HUMAN LEARNING IN THE DIGITAL ERA
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SPECIAL THANKS

A study like this cannot exist without the goodwill and open-mindedness of many people who generously gave their time

Such as,

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**ZERO KNOWLEDGE = ZERO DECISION**
The UNESCO/Netexplo Advisory Board (UNAB) is a global, collaborative network of university professors, lecturers and researchers.

Together, they are a diverse platform of thought leaders who contribute perspective and ideas on the digital future of societies and communities throughout the world.
PREFACE
Learning in the digital age is central to any discussion of the future of inclusive knowledge societies. Indeed, learning, as both the process and result of acquiring knowledge - broadly understood as a combination of information, capabilities, understanding, skills, values and attitudes - is at the heart of human existence and our hope for the future. Learning, as both a means, as well as an end, an individual practice as well as a collective endeavor, is critical to our common future.

Reexamining human learning in the digital era of artificial intelligence, big data and machine learning requires a reconfiguration of what we learn and how we learn, and how we manage multiple networks of more or less institutionalized learning spaces. More importantly, however, it requires a fundamental rethink of the ultimate purpose of education, and knowledge, for the possible sustainable futures of humanity.

Human Learning in the Digital Era follows on the first thought-provoking collection of essays on Artificial Intelligence released in 2018 by the UNESCO/Netexplo Advisory Board (UNAB). As a collaborative network of academics, it is an excellent example of the way in which collective intelligence can be leveraged to enrich our understanding of learning in the digital age. The interdisciplinary insight the network provides on the digital future of societies and communities around the world is exactly what we need to better understand the complexity of societal transformations.

The publication is a very timely contribution as UNESCO embarks on an ambitious Futures of Education project to reflect on and generate debate on how education might need to be re-thought and reimagined in a world of increasing complexity, uncertainty, and crisis. The project aims to generate an agenda for global action and debate on learning and knowledge in relation to the future of humanity by mobilizing the many rich ways of being and knowing worldwide.

This volume is a rich contribution to that collective effort.

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INTRODUCTION
Humanity’s desire to learn and progress has been both a catalyst and a challenge for the development of education. The greatness of a civilization often relies on the number of its scholars and its capacity to share their knowledge with successive generations. To quote Aristotle, “the fate of empires depends on the education of youth”.

For over 700 years, the Alexandria Library housed a profound collection of scrolls and documentation, detailing a global array of cultures, languages, disciplines and technologies. This included the sciences of mathematics, medicine, astronomy, physics, and biology, plus philosophy and the humanities, and of course literature and history. During this golden age of learning, the Alexandria Library was a sanctuary of human knowledge, attracting people from all over the world. They copied the documentation and shared it with their home countries.

The final destruction of the remaining parts of the Alexandria Library in 391AD probably set civilization back over one thousand years, giving way to an era of ignorance and darkness for the western world. This lasted until the beginning of the Renaissance Era in 1450, which saw the invention of printing by Johannes Gutenberg. Once again, knowledge was shared across societies, resulting in the rebirth of major scientific and cultural developments.

We are now on the threshold of the year 2020. Today, with access to the internet and a simple click on a smartphone or smart device, people can connect with information sources at almost anytime and almost anywhere. The digital revolution, frequently referred to as the fourth industrial revolution, has seen the emergence of a proliferation of digital innovations, in all sectors. Artificial Intelligence (AI) and Machine Learning (ML), driven by the collection and analysis of huge data sets, are beginning to have a major impact on human behaviour, and therefore our communities. The world of education and training is being completely disrupted through multiple waves of digital transformation.

Three insights can be made.
First, we now have access to a vast amount of information and knowledge, much of which is free. It is all at our fingertips and we need to do very little to get it.

Second, the new means of communication, including Internet of Things (IoT) and chatbots, can exponentially increase the efficiency of how education and training are provided. This increases the interaction between humans and technology.

Third, the steady use of AI is leading to a point where technology, in a range of instances, can outperform humans.

What then will humans need to learn, and why?

At Netexplo, we have observed many examples of how innovative, digital learning experiences can be applied to education. Some reveal how human knowledge can be provided by humans. For instance, Photomaths, a 2015 Netexplo Award Winner shows how machines can solve sophisticated mathematics problems for you. With WordLens, another Netexplo Winner in 2012, an app can automatically translate scanned content in multiple languages. These are basic examples which illustrate some of the complex challenges, education must face today.

What about global access to knowledge? Today we know that in the western world, the major, internet-based companies known as “GAFAM” (Google, Amazon, Facebook, Apple, Microsoft) or “FANG” (Facebook, Amazon, Netflix, Google) hold an exponential amount of data. This has been collected through so called ‘free’ publication of information and knowledge generated by a network of global contributors and scientists. With data being the high value currency of digital transformation, what happens if these private companies decide to heavily filter or stop the dissemination of information?

The answer is far from obvious. When Sir Tim Berners Lee founded the World Wide Web, he created the first open internet network. He envisioned a free and widely available communication space to be used by everyone, for the sake of human progress.

Yet there remains an ongoing and contentious debate, often fueled by political ideas, as to who should own global human knowledge, and scientific knowledge. The Wikipedia platform, a free open online and multilingual encyclopedia, created and edited by volunteer contributors from all over the world, is a good example of this. “Imagine a world in which every single human being can freely share in the sum of all knowledge”, states the Wikipedia Foundation. However, the idea that open data and therefore open access to knowledge is not an ideal upheld by all countries, brings into question the viability of a modern version of the Alexandria Library.
Another phenomenon has emerged from the exponential growth of online publishing. We have seen the explosion of “fake news” and “fake information”. The challenge of verifying the accuracy and validity of what can be published and posted, is immense. Guidelines for what is allowable and what should be censored exist yet can be heavily distorted unless closely monitored. Therefore, the question of verifying true and accurate knowledge has become a new challenge for education.

In the Digital Era, how can and should we be learning to ensure a civil society continues?

Professors and teachers today face the challenge of students in classrooms and lecture halls, often absorbed in their smartphones and smart devices. How can educators know if they are being heard? They cannot. They cannot know if the knowledge and expertise they are imparting, is effectively understood. Many education programs have online elements, or are wholly offered online, with very mixed results. This is another example of how the whole education system is effectively being disrupted.

Yet in India, a young and enthusiastic, self-educated entrepreneur, Byju Raveendran, Co-founder and CEO of BYJU’s, has reinvented teaching mathematics to the masses. He has made it fun, transforming thousands of passive students into passionate actors. Teaching at first in a large stadium, he subsequently created his own app that has been downloaded 15 million times. BYJU’S has now become India’s largest EdTech company, providing an innovative way for students to learn.

In the Digital Era, who is the best teacher, human or machine?

Therefore, the following three questions become prominent. Why do we learn? What do we need to learn? How can we learn?

The purpose of this book is not to analyse every aspect of how the digital revolution is impacting the world of learning and training. Instead, it explores multiple perspectives and shares newer thoughts on how education is being disrupted.

We invite you to take a deep dive into the UNAB Network’s examination of some of the major challenges that we, as humans, face in Learning in the Digital Era.

BY BRIGITTE LASRY
Head of Netexplo University Network

& HAEEL KOBAYASHI
UNAB Member
“Learning without thought is a labour lost, thought without learning is perilous.”

Confucius
PART I
UNAB’S PERSPECTIVE
“Education is the most powerful weapon which you can use to change the world.”

Nelson Mandela
CHAPTER 1

THE CHALLENGES OF LEARNING EMPOWERMENT IN THE DIGITAL ERA.
The world economy is greatly influenced by the values of western philosophers and economists, who established the concept of human rights, freedom and equality in race and gender as global principles, to be adopted worldwide. They believed that individual liberty and equality amongst men and women, regardless of their race, would bring enrichment, progress and happiness for humanity.

According to the Web Foundation, over 50% of the world population today has access to the internet. However, in order to accelerate the movement towards global internet coverage and engagement, the Web Foundation recently launched six satellites to further progress true global connectivity and to bridge the digital divide.

With the digital revolution, a vast amount of knowledge and information has been put online, with free access for millions of people across the world, including an increasing number of women and traditionally deprived populations. The digital revolution, driven by the Internet and the recent introduction of modern Artificial Intelligence, continues to open the way towards empowering more people, giving them access to newer ways of learning. There is a tremendous opportunity to ease and erase inequalities.

However, the democratization of learning, with the help of technology, faces many complex challenges.
1 • THE CHALLENGES OF INEQUALITIES AND THE DEMOCRATIZATION OF LEARNING
TEACHER EDUCATION FOR REALITIES OF 21ST CENTURY LEARNERS IN RURAL SOUTH AFRICA.
The challenge of training skilled teachers in Africa.

“...in pursuit of quality education for all in the 21st century, there is a need to rethink how teachers are trained to ensure that all learners acquire the skills they need to participate in the global economy”
The realities of the 21st Century learners require educators to teach in ways that are conducive to how digital natives learn, considering that these learners have to sift through a large amount of information at their disposal (Kelly, McCain, & Jukes 2008). Modern learners, regardless of where they come from, are much more digital oriented than their previous generation. The learners are exposed to social media and other interactive technologies and are so attached to digital tools, such that they spend most of their daytime on smartphones or tablets exploring the internet, chatting, searching and sharing videos and other content (Quinlan, 2014; Teach Thought, 2018). Such generation of learners needs teachers who can leverage the affordances of the technology available to them for quality teaching and learning. Research has shown that teachers in the developing countries are not well equipped to meet the demands of learners especially those from rural areas and economically challenged families. The question then is, how should teacher education for such environments be designed?

Teachers have a substantial responsibility in realizing quality education for all. The emphasis here is on “all”; this is line with Sustainable Development Goal (SDG) number 4 which specifically calls for quality education for all. This is particular pertinent for developing countries where the levels of inequality are stark; South Africa ranks as one of the most unequal countries in the world. Schools in rural areas and in urban poor areas are bedeviled with lack of qualified teachers and educational resources. Information and Communication Technology (ICT) has the potential to contribute to addressing some of these challenges and even the playing field (Chigona & Chigona 2010).

Teacher education programs have the responsibility of preparing teachers for the realities of the 21st Century learning needs of all learners including those from the rural and less affluent areas. Such programs require an emphasis on the importance of enhancing the theory and practice while developing a strong sense of teacher identity and teaching competencies. To be adequately prepared for the classrooms in the knowledge economy, teachers must possess 21st Century knowledge and skills and be in the position to integrate them into their pedagogies for learners to receive quality education relevant to the demands of the 21st Century. Unfortunately, the teacher education in most countries on the African continent is often blamed for feeding the classrooms with incompetent teachers who are not entirely capable of providing quality education to digital natives.

21st Century teaching should aim to promote higher level thinking skills like analysis and evaluation to remove unnecessary noise and establish the credibility of information (Teach thought, 2018). Therefore, initial teacher education (ITE) is expected to prepare Newly Qualified Teachers (NQTs) to possess, teach and assess 21st Century knowledge and skills which could enable the teachers to engage with the digital natives in the classroom with confidence and impart them appropriate skills. In other words, teacher education programs should equip teachers to be able to

“meet the demands of the global economy by exemplifying, and embedding in instruction, the mastery of 21st Century skills such as critical thinking, problem-solving, communication, collaboration and creativity and innovation” (Greenhill, 2010:6).

This requirement is not only for the initial teacher education, but also for the in-service teacher education. Through Continuing Professional Development (CPD) programs, in-service teachers are exposed to career development where they may acquire relevant 21st Century skills which their initial teacher education did not provide. In-service training may equip teachers who graduated from teacher education years ago with technological skills and the competence to integrate ICT’s in their pedagogy.
In most developing countries both CPD and ITE programs seek to equip teachers with technological skills that can help them teach in the century. However, the training is normally techno-centric; mainly focusing on how to operate the technologies rather than how to integrate the technologies into pedagogy to enhance the teaching and learning outcomes of the curriculum. While the skill to operate the technologies is necessarily, it is not in itself sufficient for the teacher to integrate the technology in their teaching. A recent study (Chigona, 2018) conducted in the rural Western Cape in South Africa on the training of in-service teachers to integrate new technologies into curriculum delivery shows a gap in the knowledge and skills imparted on the teachers. To a large extent, the training focused on how to operate technologies, like computers and smart boards, and not on how teachers can integrate the tools for effective teaching and learning. Again, the training was perceived to be too generic. Although some schools had tablets for teaching and learning, the training did not include the integration of the mobile technologies into the curriculum delivery. Most educators who participated in the study wished for subject-specific training where they could be trained on how to integrate technology into the delivery of specific subjects.

Teacher education should be geared to prepare teachers to understand the relationship between content, pedagogy and technology. The integration of Technological Pedagogical and Content Knowledge (TPACK) theory goes beyond the Shulman’s pedagogical content knowledge (PCK) theory which posit that teachers require both the content knowledge and the pedagogical knowledge on how to deliver the content. TPACK, on the other hand, recommends that over and above the PCK, teachers should have competences to use technology and to understand how to integrate it with the content and pedagogy. Such pedagogies are necessary for teachers to handle classrooms with 21st Century learners and can instill skills and knowledge for work, citizenship and self-actualization. It can be said, therefore, that TPACK contribute towards meeting the realities of the 21st Century classrooms. Through infusing TPACK into teacher education programs, educators get empowered with 21st Century knowledge and skills and the know-how to integrate them into their classroom practice so that all learners are well prepared for the challenges of a global economy.

