computer programming which has led to positive results and most importantly has developed a new way of engaging those students with special needs. This is more than just an academic process it is a learner-centred process that brings about enjoyment and fun for the child. Putting joy into computing is more than just an investment into learning outcomes but paves the way for the future job aspirations of the child.

2.5 Skills, Jobs & The Economy

COVID-19 is already accelerating things that have already happened or needed to happen. Many have spoken about the growing disconnect between the nature and philosophy of education and the real world as it is emerging. Most countries in Africa have a problem with youth unemployment; education has been extended, yet when young people finish their studies, they find a world very different from the one the education system has been preparing them for. They find a world where many of the older, formal jobs are shrinking but have been socialised and trained to expect permanent and pensionable employment. Those kinds of jobs have been shrinking for the last 20 years, whereas the number of youth requiring work has been increasing over the same period. COVID-19 may well be the catalyst that leads to a re-alignment of education with the emerging world.

Anything between 40% to 60% of the current jobs are not going to exist in the next decade. It is the responsibility of education systems across the world to re-configure and reorganise their curriculum in such a way to better prepare for these as yet undefined jobs. Take the financial sector, a lot of bank operations are being automated. The whole automation drive needs somebody to build applications and machines that will need designing, programming, and maintaining. So, we need to ensure that we produce the abilities that fit into the economy. In South Africa they partner with industry to drive advocacy and innovation. So, it is essential to give youth the opportunities, organise them and get them to compete internationally with learners from other countries.

Critically, participants spoke of what can be done to get learners into technology beyond the syllabus. Answering that question leads to how young Africans can become participants, creators, and beneficiaries of the economy that they will be driving in the future. If one is going to create stuff, then making mistakes and not being afraid to experiment is important. Now is the time to have a concerted effort in ensuring that young people can start to become developers, to let them start experimenting and learning from mistakes. This opportunity should happen at a young age and not wait until older teens and university undergraduates. Once we get kids excited and developing then them let them carry on at not allow age to be an inhibitor.

An interesting comment from Kenya was the need to stop the dialogue that Africans are not creators of technology, there is a lot of technology every day and the ICT Authority has a database right now with over 350 innovations or inventions created mostly by young Kenyans. In fact, they sometimes must pause the database because of the numbers that they are getting on a daily basis. Even such a pause can lead to a Twitter storm – young people being very vocal. Where they have failed is not in teaching these young people to invent but in creating the psychology of Africans as people who consume and do not create, because the biggest barrier to creativity is your own psychology and your own belief in yourself. There has been a global view of the African as somebody who needs to be led and who cannot lead, somebody who is not technically competent, somebody who cannot solve their own problems, somebody who doesn't have enough money to do anything. In Kenya at least, they are proving that this is not true. That said, their procurement law makes it difficult for them to consume these inventions. So, the problem can be stated as barriers erected by an older generation and not necessarily the curriculum. These kids create, even before they go to school. At school there is the danger of all the time being dedicated to succeeding in examinations, leading to things which are of little use in the future. Hence, the education system needs to allow these children to flourish and do what they do naturally.

Moving students onto devices in their homes is sometimes easier to do when there is not layers of policy that can impede implementation. Education is operationally a very busy space with lots of people and stakeholders who during COVID have been far less operationally busy, allowing the time to integrate programs and to really look at measurements of outcomes and evaluation. For example, it may not help to carry on teaching the same thing with technology when we need to start looking at what young people need for when they leave school. This requires an understanding of the important drivers of the economy and looking at what these young people should be prepared for in the future.

In South Africa, they have made the bold decision of introducing coding and robotics right from grade one. There were deep and robust discussions on what would be the right time to introduce these subjects to juniors and to prepare them with the skills for jobs of the future. They agreed, based on engagement with industry and academia, that children can begin to code right from two years old. There is evidence of research that other countries have coding and robotics from grade four, grade five and some studied even much later; in South Africa they start at the foundation grade. So the discussion about when is the right time requires putting the relevant policies in place and the curriculum plays a critical role in ensuring that we equip these learners with the skills as quickly as possible, allowing children to play and learn through playing. So, from a government point of view, the Department of Education is responsible for formulation of the curriculum policy, what is included and what learners need to learn. In South Africa they are not afraid to try and when failure happens to identify and correct them immediately, so that they can afford their learners an opportunity to develop the required skills.

The approach to developing skills and entrepreneurship in Nigeria has been more of standards and regulation driven processes, where the President has issued executive orders that you must use local content, and if you use local content, you have an incentive. So, for example, most of the Nigerian government departments are encouraged to use locally developed applications and if you host them on local environments you receive a tax break. So now they are witnessing a lot of growth in their software development protocols, such as the biggest financial payment platform that the government uses is an enterprise software built locally. Furthermore, if you are using an imported software, you must also show the local content element. By issuing standards and regulations, then one gives such incentives, creating an environment for the local content to grow. This has now been applied in the education industry. Most of the learning management solutions that are being used in Nigerian schools were developed locally.

On the question of ensuring that young Africans become the next generation of developers then it is necessary start learning the skills pre-K12. In Rwanda, their students at senior six or K12 can produce commercial products. Also, one needs to consider the post-digital technologies that are emerging: the so-called technology cocktail and how they can be infused into curriculum at a very early age. So that by the time those technologies gain popular appeal, the students have grown up with them, just like the students who grew up in the social media age, they are very comfortable using social media. As well as infusing technologies from an early age, we must keep in mind that the younger learners still need core skills and competencies. Otherwise, you will have learners who understand technology, but without the core competencies and skills they will be missing the key elements of how and when to apply their technological knowledge.

In Senegal they feel that COVID-19 has shown that there are a lot of new things to address in education,

including the realisation that for future employees, they will have to learn and acquire new skills. They started having lessons which they call 'study skills and core skills first', introduced with the aim of promoting lifelong learning. In the school programs they have developed computing and computational thinking as well as coding which is aligned with their re-orientation towards more STEM education. This is complimented with teacher training in ICTs, to ensure teachers can prepare learners as future workers across different fields.

In response to COVID in Zambia they learned the need to combine the conventional learning platforms such as TV and radio, which do not have interactivity nor the ability to assess whether the learners have understood and solve problems. If repackaging the old skills in a method that will be relevant for the future, one needs to ask what is the future? The future tells us, you will not always need to go to a physical workplace, you work remotely. So, the whole environment is different and as Africans, these new skills will bring about collaboration, communication on digital platforms, and a new space where the ecosystem contains all the actor: education managers, curriculum developers, teachers, learners and the guardians, whom all have to work together. In the context of jobs of the future, there is a need for an African way of conducting evidence-based research that enables effective change management. Blended learning is the future, but there is much more, including building capacity and having a holistic view, not just a technology issue, nor a curriculum matter.

In Cote d'Ivoire they have been looking at how they can leverage technology and 21st century skills to change the school system and asking how do they develop a whole school approach? In the context of COVID, for the old guard who were resistant to technological change, it has been a rude awakening. This has opened-up the opportunities to put more emphasis on the necessary 21st century skills of problem solving, critical thinking and communications skills, needed for the new economy.

Evidence from a number of African countries is starting to show that project-based learning and problem solving is enabling the young people to better solve local contextualised problems by taking global skills, such as software development, and putting them into practice locally. Embracing the problem-solving mindset, pertinent to the students' environment is a key goal of competency-based curricula. Looking forward, countries also must change their mindset in the way they approach job creation such that people challenge themselves, take risks and the concept of failure is built into the system. Such failure is necessary for entrepreneurship to truly develop and requires the desire to innovate from the skills learnt in school. Several speakers in the meeting referred to how there needs to be less reliance on the public sector for jobs for such entrepreneurship to truly flourish.

Some commentators referred to the role of industry and that companies give young people the opportunity to prove themselves. Developers should give local talent the chance to prosper and move away from the old mindset of bringing in foreign companies to fulfil projects. As far as digital transformation is concerned, instead of just adopting the new technologies of multi-nationals, more should be done to encourage local development that nurtures and leverages local talent. The relevancy of this point was emphasised in the context of COVID, which has now severely restricted travel and caused a slow-down in FDI. Local talent is needed now more than ever.

In Sierra Leone they have recognised that their educational system has always been geared to attaining the end goal of graduates with degrees, with not enough attention paid to the 'middle level' – the technicians and mechanics, for example. When multi-nationals come to the country, they will look for experts elsewhere because the local graduates are not trained for the job market. This has inspired the government to rethink curriculum development with a greater focus on training young people for the local market. The ministry of education in Sierra Leone is now revamping the approach to the curriculum such that it better reflects the opportunities in the job market and the training required.

During the meeting, the educators spoke of having students, just sitting in a classroom to learn computer science is not a practical approach because that does not teach them the real-world skills. So, it is better to take the learners out of the theoretical classroom environment and put them to work on practical projects. For digital technologies this may mean designing platforms such as blockchain, that involves learning but at the same time has a real-world impact. They have found this approach successful in the Seychelles and have accelerated it because of COVID, given the need to adapt quickly to the huge drop in tourism and to focus on other sectors.

The private sector should also have a voice in the discussion on skills development with closer collaboration between policy makers, training institutes, and universities. Furthermore, development agencies and NGOs have a role to play, as witnessed in Morocco where they have helped

connect classes with the community. This represents good best practice whereby the education system is fitting with local economy and is necessary to complement curriculum reforms in the schools.

In South Africa, they have been looking at the critical age of 15, where learners have completed their compulsory education and after that choose to pursue a specific academic course. They realise the system is too rigid to respond to 21st century needs and needs to have greater flexibility to ensure a secure bridge between the school and job creation. Therefore, the country is introducing the three-stream model of general, technical, and vocational education. This should then create more diversity and choices that are linked to career paths. They want their system to be more agile, to be more fluid, because these learners at 15 years old are still trying to gather themselves in what they want to do. The education system must be responsive in allowing children to find themselves, make the right career choices and then be effective contributors towards the next generation of thinkers.

In Uganda, prior to COVID, they were in the process of rolling out a new curriculum which incorporated modern skills development. They have been working to seriously integrate ICT, not just as a subject but across the board for all subjects. Higher order thinking skills are of importance to better enable students to problem solve. On the issue of employability in Uganda, they are implementing apprenticeship as a compulsory subject and include a greater number of vocational subjects in the curriculum. Regarding ICTs, they want their learners to be ICT and digitally literate at the primary school level. They are already using technology at home and for personal use, so wish to go the extra mile within the education system.

In terms of career progression, in Botswana they have introduced "educational pathways", where after 10 years of schooling students can choose their direction – vocational, general or STEM education. This policy then needs continuing collaboration with industry to ensure that the content and qualifications match the real-world requirements.

Predicting future jobs is tricky, yet a common theme from the policy makers is that science, technology, engineering, mathematics, entrepreneurship, innovation, and skills are crucial. So, the challenge is how to integrate such STEM education into existing curricula. The education ecosystem should complement digital technologies by facilitating and allowing students to access freely available knowledge and then encourage analytical thinking such that they can come up with solutions to problems that address real issues in the community.

2.6 Closing Syntheses

Note: the closing synthesis was provided by Norberto Carrascal of Intel and is accompanied by the presentation in Appendix B

Norberto Carrascal finished the meeting with a presentation of the case for innovation. Intel have revamped some of their commitments towards education, shaped in a new program called skills for innovation. The purpose is to create world changing technology that enriches the lives of every person on earth. Intel was the company that put silicon in Silicon Valley, and today they are applying all their reach and using all of their resources to deliver on a large scale.

Through this new strategy, Intel is striving to create a more responsible, inclusive, and sustainable future enabled through our technology. The transformational changes needed in our societies can only be achieved only education, and the next generation. However, the reality is we are in a moment of crisis. Over the past few months, some of the most vulnerable student populations have suffered significant learning losses, with many countries reporting that they lost 30% or more of their students. We are at a crossroads and we can ensure that technology enables the greatest positive change in human history for the worldwide education system.

At some point we may look back in five years from now, and we will probably realise that the technology or the lack of technology can widen the education gap and reduce the overall talent pool offered for diverse candidates. For sure there is big urgency because of the COVID-19 implications, but the pressure on education is not new. The elephant in the room is that we want to prepare the new generations to be ready to compete in the world that we live today. For that we need to make significant changes to our education system – changes that are by no means are easy. The quote from Jack Ma, the founder of Alibaba summarises the situation very well. "We cannot teach our kids to compete with the machines who are smarter, we have to teach our kids something unique. In this way, 30 years later, kids will have a chance."

Much has been spoken of how the fourth industrial revolution will completely transform the way we manufacture products, and this is not unique to manufacturing. Technology continues to change across all sectors, having a big impact on jobs. As robots increasingly replace whatever repetitive task in every sector, the underlying technologies that support these changes are with us now today. Artificial intelligence and machine learning are emerging as the value-added technologies to our industry. This requires tomorrows workers who understand data science, and the computer science that enables it, or cloud computing.

Just to be clear that all of us today experience and use these technologies. Every time Amazon or Netflix or your local newspaper offers you product or specific content, it is a personalized offer only for you. That is based on a recommendation engine based on artificial intelligence we all use today. Artificial Intelligence. Likewise, every time you call an Uber or every time you have a Zoom meeting, we are using the resources for the cloud. With this technology at the core of the new industrial revolution requires new skills from tomorrows workers, the students of today, not just what they do and the tools they use, but in how they think and how they innovate.

We adopted Bloom's Taxonomy as a way to bridge the gap between the technology domain and the pedagogical domain. For example, we are always looking at how to teach our students to apply what they learn or how to analyse a certain object or evaluate a certain situation. However, today we are doing this in their traditional and non-tech way. This is not about changing the curriculum. However, we believe the use of technology can be integrated into current curriculum, and everyday teaching to enable greater learning outcomes. And that is the objective.

It is necessary to create specific usage models and to map them to specific technology tools through the lessons. For that purpose, we have identified the key building blocks of each skills, and we have worked on creating a specific usage scenarios and lesson plans to show how technology can be used to effectively build those future skills.