There are also challenges on the types of technologies used in teacher training. To ensure quality teaching and learning in the rural areas in the 21st Century, there is a need to pay cognizance to affordable technologies which would be accessible in those areas. Most training programs focus on the use of Personal Computers (PCs) for teaching and learning. In most cases, the training institutions have computer laboratories and the instructors also use PCs for administration and preparation of their work. In contrast, the majority of teachers trained in these institutions end up in less affluent areas where learners and their families may not be able to afford PCs or laptops. In cases where the technology is available in the schools, the computer to student ratio is too high to make a significant impact to the teaching and learning; and may in fact negatively affect the education process. Again, internet connectivity and electricity may also be challenges to this process.
The challenge here is that though most learners in South Africa and the continent are digital natives, the most common and accessible technology they can afford is mobile technology. Mobile technology is penetrating at a fast rate in most parts of the country and the continent. According to the GSMA 2018 report, “overall subscriber penetration reached 44% in 2017, up from just 25% at the start of this decade. Access to mobile connectivity is vital to empowering consumers and driving economic growth. The technology enhances access to many essential services, including education, health and utilities”. Consequently, learners even from the most remote areas have some access to mobile phones. However, teachers and learners in these areas are not leveraging the technologies available to them. Despite this situation, there is little effort within the teacher education to adopt mobile technologies for instructions and to model teachers on how such technologies can be effectively integrated into teaching and learning. The teachers are not trained and modeled on how to integrate the mobile technologies into their curriculum delivery. It is therefore recommended that teacher education institutions ensure that teachers are well equipped to teach with and through easily accessible and affordable technologies like mobile phones and tablets to align with the technology which is available to the learners, especially in rural areas and from economically challenged families.

In conclusion, in pursuit of quality education for all in the 21st Century, there is need to rethink how teachers are trained to ensure that all learners acquire the skills they need to participate in the global economy; otherwise education may serve to perpetuate existing inequalities. Teacher education need to take into account the realities of the 21st Century learner and the realities of resource-constraints in developing countries. Firstly, there is need for pedagogies which empower teachers to integrate technologies into teaching and learning. Secondly, there is need to emphasis on technologies which are affordable and accessible to learners in resource-constrained environments; examples of such technologies would be mobile technologies. Governments need to direct ICT’s towards assisting teacher education to acquire and use resources to train and model teachers to deliver quality teaching to all learners to prepare them for the challenges of the global economy.

REFERENCES


While some progress has been made on the issue of the digital divide, it remains a significant blocker to providing equal access to people of all races and genders.
AI IS DEMOCRATIZING KNOWLEDGE AND EMPOWERING PEOPLE ACROSS AFRICA.
This article explains how learning empowerment relies on infrastructure, and the possibility to access to inexpensive internet infrastructure.

“ICT’s are empowering people to participate and make themselves heard in political discourse as well as improve their socio-economic status.”
“The world as we have created it is a process of our thinking. It cannot be changed without changing our thinking.”

When these words, attributed to Albert Einstein were said, it is unlikely the word ‘digital’ existed as we know it today.

But they continue to reverberate in today’s world of technology, which has taken centre stage in changing our thinking.

Barely a generation ago, learning in many countries was by memorisation. Today, the advance of information and communication technologies (ICT’s) has democratised knowledge and access to information, transforming the ability of people and communities to communicate and offering local businesses of any size unprecedented scale and resources.

ICT’s are empowering people to participate and make themselves heard in political discourse as well as improve their socio-economic status.

Investments in ICT’s have allowed people to access quality online education and other opportunities that never existed previously and reduced social and economic inequalities through inclusive apps.

In Nairobi, Twiga Foods, a start-up working with IBM, leveraged Artificial Intelligence (AI), Big Data and Blockchain to develop a credit score that allows them to provide unsecured loans to women-owned micro-enterprises.

Twiga Foods is empowering women who, under normal circumstances, would never have received credit of any kind from existing lending institutions.

An AI application, m-shule helps young children to learn spelling at their own pace. The application listens to the child’s speech and teaches him or her the correct pronunciation, repeatedly, until the child finally gets it.

The ‘machine’ never gets frustrated as humans do when the learner is slow to understand. It has the patience to repeatedly coach a child until the desired result is achieved.

The concept of smart content is no longer abstract. It has reached not just classrooms but it is now available on smart phones for personalized learning. Elite schools use AI to create digital content with grammar as good as the best English teacher can deliver.

At the United Nation’s Global Pulse Lab in Kampala, Uganda, machine learning is decoding satellite data to help translate the images into information. It is now possible to understand levels of poverty and progress made on the ground much faster.

Where policymakers used to get abstract information about people, today they can have actual data on their status and make informed decisions. Tests on conducting the census on the ground are currently underway. In the next few years governments will almost have real time census data for better planning.

Progress in artificial intelligence is not without challenges. Policymakers across the world need to build up human resource capacity for the emerging Fourth Industrial Revolution that will be largely underpinned by these emerging technologies.

If countries improve capacity, the fears about AI technology annihilating employment opportunities as machines take over from human beings could remain a mere narrative.
AI capabilities allow computers or machines to reason and perform tasks that typically require human intelligence. There are multiple tasks that humans, even with their intelligence, cannot easily perform, like recognizing several faces, remembering specific individuals or noticing that one transaction out of a million is wrong and notifying those responsible.

AI, in effect, is democratising knowledge in ways we never thought would happen.

Whilst providing the best education to every child through technology is possible, the challenge, especially in developing countries is ensuring affordability and access to devices and broadband internet, especially in rural areas where connectivity is limited.

Connectivity is key to greater democratization of technology and enabling inclusive development. According to the 2017 State of Broadband Report published by the UN Broadband Commission, making internet more accessible is a challenge due to the high cost of satellites and fibre optic cables. The report also show access is more difficult for landlocked countries.

There is no doubt that AI has the potential to catalyze change. As the fourth industrial revolution emerges, it is imperative that people are AI-ready, so that they can benefit from the immense potential it provides. More critically, developing countries have to dedicate resources to build sufficient human resource capacity.
WALKING A TECH TIGHTROPE: THE DIGITAL DIVIDE IS GROWING MORE COMPLEX AND MORE DANGEROUS.
In this article Susan Tu and Ian Monroe analyse how geography and poverty as causing the digital divide in the USA.

“.. geography and poverty are the biggest drivers of the digital divide at home, often undertones of race and gender”
For some students a computer is a window to the world, for others it’s still a locked door. Since the birth of computing and the internet, we’ve been flooded with visions of a utopian future for education, where all students have access to all the knowledge they need to grow as individuals and gain the skills needed for a digital future. Several decades into the digital technology revolution, technology is indeed transforming education, though not always for the better, and too often with many students left farther behind.

**ROOTS OF THE DIGITAL DIVIDE**

Technology is undoubtedly a powerful tool, but for tech to be effectively harnessed for education it must include three key components: 1) equal access to technology infrastructure, 2) equal access to high-speed internet connectivity both at school and at home, and 3) equal access to teachers who are highly trained in integrating technology into their curriculum. The “digital divide” in education widens for students whenever any of these elements are absent, with substantial learning inequity still correlated with poverty, race, gender, and rural areas.

Fundamentally, the biggest driver of the digital divide in schools is poverty, followed by geography. In the United States, local school budgets are driven by local taxes, and poor schools have far fewer resources to spend on technology. Wealthy public and private schools often have a computer for every student, matched with high-speed internet and talented teachers integrating customized digital learning into everything from history to computer science and robotics. In poorer schools, computers are generally shared and outdated, network connections are slow, teachers often aren’t trained for how to effectively integrate technology into lesson plans, with half of teachers nationwide reporting inadequate technology training. Those intrepid teachers in poor school districts who do try to harness tech are frustrated by the outdated infrastructure they’re forced to work with. When the United States Federal Communications Commission (FCC) last surveyed schools in 2016, it found that 41% of schools still did not meet the government’s goals for network connectivity capable of supporting digital learning applications.

Even when students have adequate computer and internet access at school, a lack of access at home can put students at a substantial disadvantage when they’re doing their homework. The mainstreaming of digital learning is likely extending the divide from the digital have and have-nots at home. According to reporting by the National Education Association, 70% of American teachers assign homework requiring access to broadband internet, and about 65% of students used the internet at home to complete their homework. Yet 50% of students say they have been unable to complete a homework assignment because they didn’t have access to the internet or a computer, and 42% of students say they received a lower grade on an assignment due to a lack of access. Controlling for other factors, researchers from the University of California have
found this “homework gap” from tech inaccessibility at home is lowering high school graduation rates.

Again, geography and poverty are the biggest drivers of the digital divide at home, often with undertones of race and gender. In the US, nearly 100% of students in households with annual earnings over $150,000 had broadband internet access, but only 60% of students in households earning under $25,000 could afford the same access, and access drops below 55% for Black and Latino families in the same income bracket.

Rural areas remain the most disconnected in the US, with the FCC reporting that 40% of rural and tribal households still lacked broadband access in 2016, and Pew Research finding that 58% of rural residents report problems finding high-speed internet access. It often comes as a shock to Silicon Valley visitors, but many rural areas in hyper-connected California still lack mobile network access, and residents are relegated to dial-up internet, if they have any at all.

Relative poverty and rural locations have also perpetuated the digital divide in education around the world, and in many poorer countries the digital divide has a growing element of gender. According to the International Telecommunications Union, the global internet user gender gap grew from 11% in 2013 to 12% in 2016. The digital gender gap has grown to 31% in the world’s Least Developed Countries (LDCs), with the largest regional gender gap at 23% in Africa. As technology tools become educational necessities, school becomes even more challenging for students without access, exacerbating social, racial, and gender inequities.

**BRIDGING THE DIVIDE**

The US Department of Labor projects that 77% of all jobs will require computer skills by 2020, yet many students are woefully unprepared for this near future. In one sense, the solution to the digital divide is easy: money. Poor and rural schools need funding for computers, connectivity, and teacher training that’s on par with their wealthier, urban peers, and economically disadvantaged students need the same ability to access information and do their homework as their classmates.

Higher teacher salaries can also attract top teachers to underperforming urban schools, which currently pay teachers less for a more challenging work environment. Attracting top teachers to rural areas is even more challenging, but providing the funding needed to empower rural students with the same educational opportunities can help convince families to move, alongside increased job opportunities that come with better access to technology. Equal funding for education technology and teachers won’t fix all problems, but it can do a lot to level the digital playing field, which is needed for both student and overall economic success in our modern economy.

But to fully realize the promise of technology in education, we also need to re-engineer student expectations. Teachers need to not only have all the technology tools and the
training to harness them, they must also have the ability to inspire students to see their larger potential, even if they come from a disadvantaged background. Mentors and peer networks can also be key ingredients, providing logistical guidance and emotional support for navigating complex career paths that are well-supported in more privileged communities. To be sure, not every student can or should go into a high-tech career, but all students deserve a quality education integrated with modern technology tools and a career support network so that their life path is chosen rather than determined by circumstances beyond their control.

**HOW MUCH IS TOO MUCH TECH?**

Despite our global fixation with training the engineers of the future, it’s essential to realize that not all technology helps with learning. Too much of the wrong technology can be a distraction or a downgrade from conventional instruction. Tech is, of course, a prerequisite for subjects like robotics and computer science, but the best teachers use technology elsewhere to supplement their lessons, rather than replace them. A virtual reality experience can’t replace a science experiment that makes concepts tangible, a field trip that brings history and the natural world to life, or a classroom debate that evolves into truth and complex understanding beyond an easy answer from Google.

Just as obesity is a bigger problem than starvation in many places, too much screen time is becoming a bigger issue than too little, as phones and computers become primary entertainment devices. Students are increasingly saturated by addictive habits, which distracts from learning, and can erode social cohesion and self-esteem. The New York Times reports that half of American teenagers feel addicted to their devices, with 78% checking devices at least hourly, and 72% of teens feeling pressure to respond immediately to texts, notifications, and social media messaging. University of Texas research has found that adults perform work tasks poorly when their phone is in the same room, even when the phone is silent, suggesting the mere thought of our dopamine delivering devices distracts from focused thinking.

Social media also often amplifies youthful insecurities and may be contributing to a growing epidemic of loneliness and social isolation, leading to anxiety, depression, and even suicide. As the past few years have made painfully clear, social media can also steer both students and adults towards misinformation, tribalism, hateful rhetoric, and deliberately divisive content that undermines both evidence-based learning and the shared understanding foundations of a healthy democracy.
A new digital divide is emerging in the US between wealthy parents who restrict their children’s screen time and poor (often minority) parents who don’t. Given how much profit-driven tech is optimized for engagement and distraction, it’s telling that many Silicon Valley executives and engineers are now sending their own children to technology-free schools, like the Waldorf School of the Peninsula, which doesn’t give students digital devices until 8th grade. Wealthy parents are increasingly severely restricting screen use at home, and even making nannies sign contracts to keep phones and tablets away from their children. Lower-income teens are now spending over 8 hours of screen time each day, over 2 hours more than their wealthier peers, according to research by Common Sense Media, and black and latino students spend even more time glued to digital entertainment devices.