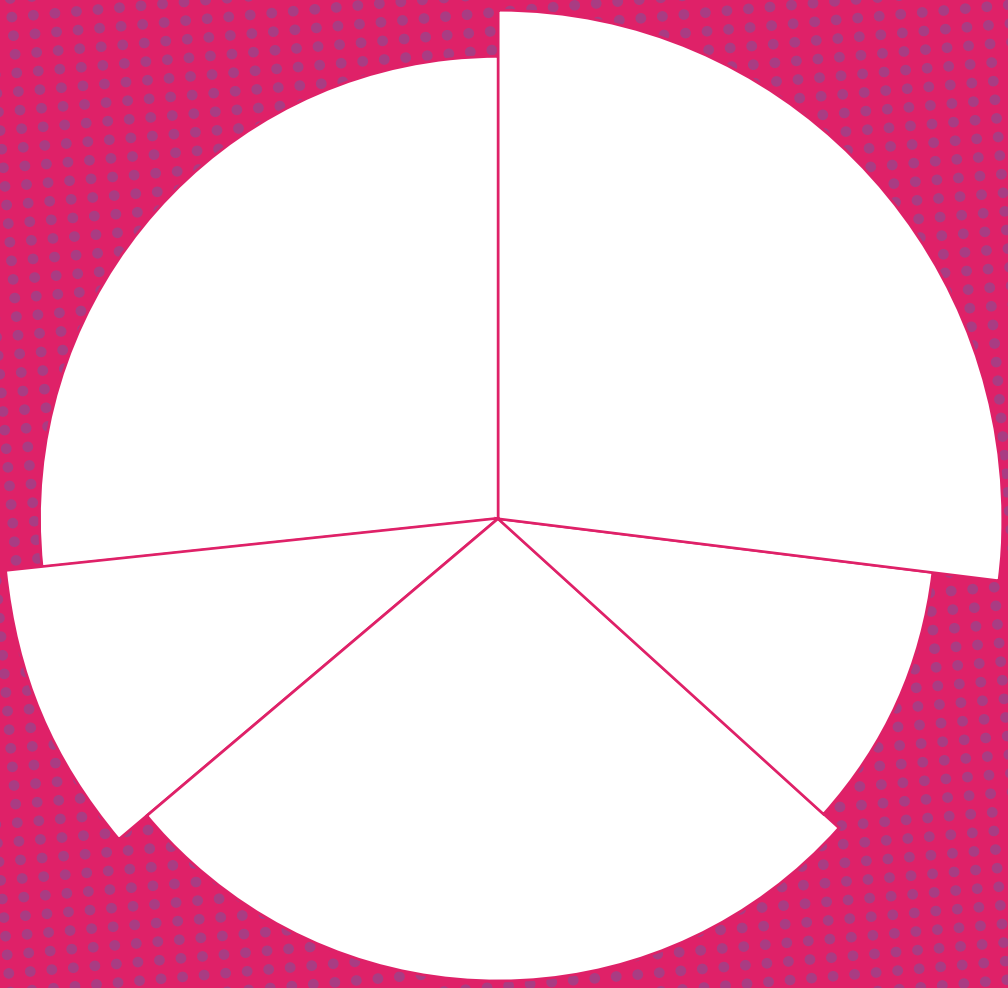
This is a great opportunity, not only to learn about the subject itself, but to have students practice the use of association software to create different mathematical models, compare and contrast them. So, we have created the supporting tools to facilitate this experience. The starting point is the decision makers toolkit. The objective of this part is to enable the education decision makers to adopt and plan for the skills for their innovation vision. The vision is developed through a conversation where we first understand the changing skills requirements of the fourth industrial revolution, to then think of the technology deployments in schools and finalize with the creation of an action plan for decision makers.

As part of such a workshop, we will be covering the financing part as we are collaborating with several foundations and funding agencies that are very keen on prioritising these programs in countries. The educator and starter pack back is directed to schools and in particular to school leaders defining the curriculum, the infrastructure, and the pedagogy. It shows how to integrate the skills-based approach into everyday teaching and learning, and it consists of a library of 70 ready to use activities of up to 140 hours of content for elementary, middle and high schools segmented into STEM, language and humanities. These activities enable the introduction of skills for innovation and to obtain a proof point of the impact in a school through an immersive learning experience. The last piece of the puzzle is the educator, in the new suite for teacher capacity building. It comprises of 60 hours of e-learning content organised in three pillars and 10 courses for building new competencies enabling the effective integration of technologies into pedagogical practice, facilitating the creation of new lessons and the modification of existing ones.

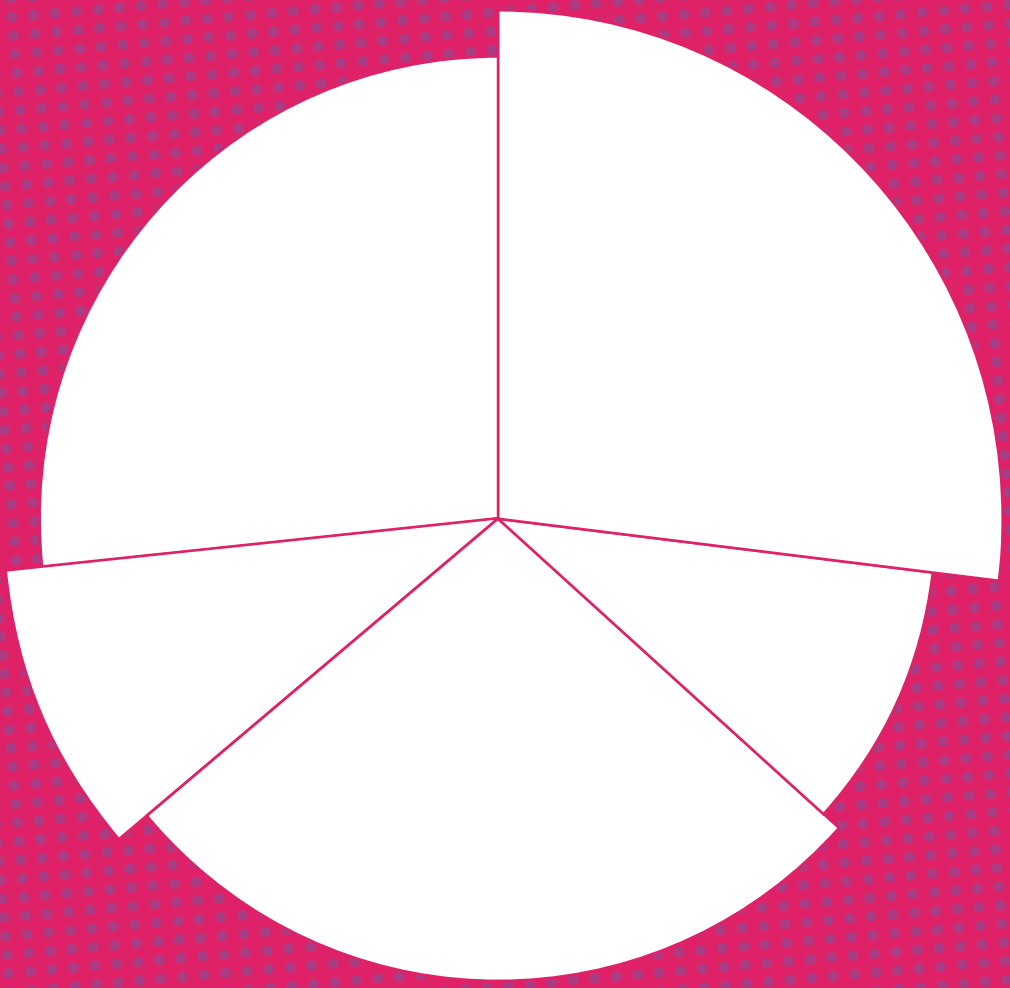
The three models allow decision makers, the schools, and educators to understand, experience and implement the skills for innovation vision.

- End -

For further details or copies of this report, please contact john.glassey@brains.global



APPENDICES



APPENDIX A

Our students with Singapore President Mdm Halimah Yacob at the launch of the Westwood Primary School Innovation Space.