The most successful students at Stanford and other top universities are creative thinkers who can synthesize complex information and use it to advance their passion, whether that’s discovering a scientific breakthrough, starting an innovative company, or emerging as a leader who can inspire others to scale change. Knowing how to harness technology to achieve learning and career goals is one element of success, but it is just as essential for students to know how to make authentic human connections, foster creative collaboration, tell compelling stories, and focus away distractions. The right mix of technology undoubtedly has a vital role to play in preparing students for our digital future, but much of the most important learning is absorbed best when the screen is off.
WHERE CAN AI REDUCE INEQUALITIES?
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This article explains how enabling people’s empowerment through knowledge and development depends on good governance and wise leaders.

“...The new technologies cannot work in isolation. A link with society and its capacity to absorb progress needs much intricate anthropological research beyond the paradigms of management studies.”
Global inequality is on the rise but government’s capacity to tackle it is getting reduced. The gradual shift of capital from public to private ownership weakens government capacity to bring meaningful reforms. New Technologies can come handy in addressing this situation but prior to that one needs to understand the nature of the problem and the subsequent plan to use them as remedies.

The new technologies are an astounding breathtaking discovery for the current era. Much of that work which involved intense human suffering such as heavy machine road building work, unsafe industrial areas, sewer cleaning, deep mining and most areas which lacked occupational safety and human respect are now being taken over by robots. These new technologies are governed by Artificial intelligence (AI) which continue to grow towards increasing sophistication through information fed by Big Data. From driverless cars to playing Beethoven on piano, the machine can do everything. Women need not sacrifice their career for home care and need not ignore the elderly and patient care for the sake of time. There is always some support from modern technologies to share much of our burden today. Our smart phone is our most loyal secretary. However, the fact whether this is reducing educational divide in terms of geography and gender is something to investigate.

Some of the pathbreaking revelations on inequality have emerged from the first ever World Inequality Report by the World Inequality Lab with studies from the Paris School of Economics and University of California, Berkeley. Inequality is a measure of how far the distribution of incomes differs from if all countries had the same income. One basic finding of the report which may be crucial for this article is that the ownership of the capital significantly influences inequality. The global top1% capturing almost double the growth of 50% poorest of the poor requires attention. This condition of global capital leads to individuals who are accumulating the benefits of increased capital and depriving the state to do so. The Report suggests that even if all countries had the same wealth, the ability to address inequality may not really be equal with all of them. Most poor nations of Asia have made wealth and increased growth rates but this has gone into the control of private few. The question here is whether the coming of new technologies such as the Artificial Intelligence (AI) powered with big data analytics can help governments to bridge and minimize persistent inequalities.

One is aware that governments have remained poor despite their countries earning huge amounts. Two problems are visible in the debate on inequality and the role of new technology to minimize it. One, can governments reclaim their lost ground to private ownerships and second, could the use of AI tools by governments help in minimizing inequality. As the world moves towards a global concern to have inclusive governance it is disturbing to see the female workforce participation rate sinking across the world. India has the lowest female workforce rate stagnating at 24% in the whole of South Asia and the Economic Survey’s 2018 startling revelation that of the 20 million women who fell off the labour map a large majority of them were educated women.
Somewhere the environment is not conducive to inclusive, safe and scientific management within organizations. Can AI resolve the daunting task which has more to do with global flow of capital than with merely the machines?

The task is not so easy to obtain. The capacity of governments to use AI tools is much limited. The role of AI in reducing educational and geographical inequalities is pushed much behind the larger questions of how economy is structured globally. Looking at the growth and distribution of global income since 1980 one is appalled by the fact that the global top 1% earners have benefitted twice as much from the growth as the 50% poorest. The global middle class which is traditionally aspiring for better educational and subsequently livelihood opportunities nationally and globally is almost 90% in Europe and a little less in India and neighbourhood nations is the most squeezed as these aspirations are becoming most obstructed. However, this is the class which has produced the richest intellectual power across the world as an ‘engine of growth’. As per the OECD estimates the size of this global middle class would increase from 1.8 billion in 2009 to 3.2 billion by 2020 and 4.9 billion by 2030. Asia will witness the bulk of this growth at 66% of global middle-class population and 59% of middle-class consumption compared to 28% and 23% respectively in 2009. Mario Pezzini in the “Emerging Middle Class” suggests that consolidating this incipient middle income group into a stable middle class could provide a solid foundation for economic progress by driving consumption and domestic demand. But how would one stabilize this ‘emerging middle class’? The only way out is to increase opportunities in education and research which would generate aptitude for global competitive skills, an edge on information generation, corroboration and application. However, notwithstanding the need for increasing opportunities in education and research, these areas on the contrary are currently slipping out of the hands of governments for reasons that the country’s capital is not really with the government but with a handful of the rich.

**INADEQUATE SPENDING ON RESEARCH & DEVELOPMENT**

There is little scope most governments to invest in new technologies as the spectre for government spending in research is already quite low and stratified. There is also a complete lack of transdisciplinary team building which provides a spine to new technologies such as AI etc. Of the major economies of Asia, India’s spending on R&D in terms of percentage of GDP is mere 0.6% which is much below the Malaysia (1.30), China (2.1), Japan (3.28), Israel (4.3) and Korea (4.2). Out of the top 2,500 global R&D spenders, India accounts for only 26 companies as compared to 301 Chinese and further India does not have a single firm in the top ten R&D sectors in contrast to China which has many firms in all ten.

The new technologies cannot work in isolation. A link with society and its capacity to absorb progress needs much intricate anthropological research beyond the paradigms of management studies. The condition in social science research (SSR) across the countries
is much worse and even in USA spending on this research is relatively a very small segment of the total of National Science Foundation funding. Interestingly even as India’s Gross Expenditure on R&D has tripled in the last decade, the spending in terms of GDP has remained stagnant. Questions such as ‘relevance of research to immediate policy implementation’, ‘to disease control’ and to ‘winning wars’ have silenced research which provides sustainable and more holistic foundations to scientific research such as the one on ancient civilizations, archival histories, arts and aesthetics, institutional evolutions, nonhuman cognition and social science based research on disaster risk reduction. In 2010-11, the share of expenditure on SSR as a percentage of the total Union budget was 0.025%, whereas it was 0.86% for pure science research. A relative scenario suggests that India lags behind in spending on SSR in significant degree and is declining.” (Falak 2016) The situation looks pretty interesting when one views India’s position in SSR vis a vis her neighbours (Dhawan et al 2015). This disparity in research spending and production further deepens as studies suggests that in the region, India overpowers the rest even though a deep disparity exists in comparison to China and Brazil which lagged much behind India till 2007 but soon after left her behind. One can understand the immense disparity which exists between research spending in South Asia vis a vis others. The region remains a home for the largest number of poor people in the world.

It is visibly evident that educational disparities ultimately create islands of progress as prosperity fails to percolate both within the country as much as outside the country. The new technologies if appropriately utilized can build bridges faster than what the governments may be capable of, but this needs a better understanding of global and local society by the engineers who generate this technology.

HOW COULD THE GOVERNMENT PLAN WITH 50 BILLION SMART OBJECTS?

There are more than 1 billion WhatsApp users and more than 80 million Netflix users in the world spending around 4 hours of their day on their mobile device. This only shows an increasing human dependence upon content, data and information over the internet. The growth of internet of things is stupendously extraordinary. In 2006, there were ‘just’ 2 billion connected objects which is likely to cross 50 billion by 2020. This suggests 7 smart objects for every human being on Earth. This may create a need for data, data traffic management, classification and crisis management to deal with contingencies of network-wide issues. BigData adoption reached 53% in 2017 up from 17% in 2015, with telecom and financial services leading early adopters. The government ought to start thinking about these issues and balance scientific and sociological research to related regulations to avoid the disaster of network failure. Governments should also start raising new institutions of transdisciplinary learning, scholars and technologists who think about their existence in an ecosystem before designing technology.
Most of the reports on educational improvement suggest a much greater attention to improve math and cognitive skills starting at the level of school teaching with encouragement to curiosity, investigator led exercises and new original context to information. Even though education cannot teach everyone to be Mozart as Aoun(2017) suggests yet education should cultivate creativity. The author of the best seller ‘Robot-Proof’(2017,Cambridge:MIT Press) is of the view that basic maths, coding which create a syntax of computing may be generating knowledge basis of the future. AI programs may have popular music and archival labs as much as labs for higher engineering skills. The Sony computing Science Lab in Paris released an original jazz and pop composition to the surprise and desire of many across the world. The landscape for AI, big data and knowledge appropriation is much larger than one can think of.

A Country which not only grabs this opportunity of investment but also does it with a plan and focus into social needs would be able to reap the benefits which otherwise have a great possibility of being wasted to deepen the pre-existing divide.

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AI and digital are an opportunities to rediscover particular cultural heritage and help fight against the temptation of global learning standardization.
3 • CULTURAL EMPOWERMENT
CAN TRADITIONAL IDEAS BE INCORPORATED INTO THE EDUCATION SYSTEM OF THE FUTURE?
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The author sees Digital Tech and AI as an opportunity to allow each culture to rediscover their own cultural heritage.

“A new education paradigm that can take the best of both systems would be perfect; it might just give our next generation a competitive advantage”
Education everywhere is going through a massive churn. It is remarkable that technological progress has made it possible to consider -- maybe even imperative to consider -- elements of traditional systems. What we have endured over the last couple of centuries is a system imposed by the (First) Industrial Revolution. It’s time to revisit it.

Among other things, that revolution created William Blake’s “dark Satanic mills” -- impersonal, soul-deadening industrial complexes that pulled people away from the agrarian life. These factories required a cohort of people who were literate, and able to follow instructions. No need for them to think, or to be creative: that was the prerogative of the small group of engineers and managers.

There is a remarkable contrast between this system and what existed earlier. It appears there existed a broad, humanistic educational system with significant customization as well as practical problem-solving.

The Fourth Industrial Revolution that is upon us, and especially the proliferation of computing power and Artificial Intelligence, negates in toto the requirements of the First. We no longer need armies of drone workers toiling away, like Charlie Chaplin in Hard Times. We have real robots to run factories, and increasingly, to take over white-collar jobs. A much-quoted Oxford study, “The Future of Employment: How Susceptible Are Jobs to Computerization?” predicted that 47% of all jobs today are at risk of being automated away in the next 20 years.

We can see that in practice: engineers once used slide rules and log tables, but the electronic calculator has made them superfluous; we had paper maps for navigation, but GPS and Google Maps have made them redundant; our children still memorize vast quantities of (useless) information, which they could look up on Google or Wikipedia in seconds. Thus, the very basis of ‘education’, the ability to memorize and regurgitate in examinations large amounts of data, is no longer a useful skill.

Furthermore, the nature of work is changing, and quite rapidly. Earlier, people used to change jobs, but now they change careers, often pursuing three or four in sequence as their interests change and opportunities arise. In addition, the half-life of knowledge is diminishing rapidly. A computer language you learned 10 years ago is almost certainly obsolete today, and so you need to keep learning all the time, just to keep up.

Besides, the very idea of a ‘job’ is looking shaky: the comparative advantage of large firms -- the reduction in transaction costs as in the Ronald Coase theory of the firm -- is being eroded as the ‘gig economy’ grows and the ‘death of distance’ is upon us. We may instead have ‘federations’ where free agent workers come together for a specific task, complete it, and move on.

There is also a nightmare scenario: a large number of people may become permanently unemployable, as their skills are no longer useful, and will never be. The conventional wisdom is that the displaced workers could be re-trained for the new types of jobs that will arise (e.g. bank tellers displaced by ATMs were re-deployed as relationship managers), but that can only go so far. The claim for Universal Basic Income in some quarters suggests a future where some people will in essence be surplus, useless to the workforce (historian Yuval Noah Harari expands on this in Homo Deus). The trick for each individual is to avoid that fate through choosing education wisely.

Thus, the demand-side for education is undergoing a sea-change. People will increasingly demand high-flexibility learning that enables them to come up with creative solutions to new problems at hand: that is what will get them the gigs and enable them to make a living as free agents.
Fortunately, the supply-side is also changing, and that’s where both technology and traditional learning come into the picture. Consider the possibilities of technology. We can now envision truly customized education. A curriculum, lesson plans, tests, and self-paced learning that are most appropriate for a specific individual are now possible through the application of AI techniques. Instead of a large classroom where the instruction necessarily focuses on the average student, thus handicapping both the bright and the slow, each student can be taught, tested and challenged according to his/her own interests and capabilities. This requires the collection of masses of detailed data about current curricula and educational outcomes. Then a machine learning algorithm can crunch these datasets and propose plans for future students.

There are also several experiments using blockchain as a mechanism to transition from ‘vertical’ learning (where a teacher lectures to a student) ‘horizontal’ learning (where there is significant collaboration between students as well). In collaborative learning, a student who helps others may also earn ‘credits’ on the blockchain and be able to leverage that in the job market.

In addition, there is a plethora of learning material out there, available to all -- the tyranny of distance is no longer a problem. With 4G bandwidth and a smartphone, most students have access to MOOCs (massive open online courses), much of which are free. There is Khan Academy, Coursera, Udacity, TED, Wikipedia and edX; and then there is YouTube. You don’t have to enroll at a premier institution to be able to (more-or-less) get the experience of being taught by an outstanding teacher. (Universities of course do of course have other virtues: the value of signaling via a degree, and of peer groups.)

Secondly, in the future that we can glimpse, the focus on STEM (science, technology, engineering and mathematics) may turn out to have been inappropriate. STEM is seen as valuable and tangible; whereas the humanities are seen as soft, intangible and essentially useless. In fact, the ‘hard’ STEM subjects have become too abstract and removed from reality. Engineers design on computers; hardly anyone does actual things with their hands. That is seen as the job of underlings, because it will get their hands dirty.

The Maker Movement, which encourages the physical creation of things, for instance through 3-D printing, may also be an antidote for bookish learning.

The other problem that has afflicted many is the preference for English. For the first time, we can see a future where real-time translation enables people to learn in their mother tongue. If automatic translation becomes routine, then all of a sudden it becomes easy for mother-tongue-speaking students to understand all the material out there in MOOCs.

That brings us back to the question of what might be useful in traditional education. The pre-industrial Indian curriculum documented by Dharampal et al included Grammar (vyakarana), Rhetoric and Logic (tarka), Mathematics/Astronomy (ganita), Esthetics (rasa), Ethics (darsana), Political Science (arthashastra), and Epistemology (pramana). Remarkably enough, these are subjects that will produce well-rounded individuals, the kind who can relatively effortlessly learn new things. Quite the broad humanities education, far removed from the narrow technical education of today.

Of course, nobody would suggest a wholesale switch from today’s CBSE syllabus overnight to a traditional syllabus, but it appears that ancient gurus knew a thing or two that the most modern could well benefit from. A new education paradigm that can take the best of both systems would be perfect; it might just give our next generation a competitive advantage.
COULD KNOWLEDGE IN THE DIGITAL ERA ALSO BE CULTURAL?
This article analyses the cultural impact of the approach to education. Strong cultural identity is strong protection against learning content standardization, which could lead to the impoverishment of cultures. According to the author, the stronger the culture, the less permeable it is to standardized content.

“Culture also plays a role in the choice of content, true understanding of the approaches as well as whether or not the values conveyed by the learning and skills offers are accepted.”
An 800-page book has just been translated from English to French using AI for the very first time. Taking just 12 hours, the translation was deemed to be highly satisfactory. The program that achieved this unthinkable feat will be made available to researchers as open source, giving them access to a whole new way to exchange knowledge.

It is important not to become blinded by our own culture when we consider digital and new learning opportunities.

Whilst it is true that making learning available within this ‘world of knowledge’ exists, cultures will be fundamental to the way learners will be able to position themselves.

Although digital provides unlimited access to knowledge - at least in certain countries - recognition will only be culturally effective.

As a country that has embraced digital in a big way, Japan is a group society where individuals must constantly position themselves in a way that is approved by others. You would think that expensive and tiresome school evening classes lasting until 9pm or even 10pm could decrease to make way for digital learning. But this is not the case. A physical presence is absolutely essential to ensure students attend the right school followed by the right university which will determine their entire lives, professionally as well as socially.

Why? Because as well as school subjects, students also learn about behaviour, being part of a physical, tangible relationship that commands authority, respect and interaction. In addition, the fact that they are deemed compliant makes them good, loyal and reliable future employees. Digital is side lined in this culturally determined relationship between teachers and students, with little appeal.

Establishments that give evening classes have a reputation to uphold. This is why there is more emphasis on image and a personal experience, rather than what is actually taught.

Childhood and adolescence are spent learning, a lot, requiring considerable effort and major sacrifices. Yet the business world will make very little use of this technical knowledge. It initially looks for the right kind of behaviour, followed by a lifetime of training in the necessary skills to suit its changing needs. It is at this point that digital could become more relevant.

This reminds me of an anecdote where a Chinese colleague who had not slept for two days proudly explained why he had taken the morning off. “I took my son for an entrance exam at the best private university in Shanghai!” His son was three and a half. He sat his son on his knee throughout the interview and hoped he would be ‘well behaved’. The interview was actually a contest for a place in the select, private nursery school that would almost certainly lead to the desired university and therefore to the very best jobs.

If we forget our culture, our understanding can never be complete. We have proof that it is possible for anyone of any age to become a high-level IT programmer in France based simply on digital training, but it is a pipe dream to believe that this phenomenon could be universally applicable.

It could be paradoxical to note that cultures where digital is becoming ‘learning’ are those where discussion and sometimes even critical thinking exist. Often, breaking away from this type of interaction and meandering individual thinking is seen as comforting and reassuring. Why elaborate on an argument if multiple choice is the end product? Each time the format of my exams is announced, I can see the students are disappointed. No, it’s not multiple choice.
French culture likes winning people over, including - or maybe especially? - in terms of work. That’s why we need to be good speakers and demonstrators, with an ability to appeal to others and get them on board. But in fact, the educational system and our renowned colleges and universities rarely teach about how digital can have a critical and constructive use. Their focus is more on production rather than interpreting the meaning and reasoning that prevailed over the construction of the content. ‘Digital self-defence’ courses are rare.

Finally, we cannot deny the remarkable way that digital has enabled knowledge to be jointly constructed and made available. Everything is at our fingertips, even the very worst content. We can learn how to build a 3D printer in the desert using semi-industrial waste, but also how to make a bomb.

Digital is also a springboard, a window on standardised knowledge. Certain cultures will choose the more practical side, with connected people seeking only what they wish to find: a language course with very little or no oral aspect, an instruction manual or a method of acquiring a very specific technique. This also explains why learning programs are often coupled with learner communities. Some people find that technical acquisition is not enough.

Last but not least, there is also the question of cultures which produce digital learning and skills content. Providing a program or MOOC is also about passing on a form of thinking that goes beyond the basics. Standardisation aims for the greatest level of understanding possible and makes it easier to assess knowledge acquisition. Ultimately, therefore, it is training for communicating more widely across the world using one language such as English, for example; as well as in ways of writing, creating hierarchy, presentation and knowledge. In this respect, digital helps bridge the gaps in accessing education in terms of social categories, geographic areas or gender.

Girls learn extensively via the internet in Japan, languages in particular. These girls will have the most contact with foreigners due to their mastery of the English language. They do not see themselves as being in competition with men, just that they have invested in a different field with different learning tools. They will be useful to their company... at least until they marry. This famous M-shaped curve - the rise of young single women in the workplace, collapsing between the ages of 24 and 29 before recovering partially then falling away drastically from the age of 50 is tending to become less pronounced due to the major Japanese demographic crisis that exists nowhere else in the world. But their status is downgraded as they move from full to part time.

In conclusion

Digital offers previously non-existent ways to access a multitude of knowledge in a short space of time, often in our own language due to machine translation. Culture also plays a role in the choice of content, true understanding of the approaches as well as whether or not the values conveyed by the learning and skills offers are accepted. Whilst claiming to be universal, the underlying elements may turn out to be deeply out of sync with cultural realities (role of the teacher, peers, age or social class, ethnicity or even caste).

This is why digital learning must be considered as part of a wider system, rather than simply being a technical way of making approved and ‘standarisable’ knowledge available. Appropriation is a cultural act, as is the recognition of its relevance and its approval by a type of human society.

It is true that digital learning is a way to access wider understanding, see and hear the best specialists in a particular discipline, receive pre-packaged and efficient knowledge, and simply to understand that other things exist beyond what we experience in the place where we experience it. But cultural differences must not be overlooked if we are to avoid suggested content being misunderstood or even rejected.
“I never teach my pupils. I only attempt to provide the conditions in which they can learn.”

Albert Einstein
CHAPTER 2

AI AUGMENTED HUMANS.
There is a big temptation to leverage the development of new technology and AI to promote more effective learning for economic profitability. It is a fact that until recently, education models focused on providing students with the requisite skills to become skilled workers. Yet how many of those education models are relevant today, when a more of those skills are now being adapted into Machine Learning (ML). Will robots or cyborgs be more efficient than humans?

Besides, as people live longer, as machines evolve, there is a broad consensus that learning is going to be a life-long activity enabling continuous re-skilling for all people.

Collaboration, cooperation, interactivity, multidisciplinary, and experience-based learning and the key words that describe learning in the digital era.
1 • INCREASED EFFICIENCY.

A newer collaboration between humans and technologies for the sake of efficiency.
PROBLEM SOLVING USING YOUR COGNITION: The Only Skill You Need to Learn to Work With AI.
Because Digital Tech and AI free us from the administrative burden and operational constraints, students can better focus on personal needs.

“Freed from efficiency, in the digital age we find a new challenge and a new unexpected ally.”
A blood glucose test requires fasting for several hours before the test. Medical science established long time ago that eating influences the level of glucose and that this would bias the test in ways that made it inconclusive.

But although fasting might make sense for glucose or triglyceride testing, entire batteries of tests are also being conducted this way just because our knowledge about this test was developed like that. Moreover, the metrics and the diagnostic algorithms that populate blood testing analysis have all been developed with the underlying assumption that people have fasten before the blood extraction.

Problem is that people in their normal state eat throughout the day, and that recent studies indicate that both fasting and non-fasting blood tests produce very useful results. In fact, recent medical studies suggest that glucose and triglyceride levels after-meals are actually more accurate predictors of disease risk than the traditional blood tests.

So, is all we know about blood testing wrong? Of course not; but it is incomplete, as it only explains one portion of the entire reality. The blood testing example is just one illustration of the type of knowledge that we rely upon today. Knowledge that was developed before the digital era.

Before the digital era, obtaining data was expensive, storing data was almost impossible (note that the data storage technology and prices have only improved significantly for the last 20 years and humans have been conducting blood tests for centuries) and computing the data has traditionally been very expensive in both time and resources.

On top of that the world around us is complex, there are a myriad ways of analyzing the data, and many of these ways yield interesting results. There are so many avenues of research that promise to deliver revealing patterns that, at the start, the question was: which patterns do we base our initial knowledge upon?

In the world where we come from, where things were expensive, the patterns that were initially used were often related to making things more efficient. Human beings even created an entire field of knowledge -- named Business Administration -- to help people organize themselves so they can produce things cheaper and with less resources. Aligned with this objective, the entire educational system revolved around this mantra and knowledge development focused on finding new patterns and disseminating them in large rooms where a lot of people could be trained more efficiently and at the same time. To make this happen memory skills were important (remember that storage was expensive) and knowing and applying the patterns that were instructed was considered ‘good knowledge’.

This system was very successful, and it enabled humanity to develop the most efficient system of creating, producing and enjoying things that has ever existed. It became so successful that it even undermined itself, by making things so efficient, it eliminated the very same constraints that created it in the first place.

Freed from efficiency, in the digital age we find a new challenge and a new unexpected ally. In blood testing, we know now that ‘fasting blood tests’ only provide a small amount of the total information that blood can provide. By the same token, most of the reality that surrounds us remains unexplained, in other words, our current portion of knowledge has only structured a small portion of the entire reality. Most of the total reality of the sciences still remains largely unexplained - and therefore unstructured.

Unstructured reality is not a good thing. This is knowledge that we don’t have and that we cannot benefit from, but it can ‘happen to us’, for instance, something happens in the body that provokes cancer, this can happen to any of us, somewhere in the body there is a switch that can start (and stop) cancer, the same happens with tornadoes, planets, companies that go bankrupt, why so many new startups fail, etc.
But now we are not alone, for the first time ever, we will never learn alone again. Artificial Intelligent (AI) systems are going to be there to make automatically efficient whatever task we need. This is a new way of learning, a new way of trying to structure knowledge and, most importantly, a new way of teaching how to learn.

So, how people should learn from now on? The one key skill that people need to develop and empower is actually “what makes you, you”, in other words, your cognition. In the era that we are entering, where only a fraction of the entire reality is known, and where we have an ally that works 24/7, that can look at the world through lenses that are not natural to us, and that can compute at speeds we are unable to, it is safe to assume that, over time, these mundane tasks will be relentlessly taken over by AI systems.

The one thing that will not be taken over by machines is our own cognition, our own way of seeing the world. The way be come up with an idea that suggests that an underlying mechanism might be there, in essence, the human cognition that made people in the past create hypotheses that were not intuitive from the phenomena or the data that was being observed.

So, how do we teach this to young people? Bottom line is that finding a new way of solving a problem is more important that getting the answer right, especially if the answer was obtained using a known method. To do that students of learning can benefit from many sources of inspiration, such as how a similar problem was solved in another field, or how they solved it in the past. Or maybe they saw something similar in a videogame, or from a simple observation that they gathered when someone was cooking dinner.