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Approaches to integrating skills

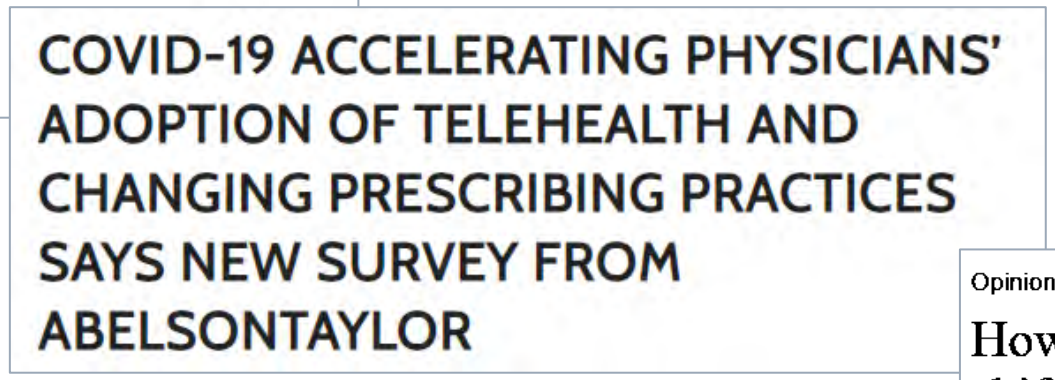
VEERAPPAN SWAMINATHAN

CEO, EDM8KER |VEERA@EDM8KER.COM

Covid-19 is accelerating change

Source: https://medium.com/@katicaroy/why-covid-19-is-accelerating-the-future-of-gender-equity-b9daeae900a4

Source: https://www.heavyliftpfi.com/news/covid-19-accelerating-digitalisation/



Source: https://www.pharmalive.com/covid-19-accelerating-physicians-adoption-of-telehealth-and-changing-prescribing-practices-says-new-survey-from-abelsontaylor/

Source: https://www.ft.com/content/050ea832-7268-11ea-95fe-fcd274e920ca

Source: https://dieselgasturbine.com/covid-19-accelerating-energy-transition-study-suggests/

Source: https://www.channelnewsasia.com/news/commentary/coronavirus-covid-19-digital-payment-cash-infect-china-europe-us-12583302

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How can we ensure that our young people are the next generation of technology developers rather than just being users?

CLEARLY, WE SHOULD REFORM THE EDUCATION SYSTEM AND FOCUS ON SKILL DEVELOPMENT… BUT HOW?

3 Key Questions

1. What kind of skills to focus on?
2. How do we integrate skills without creating disruption (and pushback) in our education system?
3. How do we leave in a place a system that will self-correct for the future?

Strategic to focus on Innovation & Higher Order Thinking Skills

2022 Skills Outlook

GROWING

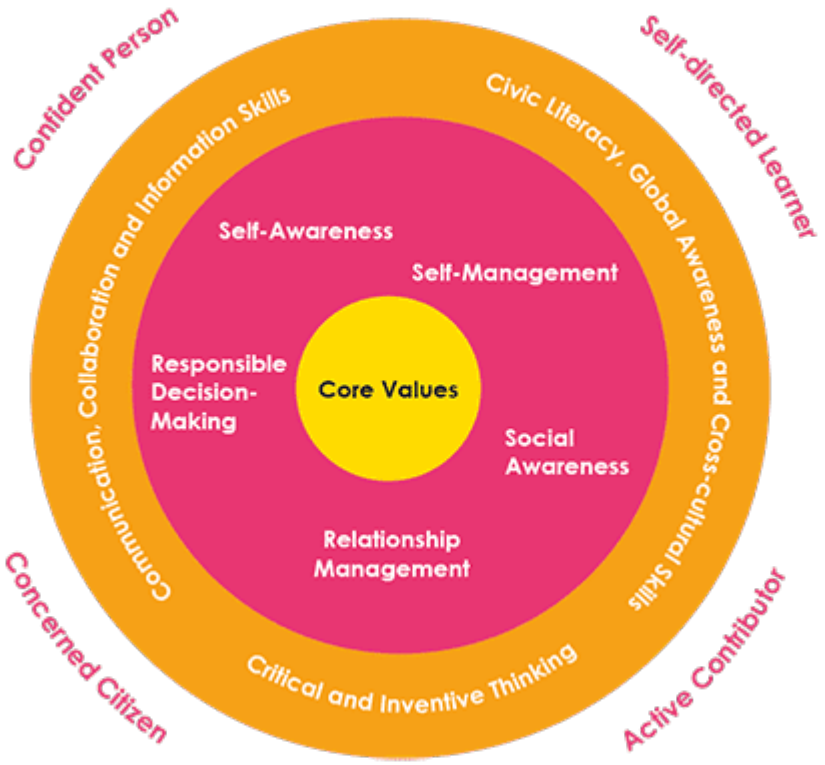
1. Analytical thinking and innovation
2. Active learning and learning strategies
3. Creativity, originality and initiative
4. Technology design and programming
5. Critical thinking and analysis
6. Complex problem-solving
7. Leadership and social influence
8. Emotional intelligence
9. Reasoning, problem-solving and ideation
10. Systems analysis and evaluation

DECLINING

1. Manual dexterity, endurance and precision
2. Memory, verbal, auditory and spatial abilities
3. Management of financial material resources
4. Technology installation and maintenance
5. Reading, writing, math and active listening
6. Management of personnel
7. Quality control and safety awareness
8. Coordination and time management
9. Visual, auditory and speech abilities
10. Technology use, monitoring and control

Source: Future of Jobs Report 2018 World Economic Forum

Contextualizing Innovation & Higher Order Thinking Skills



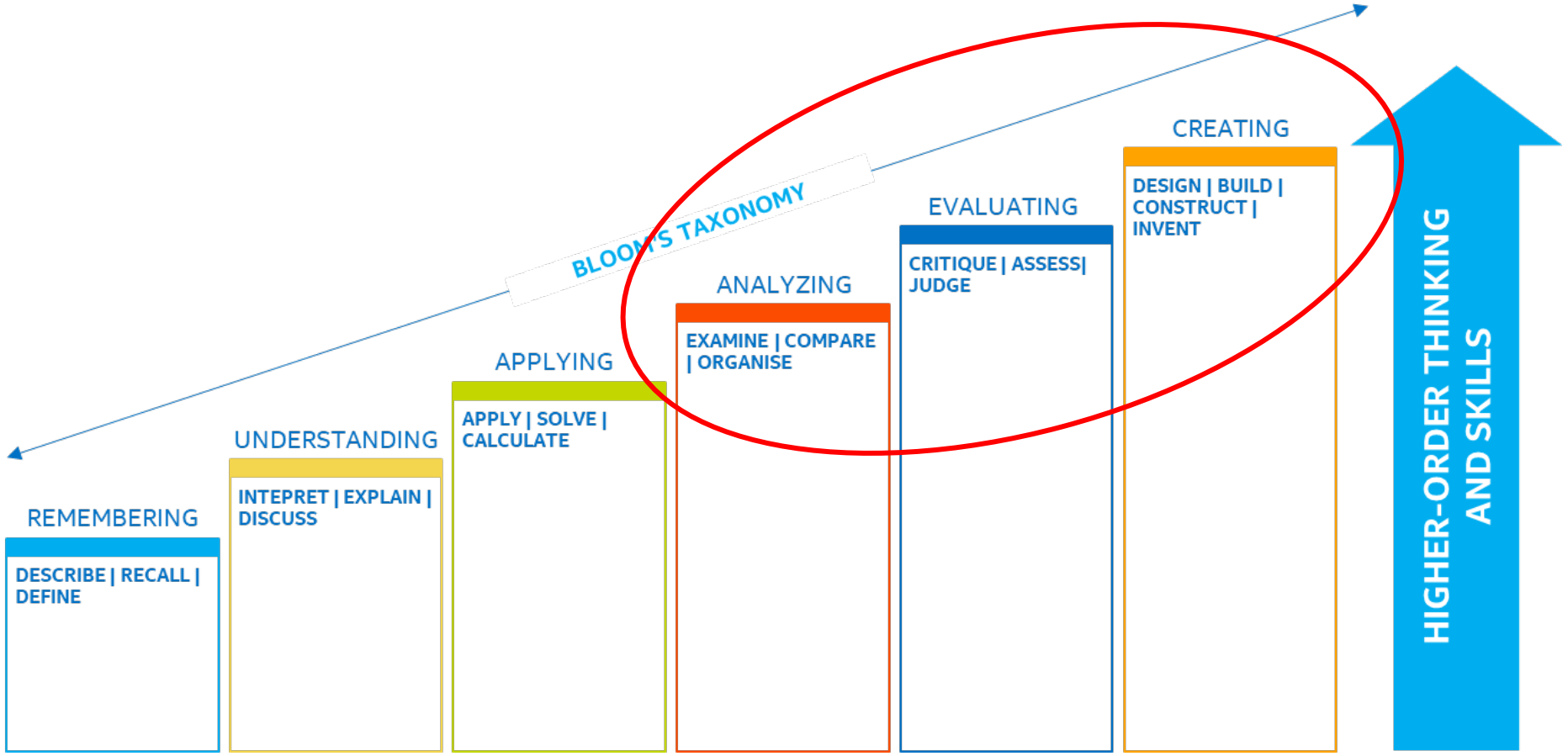
Source: Singapore Ministry of Education

- **Social Emotional Skills**
- **Mindsets**
  - *Design Thinking, Computational Thinking, Systems Thinking etc…*
- **Technology Skillsets**
  - *Data Science, Modelling, Coding etc…*

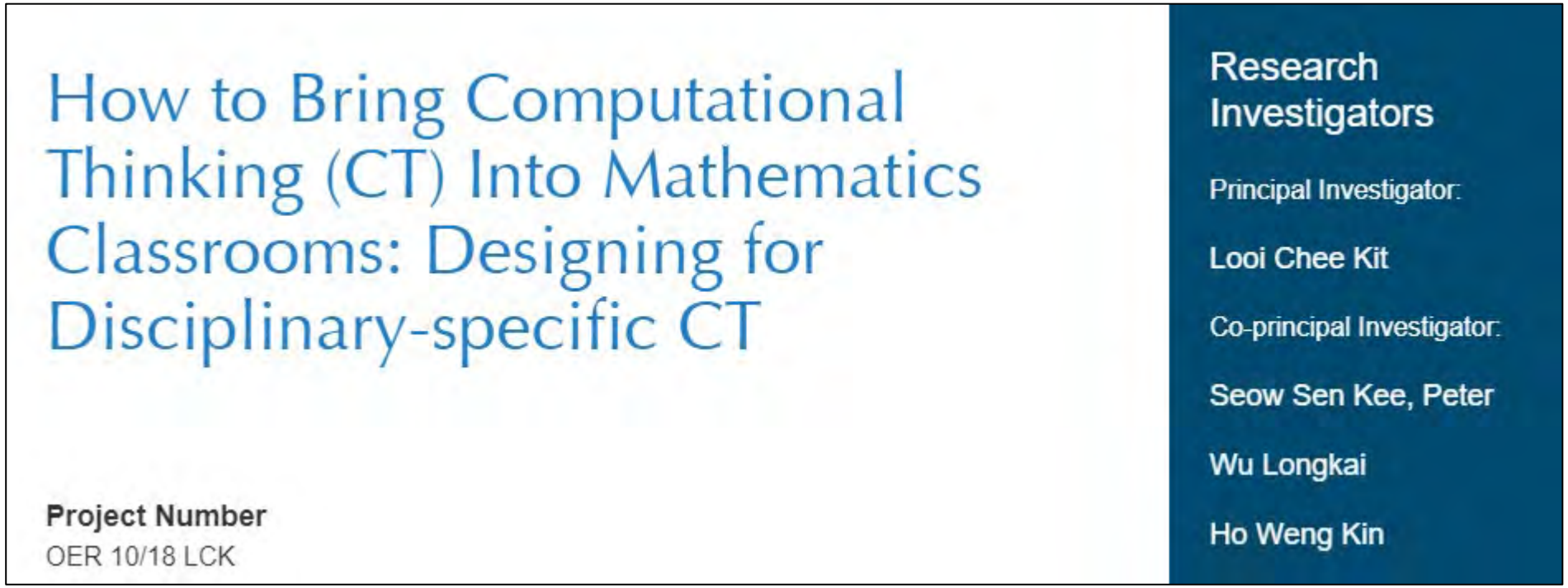
3 Key Questions

1. What kind of skills to focus on?
2. How do we integrate skills without creating disruption (and pushback) in our education system?
3. How do we leave in a place a system that will self-correct for the future?

Map skills to curriculum activities with higher cognitive demand



Implementing Computational Thinking within Math Syllabus



Source: National Institute of Education, Singapore

3 Key Questions

1. What kind of skills to focus on?
2. How do we integrate skills without creating disruption (and pushback) in our education system?
3. How do we leave in a place a system that will self-correct for the future?

Create a culture of lifelong learning through policy & action

Source: Civil Service College and Ministry of Manpower, Singapore

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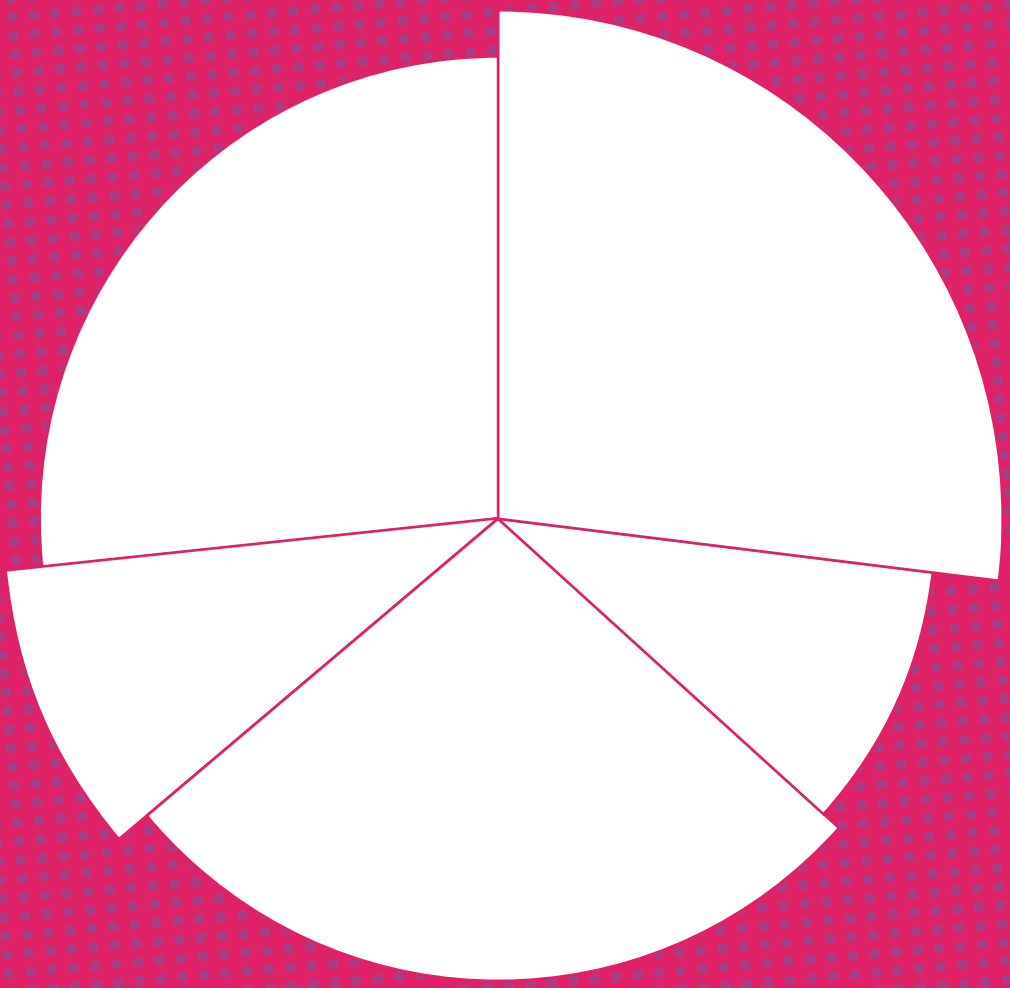
Putting it all together