For students of learning finding new ways to solve problems where the answer is known will prepare them for the kind of life they are going to live. This is a live where they will have to find a way to solve a problem in a world where most of the answers are still unknown. Learners can face this future well equipped if they understand the concepts inherited from the pre-digitalization era together with a well-honed creativity for problem solving that comes from their own way of looking at the world - in the digital era knowledge is the advantage of seeing a pattern for solving a problem that the others can’t see.

Blood carries your heritage, same as the pre-digitalization gave us some gifts. A small portion of reality was untangled and an AI system was enabled to help us decipher the next chunk of reality. It is the responsibility of the students of learning to empower their perception of the world. They can do that first with problems that are well known and during throughout their lives by tackling unsolved problems. After all, AI can accompany you through the learning process, but the responsibility of learning by empowering your cognition -- is still yours.
HOW DOES AI IMPACT EDUCATION?
AI is a high performing technology tool. It improves personalized learning, provides individualized education and allows teachers to concentrate on their core mission, instead of carrying a substantial amount of time consuming, administrative tasks. When used properly, it can eliminate social differences.

“It will make future education easy, accessible, and more effective than ever.”
Artificial intelligence has changing the way we live, work, and communicate with each other. These days, we are witnessing the emergence of unprecedented services and applications such as autonomous vehicles, drone-based deliveries, smart cities and factories, remote medical surgery. In these applications, we see that AI technologies are extending the horizon of human intelligence, adding new values and improving the quality of services and applications. Indeed, AI technology has changed various fields previously considered to be in the human realm. One such field is the education. Simply put, education is a process to deliver of knowledge, skills, values, and information from the educator (teacher) to the learner (student). By using AI as an educator or assistant of the educator, education can provide far greater value than today’s education does. There are many discussions among educators, engineers and researchers on how AI will shape the future of education. It is not easy to predict all detailed aspects. However, general direction is clear and inevitable; It will make future education easy, accessible, and more effective than ever. We will go over some benefits that AI-based education can offer.

**AI CAN PROVIDE INDIVIDUALIZED AND INTERACTIVE EDUCATION**

Imagine a classroom with lots students. There would be a brilliant student who understand fast and wants to know advanced issue. There are also students who learns very slowly. Teacher cannot satisfy all the students since the level of understanding is quite different. Clearly, it is impossible mission to satisfy all students’ need and this is the case where AI can come into play. AI based education system can provide a learning to satisfy individual student’s needs. Specifically, AI-based system in a form of chatbot and interactive system (monitor, speaker, and mic) can check the student’s level and then provide an education optimized for the student’s level. These days, there are some efforts to develop AI-based digital platforms to provide customized learning, testing and feedback to all level of students. As we are all aware, the problem in our education system is that there are too many students who cannot follow the class and thus derailed from the course, ending up being juvenile delinquents. AI-based education system will be a powerful tool to help students who cannot achieve his/her goal with a today’s education system.
AI CAN TAKE CARE OF ADMINISTRATIVE PROCESS

In our life, many of dirty and hard works have been done by the machine. Imagine cleaning, dish washing, laundry, and even patrolling. Same thing can be applied to the education by the help of the AI technology. AI-based smart education system can take care of the tedious and painful administrative process. By administrative process, we mean the homework generation, posting, and grading, evaluating essays and providing feedback and markup to the student. It is a boring process, taking lots of time, yet not so rewarding and unavoidable part of the education. Traditionally, these types of works have been done by the teacher and teaching assistant. Over the years, however, machines have taken care of basic stuff like simple grading (such as the grading of multiple choices type exam). With the help of AI, machine will evaluate essay-type problem and also take care of more atypical jobs. Teachers can save time and focus more on the productive and meaningful things, such as developing creative problem set, re-designing the lecture, or finding innovative way in the education.

AI CAN IMPROVE ACCESSIBILITY, LESSENING UNEQUAL OPPORTUNITY

One serious problem in today’s education system is that lots of students have different starting line due to lower wealth, lower health, lower parental education levels. We need a new platform to provide better accessibility to those having unequal opportunity. AI would be a knight in shining armor in solving the problem! AI-based education system, along with improved communication infrastructure, can help those who speak different languages or who have hearing problem or even those struggling with basic concepts. Language translation can be done quickly and in fact instantaneous, student in an undeveloped country can learn directly from the world-renowned scholar in the developed country without hassle. If you cannot come to school due to the medical illness, AI-based system will help you.
We see more and more examples of cooperation between humans and machines for increased efficiency. We are learning in different ways, learning through experience, using different technologies. AI can be designed to cooperate with humans to help them achieve their goals.
2 • LEARN DIFFERENTLY.
MICROLEARNING: TURNING LEARNING INTO HABIT
The efficiency of micro-learning, a possible lifelong activity. According to the author, this means better focus on skills rather than just learning the facts.

“that in the world of ever more radical and rapid changes, acquiring the habit of learning is a matter of survival”
You may have heard that it is possible to change a habit after repeated a new routine for 21 days. Jeremy Dean psychologist has a profound study on the subject, which shows that this cannot be generalized (varies from person to person), plus there are habits that are easier to be adopted in than others. An example: drinking a glass of morning water took 20 days to change a habit, while tasks more “difficult” as do 45 minutes of exercise every day, it took up to 84 days to be incorporated to everyday life. In the best-selling book “The Power of Habit”, Charles Duhigg reveals the cycle that makes an activity turn routine: Trigger / Action / Reward. If the reward generates value, the looping begins, and the habit is established by repeating the action with each trigger.

This reasoning is important in the face of the challenge I have been seeking to address: how can we encourage habit by continuous learning? If we live in the age of information and knowledge, how to awaken in people the pleasure of discovery? Or, in a different way, how to assimilate habits and routines that can meet a recent demand that is to learn and unlearn continuously. If, on the one hand, there is new knowledge being built in real time, on a planet connected by the networks, on the other hand there is a need for old beliefs to be discarded because it is necessary to open the mind to new ways of looking and not only to reaffirm what has worked out in the past. Looking in the rearview mirror is not going to point us to the future, it just helps us understand the past.

One of the first s assumptions that I believe are fundamental to this new paradigm of education in the digital age is to end up like the myth that learning needs to be “boring” tedious, sitting in class listening a teacher “that knows everything.” As a teacher / student of the digital society, I am convinced that in the world of ever more radical and rapid changes, acquiring the habit of learning is a matter of survival. And that is where an approach that brings newness to the process of teaching and learning comes in: microlearning. Microsoft has a study that shows you can teach something in eight seconds.

Microlearning can provide answers to social phenomena that are incontestable, such as:
- Inattention: more and more people get tired of everything. Quickly;
- There is no time to lose: there is no time for superfluous things;
- An average citizen does on average 140 phone interactions per day. That is: there are those who do ten or 20 interactions, while there are “heavy-users” who perform hundreds of activities.
Some cases in the market begin to show that microlearning can be transformative. The Duolingo application, a leader in language teaching, today has more than 10 million users. And it is interesting to understand the behavior of this user: a survey released by the site shows that 30% are nothing or little active, but 10% of users break all records and win every stage.

Companies like Bloomindale’s, Merck, Toy “R” US Canadas, among others are also using this approach for amazing corporate training. Merck has achieved an 80% increase in its voluntary program using microlearning. British Telecom points out that it has been able to increase the call center’s knowledge about call processes by 86% - even using a total training time of 24%.

In Brazil, there are cases that prove that microlearning is not a dream. The Qranio - Making Learning Fun, is an application, from Juiz de Fora (MG), has 1.3 million users who learn and earn awards for it. In addition to the so-called direct-to-consumer (B2C) market, the platform is also used in corporate (B2B) projects by companies such as Bradesco, Bob’s and Eli Lily who use Qranio technology to empower their employees.

Faced with so many facts, research and studies - I started a series of conversations with potential partners to take advantage of some opportunities and I received the positive signal for two initiatives, both using a platform that is the Brazilian preferred in the case of electronic message - WhatsApp. Using simultaneously two resources - the distribution list, for sending videos and audios of 3 to 5 minutes duration, infographics, links to videos, articles, eBooks and presentations on the web.

The first project was with Secovi University, the school of executive programs that aims to train professionals for the real estate market in the State of São Paulo. We developed a one-month course - “Innovate or Die” - where participants, mainly brokers and business agents, can learn concepts such as the new consumer, human-centered design, innovation in business models and trends and opportunities in the industry, mainly due to the impact of startups like Craigslist, AirBNB, Open Door, Quinto Andar, among others - that offer different solutions to old problems. The first group started in June 2018 and the second in September.
The second partner that accepted the challenge was the Sebrae/RS, the unit of the National Service of Support to Micro and Small Business (Serviço Nacional de Apoio a Micro e Pequena Empresa) in the State of Rio Grande do Sul. With this partner, three projects have already been developed, with three different courses, for different public:

- A two-week course on “How to Sell More WhatsApp”, targeted at individual entrepreneurs, micro-entrepreneurs who earn up to $ 20,000 / year. The content of this course deals with techniques of sales, service and digital marketing to improve the performance of these entrepreneurs;

- The second course, lasting three weeks, “People Management in the Digital Age” aimed at owners and managers of human resources of small companies, (with invoice between US $ 90,000.00 and US $ 900,000.00). The topics of this course were how to reconcile conflicts and interests between different generations, trends in people management and new and best practices to attract, select, hire and retain talent.

- The third, also lasting two weeks “Tendencies and News in Agribusiness” is directed to the small rural producer and aims to guide you on new technologies such as artificial intelligence, drones, robotics, ecommerce, internet of things and other news in the day-to-day of the small property.

The results so far have been encouraging to the point that Sebrae/RS has already made the first group of facilitators - professionals able to create and facilitate courses in this format in order to multiply the number of students in the coming years.

The hypothesis we pursue consists of:

- organize the content in small doses of knowledge, in different formats (videos, audios, images), consuming varied slices of time to allow each one to be able to fit the study into his routine, be it in the bus, in the subway, in his favorite room home or library;

- encourage group discussion of instant messaging, bringing questions that link the contents with the reality of each one in their professional day-to-day;

- individual creative activities. That they are simple, quick to do, but require reflection on how the content can stimulate a change in behavior and in the activities of each participant;

- encourage that learning through microlearning can become a habit for all participants.
“Innovative since sending content”. This is how Raffaella Zampieri Bof, partner and CEO of RARA Imóveis real estate, classified the course “Real Estate: Inovative or Die”. A student of the first class, Raffaela praised not only the quality of the course and the practicality of using WhatsApp, but the adherence of the microlearning approach to day-to-day life. “With the content in the palm of my hand, I took advantage of loopholes in my day to listen to audios and watch videos”, comments the student.

“Today we live in a society that is increasingly looking for quick answers to solutions to problems, especially when it comes to adult education, in this sense using WhatsApp as a tool to promote and generate knowledge become indispensable to meet the demand of this consumer, quickly, and from anywhere the participant can connect and be learning and sharing experiences and knowledge. It is an excellent option for entities that act with capacity building, “believes Miriam de Lourdes Menezes da Silva, Sebrae-RS’s educational solutions management.

This same type of opinion is shared by Rubia Marques Dornelles, who is Miriam’s colleague and also responsible for the production of these new products: “Looking for new learning methods is a challenge. Tackling people’s time really has to be about something that piques interest and makes it worthwhile. Using WhatsApp as a training tool was the means to which we decided to invest. The strategy was to use the practicality of the application with educational contents, where the participants can view at any time and place and share their doubts and experiences with the other participants. The exchange and facilitation of the tutor is what enriches this method. “

At the same time, it must be considered that content fragmentation can bring more complex and profound damage to the approach, there is nothing to fear to try out these new formats in order to connect with an increasingly impatient consumer. In tune with thoughts like design thinking, lean startup and fail fast, we believe that these initiatives contribute to the accumulation of experiences - bringing creative aids to create alternatives to new digital education formats.
TO KNOW OR NOT TO KNOW, DEPORTED MEMORY.
THAT IS THE QUESTION OF AI, PERCHANCE TO DREAM
Will there still be a need for human experts in the digital era? The author believes that AI is merely an efficient assessment tool which must be used for the sake of a specific strategy. Accordingly, there is no competition between humans and machines. The idea is how to use technology and AI to help humans select tomorrow’s elite talents, which humans cannot detect because of their ego.

“Here, he who is knowledgeable is not so much he who knows as he who knows where to look.”
“...All that we see or seem is but a dream within a dream...”

Edgar Allan Poe,

“A Dream Within a Dream”

“To be or not to be”, mused the Danish philosopher prince, and he had two wives at the same time

“To have or not to have”, pondered the political economist, and the immigrant who became an Englishman spoke of comparative advantage

“To know or not to know”, worried the investigator, and artificial intelligence, in reply, observed his brain

But for those who are not contemplating a human skull, or calculating price elasticity, and who are considering far-away artificial intelligence, with the worried concentration specific to a change of scale in society and representation of the other side of the looking glass, where the word returns only after a voyage into the unknown, on a digital vessel named signal, a ship that carries other hidden words, a skiff that crosses the invisible, and who then wonder, like Alice who asked doubtfully, “Must a name mean something?” The question Alice asks, and its form, mark the modest component of genuine knowledge opposed to the arrogance of immediacy of answers on the net, when one need only enter a word to claim to know it. The answer of AI comes to us after travelling through a hidden unknown, the very limits of which we are unaware of.