- Involve Whole-of-System – Education Policymakers, School Leaders and Teachers.
- When it comes to change, supplement first. Then perhaps, supplant.
- These approaches have been embedded into the Intel® Skills For Innovation program.



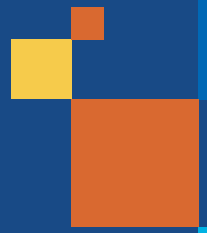
APPENDIX B

Africa Special on 21st Century Competencies: Skills & Innovation for Job Creation

Skills For Innovation

Norberto Carrascal

Education and Public Sector Director. EMEA Territory

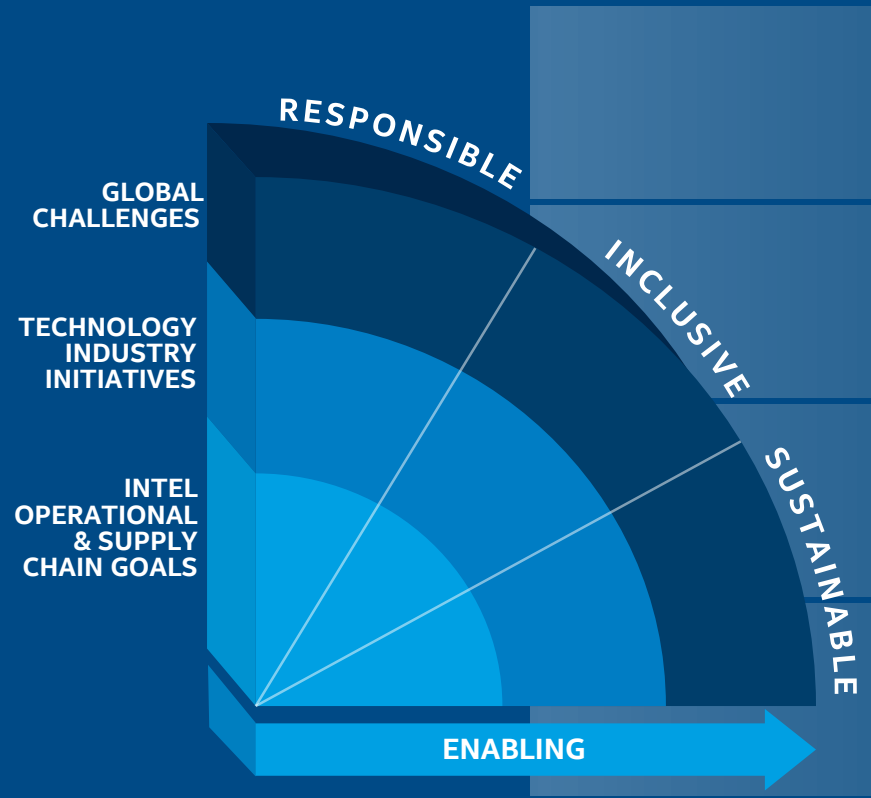


intel®

Our purpose
is to create world-changing technology that enriches the lives of every person on earth

INTEL'S **RISE** STRATEGY

Making a positive impact on society, business, planet



RESPONSIBLE Revolutionize how technology will improve health and safety

INCLUSIVE Make technology fully inclusive and expand digital readiness

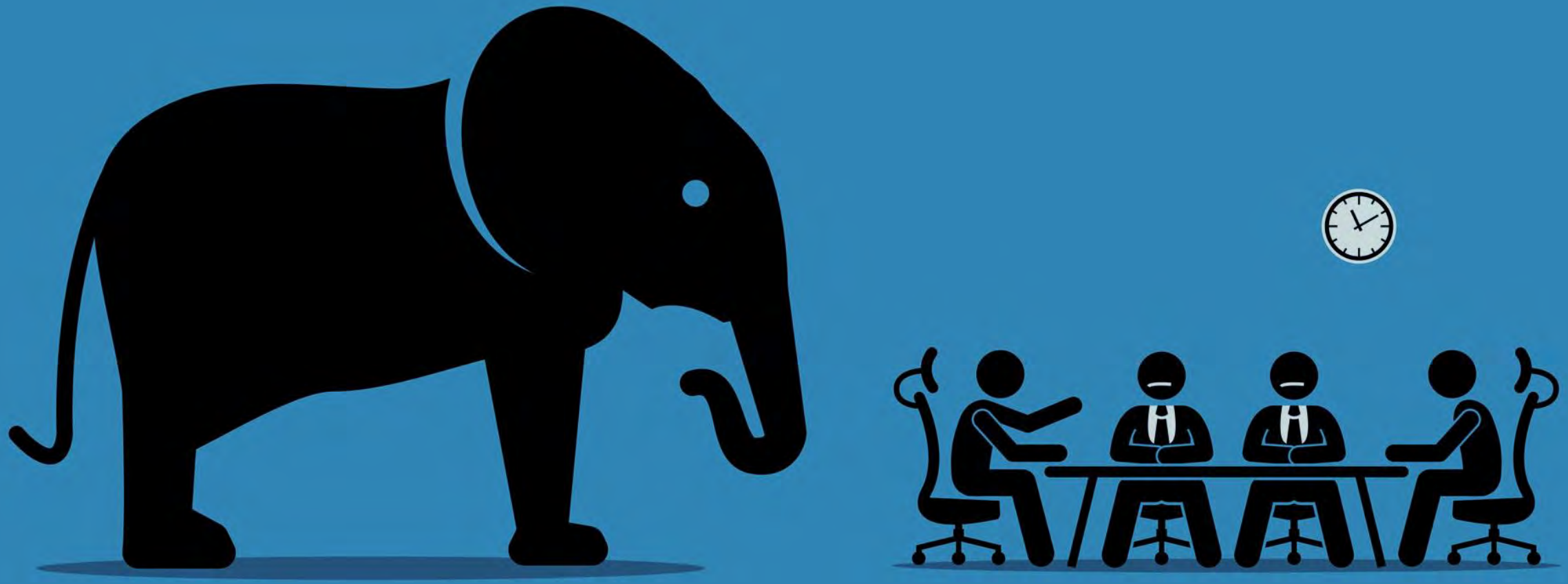
SUSTAINABLE Achieve carbon neutral computing to address climate change

ENABLING Accelerate the ways we enable progress through our technology and the expertise and passion of our employees

Education in COVID-19 Crisis

The time for authentic, engaging, seamless, anytime-anywhere learning has come.

What will Intel do to provide an equitable environment for all learners, and ensure that technology enables the greatest positive change in human history for our worldwide education system?



We cannot teach our kids to compete with the machines who are smarter – we have to teach our kids something unique. In this way, 30 years later, kids will have a chance.

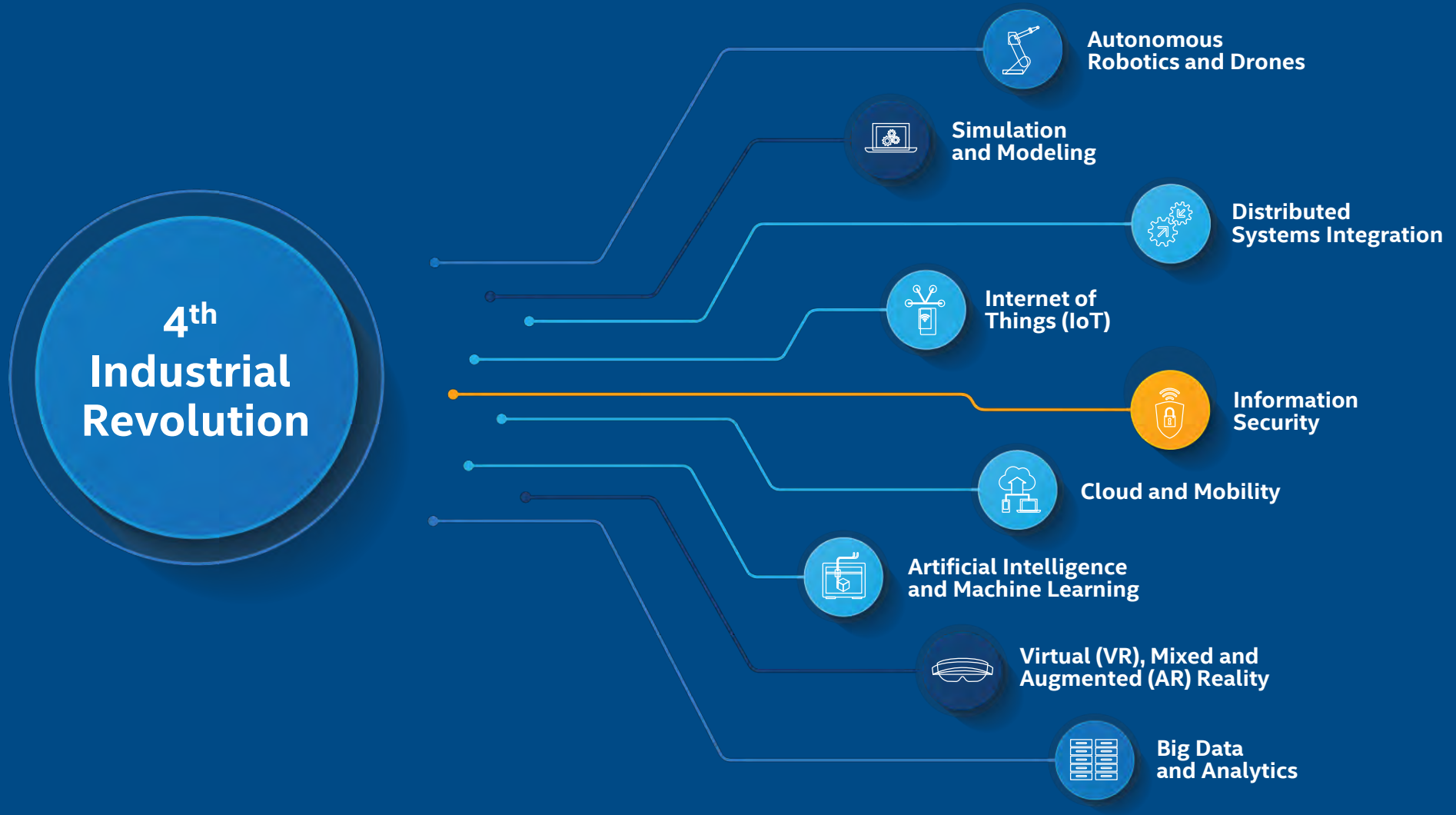
JACK MA,
former head of Alibaba speaking to 2018 World Economic Forum

NEW INTEL® EDUCATION VISION

“SKILLS FOR INNOVATION”

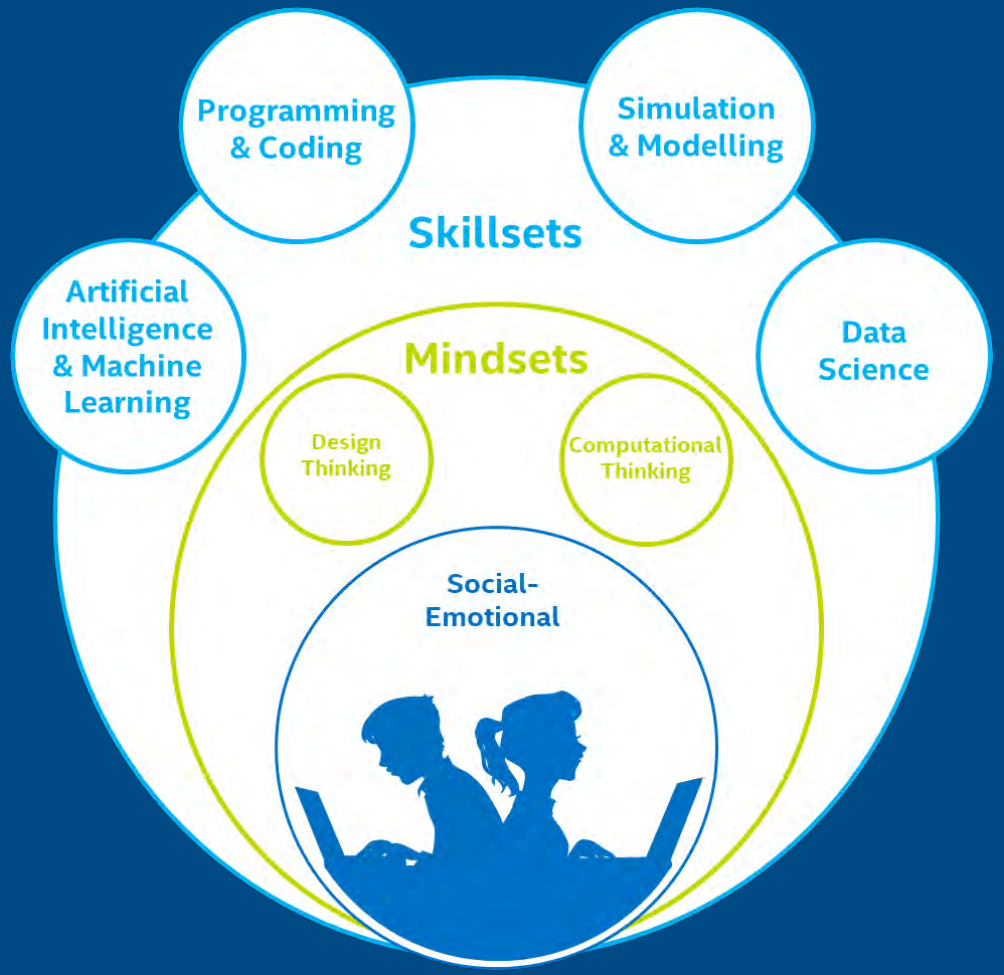
Empowering the Next Generation of Innovators