Who today needs a grammatical, literate rendition? AI stores answers in coded digital form and, through a strange movement of meanings and words, we refer to that as digital, as if we could still count on our fingers or refer to that abstract unknown by a gesture of the hand. Counting, with an ironic and mischievous nursery rhyme which, to teach us to count using our fingers, reminds us of the presence of heaven and hell, the immediate issue being elsewhere. “Cinq quatre trois deux un et une” - to quote the French ditty referring to hell - “plume de fer, nous nous retrouverons en enfer” - and the English, in turn, say - “one two three four five six seven, all good children go to heaven”. Does this mean that digitizing involves either a punishment for evil or a reward in paradise? And can knowledge, that human transgression, still avoid the foretold extremes, fingertips or destiny?

We were familiar with deported memory to an elsewhere which is not oblivion, the computer, the cloud or big data, among other designations, always far removed from us, physically disrupted from our bodies and neurons, at the frontiers of AI. Here, he who is knowledgeable is not so much he who knows as he who knows where to look. But in the world of AI, the very fact of knowing where the information can be found is no longer important to us, except if we want to programme. The regained power of programmers is very probably transitional, just for the time it will take AI to achieve a subtle adaptation to its own assisted or spontaneous programming, as we say in brand awareness, inevitably necessary and precarious.

This situation leads us to consider three consequences and to suggest suitable attitudes, and we do this from our vantage point of observation and action, involving consultancy and teaching at a business school.

**Situation 1:** How can business leaders get their strategy across and apply it, when today any executive and tomorrow any employee has the possibility, simply by hiring an intern, to programme a form of artificial intelligence which strictly answers questions asked without strategic monitoring?

**Situation 2:** As the selection of elites does not require the use of memory, and now not even the capacity to implement a comparative process, will it be carried out on the only remaining individual basis, apart from preferential treatment, namely theoretical capacity?

**Situation 3:** Is AI confiscating knowledge or giving a signal to start the digital rush, along the same lines as the gold rush, which made fortunes for shovel vendors and oil drillers, but not for gold prospectors?
SITUATION 1: AI KEEPING STRATEGY AT A DISTANCE.

Contrary to what most leaders are telling us, we have observed that many developments in digital technologies and AI serve local interests and not strategic interests. Use of the often very costly services of experts, combined with the forced guilt of leaders who fear that they will lose control and seek to hide that fear through increased innovation requirements, have led many companies down a road that has never been proved to be necessary or even chosen. Power is changing sides. The older ones among us worship youth culture and the younger ones no longer have any guides or mentors in their learning process, focused on short-term ambitions and the desire to access the privacy of their extended hierarchy which often implicitly pledges allegiance to them. In the name of innovation and modernisation of processes and mentalities, draped in the often meaningless words of AI, millions of quasi-impostors weave their way into what one might term traditional structures and weaken them, neglecting strategies and making innovative youth culture a key without a lock.

We therefore suggest, for example, that Chief Digital Officers be assessed on their quantified contribution to strategy and not on modernisation of companies. We also suggest that this position be systemically reviewed in terms of assignments and that CDOs be evaluated based on the relevance of what they propose precisely regarding requalification of their position, including by means of changes involving voluntary reduction of their scope of action. Accordingly, other leaders must also show their strategic contribution to digitisation and not align projects which are not necessarily completely thought-out and qualified.
SITUATION 2: HIGH-PERFORMANCE AI AND HUMAN ELITES.

In its very nature, the competition between humans and AI is as old as children’s fairy tales, with the role of AI played by the wolf or the devouring ogre, but also by witches and magicians with greater powers, and humans represented by industrious dwarves along with bland princes and princesses caught in a future dedicated to the same everlasting loop of procreation and inheritance.

The question is not, therefore, that of complementarity or opposition between us and AI, except if we want to tell scary stories and structure the social Oedipus with digital fairy tales. The paper logarithmic table, the wooden slide rule, the steel cash register did not threaten or compete with the individual, no more that AI and its electrons. The question is elsewhere and it is dual: Which elites should be recruited, and will they be able to create income generating prosperity for the greatest number and thereby protect democracy?

Personally, in a mid-career diploma course, I have already selected people for reasons others might deem negative, giving rise to refusal; for example shyness in a candidate, a factor that could discourage recruiters, could in fact bring new dynamics to a group that is too sure of itself, to the point of cynicism, as long as the community code of practice imposes respecting each form of intervention. This unconventional recruitment, in light of the more aggressive standards of business, was by no means a mistake. On the contrary, some candidates chosen in this manner have turned out to be outstanding leaders, even at the very top level. But where the elite of company leadership consists of slavish imitators of the CEO, in particular if the CEO uses this devotion to satisfy a form of narcissism, the company is taking risks because it eliminates talents and differences, not only regarding gender or origin, which are covered by self-glorifying statistics celebrating the progress made in this field, but real talent, which also consists of weaknesses and genuine values.

AI clearly compels us to be really thorough in our open-minded approach and to select not only skills, which is in fact quite simple, but inimitable and talented human beings, who are continuously slightly neurotic and always skilfully managed. Selection of elites should focus on a strong appetite for discussion and theorisation, the opposite of the conformism of current discourse.

We therefore suggest restricting, containing or doing away with all the empty discourse, expressed by slavish slides in costly meetings that encourage very little genuine contribution, and, conversely, we owe it to ourselves to give a chance or another chance to potential elites who are not in the corporate spotlight for three main reasons: The wrong degree, a mediocre hierarchy who chooses to ignore them or who fears them as competitors, a human resources department which is too close to those in power. AI can make an exceptional contribution to redistributing the map of aptitudes, but without the usual preconceived ideas and established clans, including in start-ups and major companies quoted as examples based on criteria which are in fact futile and merely fad-related.
SITUATION 3: THE DIGITAL GOLD RUSH VIA THE ARTIFICIAL INTELLIGENCE HIGHWAY.

There are sentences which are falsely relevant and which today build a socioeconomic consensus. Here are a few examples: “We need to cultivate humanity in the digital world”, “you have to be twenty to succeed in a digital operation”, “digital innovation is inevitable”. Following these signals, which are mostly given by business leaders, the digital rush comes to life, with preconceived ideas which are often outdated as soon as they are expressed. Without control, with a transition from stable powers to so-called innovators, the opportunists of the digital world travel inscribed artificial intelligence without aim and without any strategy other than innovation to stay in the modernity race of international market competition. For a few winners who are already well-known and who are publicly uncontrollable for the most part, we have a host of AI forgers, who claim to be experts or visionaries and who are not brave enough to admit that we are moving forward by groping in the dark. The discouragement of those left by the wayside, the temporary arrogance of millennials, outstanding accounts settled in failure are not only removed from the scope of evaluation but knowingly hidden from leaders flattered in their narcissistic ego of unfailing competence and youth. Even bankers are discreet on this issue, as no-one wants to discourage the new workers aristocracy of digital innovations.

I simply recommend an audit of what companies have really undertaken in terms of digital technologies and AI, including all aspects, and urgent rethinking, taking into account objectives, real and not formal usefulness, successes and failures, and costs, including human costs.

As Albert Einstein put it, “If you judge a fish by its ability to climb a tree, it will live its whole life believing that it is stupid”.

AI is not intended to make us stupid or smart, no more than a self-guided car or assisted word processor would. The question of knowledge remains intact as AI will affect neither our protective reflex knowledge managed by the brain nor our in-depth and questioning knowledge on the meaning of things. AI affects transitional knowledge, though, violently and radically. Alas, leaders are too often drawn to the mermaids as they don’t tie themselves to the mast to stay on track, they frequently prefer the techno-demagogue discourse of the new courtiers, without regard to the foreseeable backlash that will be initiated by the stock exchange because the drop will be marginal at first and will therefore be visible only through listings, which are themselves essentially marginal in nature.

We still have knowledge, which is still so secret, and also, we have ourselves.

At the end of the day, AI is an ally and not a danger, but not in the way it is seen in leadership circles when they reason in terms of skills and forget knowledge. To know or not to know, that is the question. We should thank AI for bringing us back to that essential point.
In a society driven by high performance, there is a mandate to keep pace with the development of Machine Learning development, and ultimately win the competition with machines to avoid the obsolescence of humans. This chapter examines a range of approaches to learning principles to ensure human survival.
3 • ENSURING HUMANS REMAIN RELEVANT.
THE NEED FOR ETHICAL AI IN AND FOR EDUCATION.
The need for ethical AI in, and for, education content is an important essential. Without ethics, there is potential for great harm. Imagine AI-generated knowledge plugged into humans. We need ethical content, and to use ethical technologies.

“....we have stringent regulation and clear medical ethics that must be adhered to. We now need the same for education, because AI is changing the nature of the world and education forever”
A class teacher in a primary school using AI software to help my class understand about the different religions across the world. The AI has an animated character on the screen that the children can interact with and it asks questions about the children’s beliefs and the festivals that they take part in during the year. The complexity of the answers that the on-screen character provides is individualised to each child’s comprehension level to help ensure that each child understands. However, the class teacher notices that the answers for questions about Christianity that the on-screen character provides are always much simpler and positive than the answers for other faiths such as Islam or Judaism.

This scenario is technically possible, and sadly it is also quite likely. It is an example of the one of the reasons why we need to start asking: What are the real dangers if we do not address the ethical implications an Artificial Intelligence being used in education?

As a scientist, I am excited by the innovation that is artificial intelligence. We have built machines that can learn. Learning is the holy grail of humanity, it is the vehicle that allows us to develop to become so sophisticated and advanced that we can build things like Artificial Intelligence (AI). As an educator, I cannot but stand back in awe at the prospect of a world where everyone is educated. The slightly clichéd phrase ‘no child left behind’ starts to have real meaning. Because we now have the technical capability to deliver personalised education and training to every individual. Imagine what the world would be like if it were a world where everyone had an education. This is a future that is worth shooting for, we really could make sure that every individual is educated in a way that enables them to flourish mentally, emotionally and economically alongside AI.

Education changes lives. Education is without question the most potent area for AI to bring huge benefit, it is also the least regulated when it comes to technology and particularly when it comes to AI. Educational technology really is the ‘Wild West’ and it has to be tamed. Without paying attention to the need to ensure the ethical quality if AI for education, society will be doing a tremendous disservice to many people, in particular the most vulnerable populations. As a society, we have a responsibility to ensure that we do everything we possibly can to ensure that the AI industry does not harm any Through its engagement in education.

As an academic, I am quite rightly duty-bound to seek and receive ethical approval from a committee of ethics experts for any research work I conduct that involves people. This is the case even if I am only using secondary data that someone else has collected in a manner that has been approved by the ethics committee. Put simply, I have to demonstrate that I will do no harm. I have to demonstrate that everyone with whom I engage is able to give informed consent to my conducting research that involves them and all their data in some way and so it should be. This must be the case for all AI companies who wish to work in Education, because they are experimenting as they and their algorithms learn. Education IS a special case, and we must demand the highest standards.
Education is a special case because, not least because we are increasingly aware every individual will be learning and being educated throughout their lives. Education is quite unlike any other ‘service’. If, for example we compare to the health service, which also engages with vulnerable populations and populations of individuals who are in a vulnerable position. We sincerely hope that everybody won’t be requiring the health service throughout their lives, in fact we hope they will need it as little as possible. And yet, we have stringent regulation and clear medical ethics that must be adhered to. We now need the same for education, because AI is changing the nature of the world and education forever.

We must therefore ask the tough question: What are the real dangers if we do not address the ethical implications an Artificial Intelligence being used in education?

I like to focus on the positive benefits that AI might bring to those of us involved with education and training, and there are many of them. I find the question of what harm might be done by those whose motives for the smart AI we can design to be a more challenging question. It is however essential to answer it effectively in order to explore how best to protect and educate people, so that they do reap the benefits. One only has to look at social media to appreciate how what starts off as being something intended to support friendly social interaction can cause a great deal of harm, particularly to the vulnerable. The potential for harm is much greater once we add AI into the equation.

We must answer the question: “what is the worst that can happen if we do not effectively assure that AI used for education is ethically developed and used?” I find it useful to break AI down into its different elements. Let’s start with Machine Learning, which is the most popular method of creating AI at the moment. Machine Learning requires data and algorithms to process that data.

**Data**

If we start with the data, then we can draw some comfort from the General Data Protection Regulations (GDPR), which form part of the data protection regime in the UK, together with the Data Protection Act 2018 (DPA 2018), which came into force from 25 May 2018. This gives us rights as individuals to know what when our data is being collected, why it is being collected, how and how long it will be stored our data is being used for. We have the right to access our personal data, to have incorrect data rectified, and to have our data erased. We have the right to know if a company is profiling us using our personal data, to know if they are making decisions based on our data or profile and we can object to this. These rights are intended to protect us from harmful use of our data. However, a great deal of harm can still be done, even when these regulations are being complied with, because even the people who have written the algorithms that process our data do not know exactly how the processing works, and they cannot predict all that it will produce. For example, I may be give consent for my data to be stored and processed by a recruitment algorithm, when applying
for a job. The recruitment organisation may well be GDPR compliant and yet if the recruitment algorithm has been trained on a biased data set, then it may disadvantage me on the basis of gender, ethnicity or age. In addition to which true ‘informed’ consent is a complex concept and requires that we ensure that the consenting individual understand exactly what they are agreeing to. We need to also bear in mind that the consequences of breaking the GDPR or DPA, may not be severe enough to discourage some people from contravening them.