4th Industrial Revolution

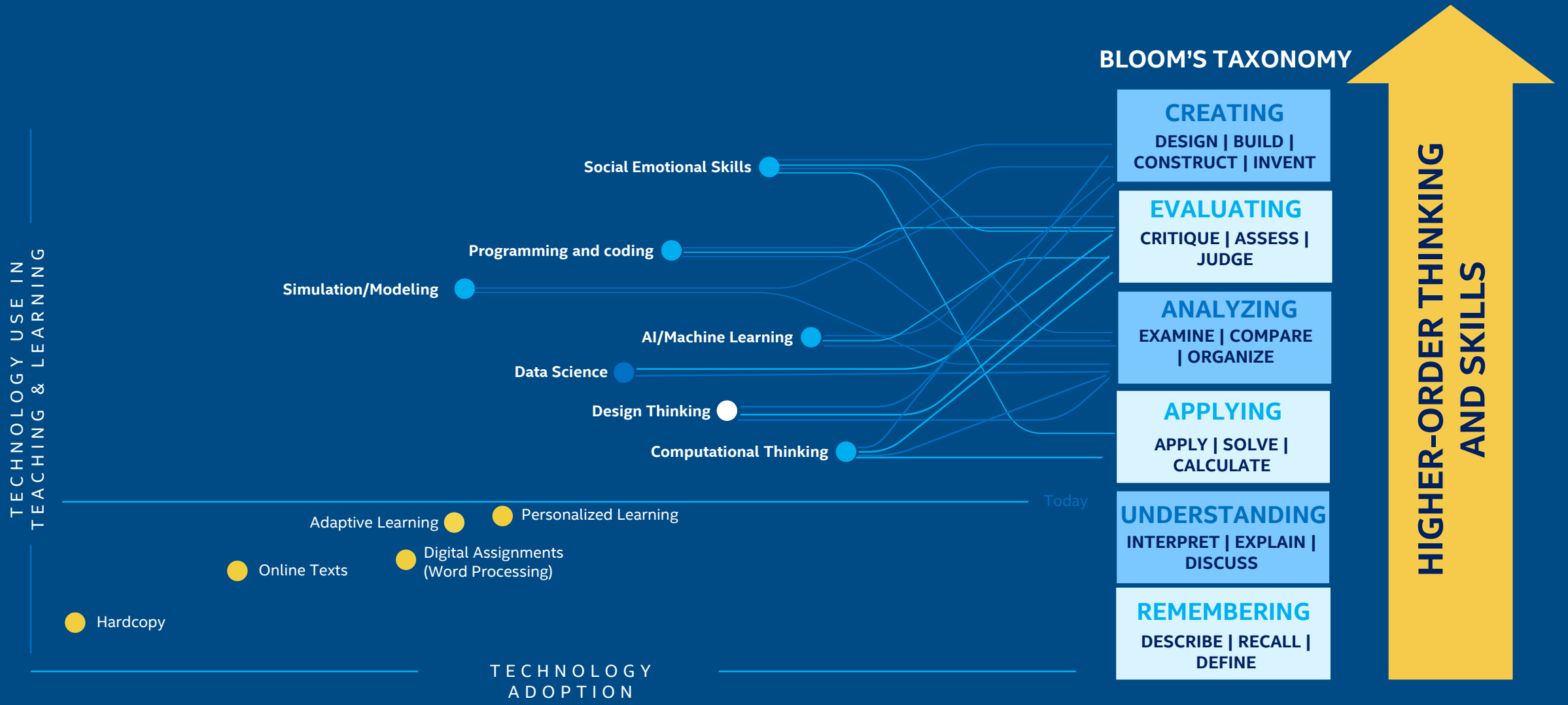


Skill areas under focus

- Intel's Skills for Innovation approach is based on a model of necessary skills for student success in the 'new collar,' industry 4.0 economy.
- List of skills is not exhaustive but is to be considered as a starting point.

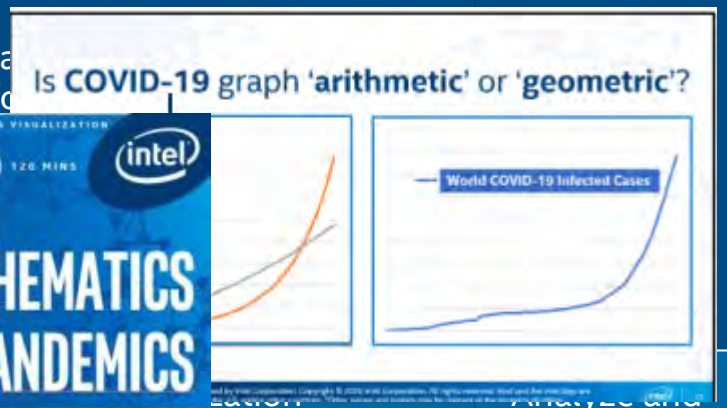


Technology-Enabled Learning Skills Development

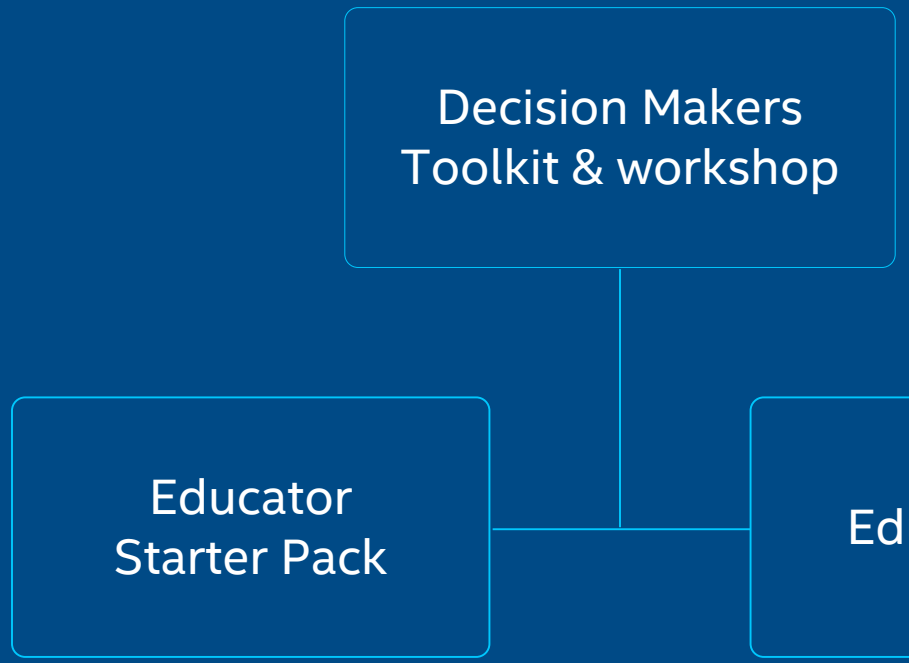


INTEGRATE SKILL BUILDING ACTIVITIES INTO TEACHING & LEARNING

LEVEL	SUBJECT	LEARNING EXPERIENCES	TECHNOLOGY USAGE	COGNITIVE OUTCOMES
HIGH SCHOOL	STEM	• Model rooftop availability and solar coverage across an urban environment to identify possible location sit • Create rooftop farm prototy withstand wind-loading.	• Usa info	
MIDDLE SCHOOL	Humanities	Modelling of virulence and spr epidemics (Spanish Flu, SARS, study historical impact.	disease models to compare and contrast.	evaluate
PRIMARY SCHOOL	Language	Create an advertisement to invite your friends to ride in your roller coaster	Green screen video recording, video editing, audio transcription and online publishing tools.	Evaluate and create



Skills For Innovation Resources



Allows decision makers and educators to understand, experience, and implement SFI vision

Reach out to us through Africa Brains!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