**Who is processing my data using AI and who regulated them?**

Anyone can set themselves up as an educational technology company and there is little regulation of their activity beyond the financial regulatory processes and the data regulation that apply to all businesses. Formal educational establishments across the world are invariably inspected. However, a company offering AI driven educational services or products is mostly unregulated. And, many of these companies are driven purely by the return they can give their shareholders and they are controlled by a small number individuals.

**What educational need are they serving and how will I know if it benefits me, my family, my students?**

You only have to look at the thousands of apps claiming to provide learning, many of them claiming to be ‘free’ to realise how unregulated educational technology is. Likewise, all the software and other services we can access via many devices from TVs to tablets, phones and the Internet of Things. Anything from YouTube for Learning to Amazon’s Alexa for kids. These organisations have no educational credentials and yet they can provide education to millions of people. We have no idea if these educational products or services have any benefits and we currently have no way of being assured that they are doing no harm.

**Who is developing the AI that is being used and how do I know they are causing no harm?**

In a world driven by ROI for shareholders, where the service or product providers are largely unregulated, what harm could education providers of AI be doing? How do we know they are not using learning as a cover for unsavoury activity? It really is a case of imagine your worst fear and then think through how we can be assured that it is not possible?

**The veil of charitable acts**

Imagine the scenario in which a technology company agrees to provide a disadvantaged community or country with highly sophisticated AI technology that will provide individualised education for free, including the technology infrastructure to enable this to happen. Who would challenge them? It would seem wrong wouldn’t it, to deprive needy people of an education that could vastly improve their life chances. But, not only could this company be collecting data that would be enormously valuable for them, from demographics to personal preferences, misconceptions, key areas of ignorance etc. etc. It could also be allowing
them to control the education of entire populations to spread misinformation, to skew and manipulate beliefs to suit particular political attitudes or corporate goals. When the motivation is profit alone, then there is little to stand in the way of unethical manipulation, that could go undetected and is way beyond current regulation, particularly outside the EU. The control of Knowledge is power and such generous gifts could be putting power in the hands of the wrong people.

The veil of invisibility

One of the greatest problems when it comes to designing ethical principles and foundations, and to training and educating people to keep themselves safe is that the threat is almost always invisible. How can we know when an inappropriate video will appear, when we will be engaged in a pointless interaction that has no potential to support our learning, when our belief is being changed, without us knowing about it? How can we know for our children and grandchildren that the educational software or applications that we buy and download are not going to cause them harm? In most cases we know little about who has developed them, other than in most cases they are driven by making a profit? We may well be able to design regulation that can help to marshal this invisibility into some sort of order, but we will never be able to guarantee that everything will be safe and ethically motivated.

Ignorance is a sin

The only way in which we can really tackle the ethical vacuum currently threatening to undermine the transformative potential of high quality education for everyone, is through a combination of education and regulation. We have to develop a savvy well education population who can help the regulators to keep them safe in an educational landscape enriched by AI augmented technology. We need everyone to understand why data is important to AI, how AI processes data to reach decisions, how AI is trained, what AI can’t do, when to challenge an AI, when to worry about saying yes to the terms and conditions that we are asked to agree to when using some technology. We need people to understand exactly how visible the data collection about them that has already happened has made them, to understand that the inferences that a company has derived from our data is more valuable than our personal data in and of itself. The first thing we therefore need to do is to ensure that we have people within education and training who know these things and who can help everyone else to understand them and learn about them.

The worst-case scenarios of getting ethical regulation and education wrong when it comes to AI and education are indeed a catastrophic - just pick your personal horror story and it’s probably possible with AI big data and the credible veil of education. We have to act now to prepare people for a future in which they must become increasingly vigilant and much better educated about AI, if they and their families are to benefit from the intellectual riches that are on offer.
EDUCATION: FROM INFORMATION TO REPUTATION.
The author addresses the issue of fake content and fake information. For him, it is essential to manage learning content to avoid learning fake information. It is essential to develop the ability to discern what is fake. Otherwise, we will be useless and unable to defend ourselves from the dominance of machine intelligence.

“Critical thinking must be a fundamental element in our children’s education if we do not want to end up with a society of idiots”
The evolution of human societies is inseparably linked to the development of technology, and to the environment defined by its adoption and use. At times, we have even defined periods in that evolution such as the stone age, the bronze age, or the iron age, classifications criticized today by some for being too simplistic and Eurocentric, but that nevertheless clearly show that our development has always been influenced by the technology within our reach.

In the wake of the recent controversy over the influence of fake or false news on the outcome of the 2016 US presidential election, a study by Stanford University identifies one of the main problems of education today by showing how most young people are unable to clearly differentiate false from true news, and are not even able to recognize sponsored content, even when it is labeled as such.

One of the great properties of the internet is, undoubtedly, that it facilitates access to information. It is precisely for this reason that critical thinking and judgment are increasingly important, constituting a fundamental part of our digital competence in all aspects of life.

But development of critical thinking is notoriously absent in our educational models. Understanding what the internet can give us, to be able to ascribe credibility according to the source or the characteristics of the information we access, and to possess the skepticism to understand that all conclusions demand evidence, or to be able to fact check, are skills that previously belonged to the field of journalism in which society, justifiably or not, placed its trust, but that are now increasingly essential for us all to possess or develop.

The results of the Stanford study are disheartening at all levels: any hopes that younger people were minimally more savvy and would not accept the first result of a search or share information without checking it have been shown to be without basis, and shows, as I have already said on numerous occasions, that the so-called digital natives are a figment of our imagination.

It seems that young people are even more trusting and easier to deceive than their parents, who were supposed to educate them in the importance of critical thinking. Schools, for their part, have avoided all responsibility on this issue, as might be expected from institutions that, with few honorable exceptions, have chosen to shield themselves from the advance of technology, banning children from putting their smartphones to good use, in case they are distracted by them in the classroom. In the internet age, we continue to educate children on the basis of the erroneous concept that truth is to be found only in books, instead of taking the opportunity to develop skepticism and critical thinking about the most important tool for accessing information we have ever developed.
Ours is now a society that produces idiots who believe everything they read on the internet, who are incapable of suspecting or thinking that an article is sponsored content or represents certain interests, and who believe sensational headlines that would not stand up to the slightest scrutiny. Asking social networks to try to develop algorithmic metrics to assess the credibility of news is not a bad idea, but in reality, the real problem is the inability of many of us to adapt to the availability of masses of information on the internet and to manage it properly.

When you think about education, think about the importance of critical thinking as a variable. Think of the need to educate your children in the context in which they will live, one of hyper-abundance in which access to information must respond to patterns of best practice. Think about how to explain to them which sites are good and which are bad, and how to differentiate fake news from satire or parody or humor, how to contrast information, why it is necessary to do so before sharing something, and how to acquire the discipline of information management so as to prevent them from passing on false, sensational or biased news.

The internet, with its hyper-abundance of information, could be a fundamental tool in developing our critical faculties: all we have to do is teach children that information is no longer only to be found in textbooks, but that it is out there, and then to correct them according to the type of information they decide to use, through trial and error, generating methodologies in the process. Critical thinking must be a fundamental element in our children’s education if we do not want to end up with a society of idiots.

The challenge of education, consequently, is to move forward from processes designed for a time when information was expensive and difficult to acquire, and therefore it made sense to try to memorize it and store it. We now live in an age when information is available at the touch of a button and can be memorized or used as needed, meaning that we can now address other issues.
Needless to say, this doesn’t mean we consign memorizing things to the past because the internet exists, but instead we need establish processes whereby the goal isn’t memorization but understanding. Too many aspects of our education systems are still focused on memorization: class formats, note taking, the way we study, exams to evaluate what we have learned by repeating in a piece of paper or in front of a tribunal the concepts that we spent time memorizing a few hours or days before... these all need to be redesigned in light of existing technologies. Obviously, it’s good to know history, but there’s a huge difference between teaching history by trying to focus on the reasons why things happen and doing so through memorizing a mountain of dates and events.

The ability to remember things is not the goal of learning, or at least it shouldn’t be. But we still put memorizing things at the center of the exam process: the regurgitation of facts onto paper or recited before a tribunal. Absurd as it is, this is still the way that a wide range of posts and responsibilities are appointed, as though the ability to remember something were in itself a guarantee of something. Of course, there is considerable resistance to change, in large part because those in power got where they are in this way.

The day that education reform is carried out by adapting to our technological environment will be the day that we really start moving forward into a new age. The ongoing transition from the so-called information age, when what mattered was access to as much information as possible, to the reputation age, when the name of the game is being able to distinguish between reliable and unreliable information, a skill we need to teach our children from primary level onward.

If more and more of us now take access to information for granted, then what matters is knowing how to manage that information. The new idiots, in the literal sense, are those people who search for something online and who systematically accept as the absolute truth the first result they are given, or those who swallow every hoax that pops up on their screen or who are incapable of differentiating a reliable source from an unreliable one. Information is only of value if it has been verified, filtered, evaluated and discussed, and reputation is thus the basis of our collective intelligence construction process.

Believing conspiracy theories and assertions with no scientific basis, whether they’re against vaccination, about chemtrails, that we never landed on the moon or that climate change does not exist, automatically label us as misinformed fools unable to differentiate the truth from nonsense, the new illiterates, who can be easily manipulated. These are the people who help spread lies and impoverish the internet—and society. The new idiots pass on hoaxes they receive through WhatsApp groups in the hope of being seen as smart, somebody with their finger on the pulse or who is trying to make the world a better place. All this starts in childhood: YouTube Kids is awash with videos about reptilian conspiracies or that say the moon landings were a hoax, as if it were okay to expose young minds that know nothing about fact-checking to this garbage; meanwhile, their parents are just glad that their children are out of their hair for a few hours.
Countering these issues by taking our children’s smartphones away from them or restricting how much time they spend at their computers will not help our collective evolution into the reputation age: instead, we have to incorporate those devices fully into the educational process, teaching them not so much about technology, but information management. We need to get rid of textbooks once and for all and collectively understand that the truth is not necessarily to be found in this or that tome: the truth is out there on the internet, and we can find it if we know how to filter, to check sources, compare and contrast, separate the wheat from the chaff and develop critical judgment. That is the fundamental skill we have to teach our children... and clearly, one that many of their elders need help with as well. Framing the discussion about internet use in terms of addictions completely misses the point: this is about education. There is nothing wrong in being connected at all times, as long as it’s done with the appropriate criteria.

For some reason, we have tried to eliminate debate and questioning from education, we have become complacent, while our children are being deprived of the opportunity to prepare for a world in which smartphones will be ubiquitous and correct use of information essential.

We have arguably created the most powerful tool in our history and then placed it in the hands of people with no training, critical judgment or understanding of technology; people who perhaps believe that a smartphone or a computer gives them some kind of status, when the reality is that, lacking any kind of criteria, they are vehicles for misinformation. The idiots of the reputation age maybe older people who have failed to adapt, they may be younger people who have not been taught the real potential of technology, or there may be any number of other reasons. Either way, we face a major challenge and one of the reasons why I continue working in education is the conviction that we still have much to do in meeting that challenge.
INTELLIGENCE WILL CHANGE THE WAY WE ACQUIRE AND GROW SKILLS.
As safeguards, the authors elaborate on four guiding principles for learning in the age of AI.

“.... The most fundamental change in the area of education has not been about the ‘how we learn or what we learn’ but about the ‘why we learn’”
Artificial intelligence has been around for quite some time, at least as an intellectual concept. Since the pioneering work of Alan Turing, Van and others much research has been invested in providing machines with the ability to recognize shapes, colors, and handle increasingly complex tasks, in particular in industrial environments (robots). In much of those cases, the intelligence imbedded in machines was replicating the ways in which most organisms would respond to signals (natural intelligent process): data is collected or received (eg a moving object is detected), relevant data is stored and compared to other data previously memorized (eg is this moving object a predator or does it represent any kind of danger ?), and finally some decision process (algorithm) would determine whether action is necessary and what it should consist of (is running away an option ? is fighting a viable one ? should defence mechanisms be preferred - eg playing dead - ?). For a robot, the same process could translate as: are those two auto parts ready for welding? when fitted together, do they correspond to the assembly I have been programmed to produce? then weld them together. (figure 1).

**Explicability and the black box issue**

« ...AI is giving spectacular results today, for reasons that researchers sometimes find difficult to explain. This is the infamous ‘black box’ issue: algorithm systems that let you observe what data come in (input), and what data come out (output) but whose internal functioning remains difficult to understand. In a context where IA is likely to reproduce biases and discriminations, and as it will be more and more a part of our social and lives, to be able to ‘open these black boxes’ should be seen as a democratic imperative ».

In the 1990s and early this century, significant work and research was produced around neural networks, and concerns started to emerge about the upcoming ‘singularity’. However, it is not until the last few years that real artificial intelligence started to enter and influence our everyday lives: after an IBM machine beat the then chess world champion Gary Kasparov in 1997 it became clear that competition between humans and machines could happen in highly sophisticated and ‘intelligence-intensive’ areas. However, it is not until AlphaGo, an artificial intelligence system, first beat KeJie, the then world champion of go in 2017 that experts started to realize that artificial intelligence could be qualitatively different from human intelligence; simultaneously, we have become used to seeing artificial intelligence outperforming humans in areas like automated translation, medical diagnosis, face recognition, or driverless transport to name only a few. What happened between then and now? A conjunction of technological advances did affect all of the three ‘steps’ described above: big data (the routine collection of huge amounts of information, especially through the development of the Internet Of Things - IOT -), cloud computing (the dramatic decrease in the cost of storing such information and turning it into remote databases that could be accessed and processed at any time from virtually anywhere though the Internet), and - most importantly - deep learning (by which hardware can modify its own software and continuously improve its performance). (figure 2).
FIGURE 2 - SETTING UP THE SCENE FOR THE EMERGENCE OF AI

This new environment raises a number of complex issues, going from explicability, to governance, or intellectual property, to name only a few. However, there is little doubt that the core of the AI revolution is (and will be) machine learning. Since learning has been the core engine of social, economic and intellectual progress for humans, the question ‘how will AI’s ’deep learning’ change the way we (humans) learn’, should be seen as of critical importance for our future.

In the short and medium run, the advent of ‘ubiquitous AI’ raises at least three questions: namely (1) why and how should we learn in the digital age? (2) what will ubiquitous AI change to this, and finally (3) what are the policy challenges that arise from the answers to the first two questions?

Why and how do we learn in the digital age?

Over the last twenty years or so, learning has been moving away from rote learning. Classes have become interactive, often mixing classroom and on-line sessions. It has become an acceptable principle that abilities to add, subtract, divide and multiply were less valuable when so many devices (computers, phones, watches) could do it for you. It has also become less important for pupils and students to memorize dates, facts and bookish references since the internet makes this kind of knowledge available on continuous and real time basis. Experience, combined with the ability to work in teams and solve problems, have become more central in formal education. Coding has also gained in importance and visibility as early as kindergarten.

But the most fundamental change in the area of education has not been about the ‘how we learn or what we learn’ but about the ‘why we learn’. The old model of ‘twenty years of learning followed by forty years of applying the acquired knowledge to a specific job or function’ has lost most of its meaning in a world where skills need to be updated regularly in the face of technological changes, and the constant reshaping of the ‘future of work’. Younger generations had seen their parents work for several employers in a lifetime; they are now entering a world in which they may contemplate having several careers in that same lifetime (eg being an engineer, then a management strategist or a journalist, then a designer or a psychanalyst), and, more importantly being ‘free agents’ i.e. having several work contracts (with different employers) at the same time. As underlined in the Global Talent Competitiveness Report of 2017, ‘we are undergoing a transition from work grounded on
traditional long-term contract-based employment to an era where around 30% of the US and European working population are free agents, in the sense of having freelance work as their primary or secondary source of income. All of these fundamental changes to education and labor markets are going to be accelerated by the emergence of ubiquitous artificial intelligence.

It is equally clear that, as the possibility of ‘credible fake news’ will continue to increase with the number of ‘bots’ used in the press, media and social networks, the citizens of tomorrow will need to be well equipped to check facts, and exert critical judgement. A sound knowledge of history for example will take renewed importance in that context.

What will AI change to all of this?

The emergence of affordable, ubiquitous and socially acceptable artificial intelligence will affect education, knowledge and learning through four main channels, namely continuity, separability, upskilling and explicability.

Figure 3 - The four guiding principles of learning in the age of AI

Continuity: learning will continue to see the replacement of ‘discreet memorized knowledge’ (rote learning) with ‘continuous problem solving’, in which pupils and students are expected to draw on multiple intellectual resources (experience, culture, logical thinking, imagination and creativity e.g.) to address complex problems; practical implications will include coding classes at an early age, and variable mixes between classroom and on-line teaching on one hand and practical acquisition of knowledge through real or virtual experiences.

Separability: younger generations consider it natural to rely on electronic devices (calculator, smart phone or tablet) to perform most arithmetic operations; few of them would indeed be able to extract a square root manually. This should not be seen as a lost ability, but on the contrary as a way to free time and bandwidth for the development of higher capabilities. By separating ‘calculations’ from ‘reasoning’, education systems will replicate what has been at the core of progress in activities like aircraft piloting or heart surgery, where machines do ‘better, faster and more accurately) a number of tasks, while humans continue to ensure the overall consistency and adequacy of the tasks involved.

Upskilling: the necessary re-definition of ‘employable human skills’ (EHS) and how they can be taught and acquired needs to acknowledge that (1) the future of work will involve multiple careers and free-agents (see above), (2) learning and education will be life-long processes, and (3) deep learning will allow machines to teach humans. This last trend is already present in advanced machine-tools that can be re-programmed and improved on the basis of lessons learned from experience; soon, the software and hardware of such equipment will ‘self-improve’, and the operator will learn from using it, acquiring new skills in the process.

Explicability: as underlined earlier, this is most probably the biggest problem about harnessing the future power of AI. It has just started to be explored by researcher, philosophers and practitioners, and relates to the degree of trust that citizens should be able to grant to AI-based decisions: if the algorithms behind such decisions remain opaque and ‘unexplained’, humans may not accept easily machine-produced decisions and actions, especially if they run against their intuitions or beliefs: ‘for Artificial Intelligence to thrive, it needs to explain itself’ (The Economist, February 2018). This is a critical point of the report recently commissioned by the French Government on the future of AI (rapport Villani, see Villani 2018, and Bousquet and al. 2018). The ways in which this issue will be tackled by governments and regulators will have massive implications in the area of learning and education.

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1 Alain Dehaze, Global CEO of Adecco, in Lanvin and al. (2017).
2 See previous section.
3 One practical example of users ‘learning from their machines’ is that of Tesla cars: users periodically receive notifications on their smart phones that the software of their cars (autopilot eg) will be ‘upgraded during the night’. They then discover (and progressively master) the new functions of their vehicle the next morning.
**Conclusion: possible consequences and policy challenges**

Based on the elements explored above, what should be the optimal strategies for business, governments and individuals?

**Businesses -** First, one needs to acknowledge that business in general (and large firms in particular) have started to take AI and deep learning seriously. As recently underlined by The Economist, ‘The West’s largest tech firms, including Alphabet (Google’s parent), Amazon, Apple, Facebook, IBM and Microsoft are investing huge sums to develop their AI capabilities, as are their counterparts in China. Although it is difficult to separate tech firms’ investments in AI from other kinds, so far in 2017 companies globally have completed around $21.3bn in mergers and acquisitions related to AI, according to PitchBook, a data provider, or around 26 times more than in 2015. Machine learning is the branch of AI that is most relevant to these firms’ (The Economist, 2017d). Predictions converge to estimate that AI-induced productivity gains will be huge - over 15 per cent - in key industries (see Purdy and Daugherty, 2017, as well as Ransbothan and al., 2018). Yet, it would be wrong to reduce these massive investments to the result of a pure ‘capital vs labour’ arbitration: deep learning and talent competition will hold the keys to even more massive competitiveness shifts in most sectors.

**Governments -** public authorities (including regulators) will have the heavy responsibility of assessing (and guiding) the potential impact of AI and deep learning on at least four major areas, namely: labour markets, social inclusion, national competitiveness, and governance. As far as labour markets are concerned, governments will bear the ultimate responsibility to ensure the adequation between national education systems (skills produced) and employability (skills required by firms and organizations); the task is all the more daunting that ‘future jobs’ are yet to be defined. In such a context, governments (and education systems) need to focus on equipping pupils and students to ‘learn how to learn’ (preparing for life-long learning and constant upskilling and reskilling), and providing relevant ‘generic skills’ (coding, problem solving e.g.), along the lines detailed below (see ‘Individuals’ sub-section). Regarding social inclusion, much will be expected from governments in mitigating the uneven effects of AI and deep learning: in the social maelstrom resulting from the disappearance of many jobs, and the concomitant creation of new ones, transitory as well as structural issues will need to be addressed, including access to learning opportunities, and possibly some kind of guaranteed minimal income for those lacking the skills or abilities to compete with robots and algorithms (see ‘Individuals’ sub-section below).4 Current biases affecting AI and related learning process will also need to be addressed at government level, such as gender balance for example: recent studies have underlined that there are currently only 12% of women among AI researchers, which may induce bias as new neuronal networks are being built (see WIRED, 2018).

International competitiveness issues are currently dominated by one major trend, namely the growing dominance of China as the ‘upcoming AI superpower’. In a world where ‘data is the new oil’, China is indeed well positioned to be ‘the Saudi Arabia of data’, considering its large (and growing) superiority in terms of amount of data collected by giants such as Alibaba, Tencent or Baidu, inter alia from a considerable pool of users (800 million Internet users in China alone, see The Economist, 2017c and 2018b).5

Finally, from a governance point of view, issues flagged above (explicability e.g.) will require urgent attention from governments and relevant regulators (current or

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4 Such inequalities will also need to be addressed at the international level (typically by relevant multilateral organizations). Behind the likely two superpowers of AI (China and the US), other countries will strive to catch up, for those that are less equipped in IT infrastructure (e.g. most of Africa), a new kind of digital divide may soon be widening at a fast pace.

5 Reviewing Kai-Fu Lee’s recent book on ‘AI Superpowers’ (Kai-Fu Lee 2018), The Economist also noted that China’s ‘Sputnik moment’ came on May 27th 2017. On that day an algorithm thrashed Ke Jie, the world’s best player of Go, an ancient and demanding Chinese board game. Mr Ke’s defeat by AlphaGo, an artificial intelligence (AI) system developed by DeepMind, a British firm that had been bought by Google, was as much a blow to China’s psyche as the Soviet satellite was to America’s self-esteem in 1957. Within months, China announced ambitious plans to dominate AI by 2030’ (The Economist, 2018c).
yet to be created) in the field of AI and deep learning. Fears (founded or not) will also need to be addressed and mitigated regarding sensitive issues related to military uses of AI as well as ethical principles to be imbedded in deep-learning processes and equipment (refs here ‘teaching ethics to robots). Here again, multilateral institutions will be called to play important roles, yet to be defined.

Individuals - A key to wide acceptance and success of AI will result from citizen’s perceptions that they can enjoy fulfilling and meaningful lives in the age of AI. Among the most pressing issues in this regard will be whether access to learning opportunities, and the ability to acquire the skills that may make individuals able to contribute to society through employment, innovation and creativity. Although governments and the education sector have central roles to play in this regard (see above), individuals will also need to identify and adopt the strategies best suited to their respective situations and aspirations. Most recent research underline that AI will create more jobs than it will destroy; however, it is undeniable that entire industries will be ‘displaced’ by the advent of ubiquitous AI.

Our societies’ ability to identify the skills where human may retain an advantage over robots is hence key to adapting our education systems and learning practices to an AI-enabled future. Most of the skills identified by cross-sectoral studies6 fall under the ‘four Cs’: creativity, co-operation, complexity and communication.

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FIGURE 3 - THE FOUR ‘CS’ TO BE MASTERED IN THE AGE OF AI

Situations in which creativity and imagination are required will still see humans outperforming machines for quite some time. Enhancing relevant skills will require profound changes in our formal education systems. The success of countries like Finland and Singapore in promoting ‘multi-disciplinary tertiary education’ (combining degrees in engineering, business and design for example) should be broadly emulated.

Similarly, abilities to co-operate and communicate should be fostered as opposed to stressing specialization and competition. This should start at early ages (kindergarten) and be valued through career incentives. Diversity and mobility will increase students’ ability to understand and leverage inputs from different backgrounds and cultures.

Last but not least, mastering complex situations (sometime leaving room for intuition) will benefit from the early acquisition of basic problem-solving skills. Since such complex situations may increasingly have to do with mastering intelligent and fast-learning machines, coding should become part of basic acquired skills, next to reading, writing and counting. And critical judgement will remain an increasingly valuable asset.
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UNDERSTANDING DATA
INTERVIEW WITH JENI TENNISON

PHD in Artificial intelligence
OBE, Chief Executive Officer of The Open Data Institute

In this interview, Jeni Tennison outlines the significant challenges that are presented in how data can be used in learning. From building trust to overcoming bias, we have the opportunity to determine how data knowledge is shaped in the digital era. The role of trust and ethics in data management.

“...The thing we really need to develop is trust.”
**Q:** Thinking about knowledge and learning in the 21st century, we are increasingly aware of the importance of data and data literacy. How would you define data literacy?

**A:** It’s useful to think about this in the same way we think about the difference between English language and English literature in the education system. There are two parts of data literacy. There is ‘data language’, which is about creating things with data: how to collect it, how to manipulate it, how to run statistics over data. But in some ways, the more important part is the ‘data literature’ side, which is understanding the role that data has in society. This includes the history of the way that data is used and has been used in the past. It includes the way that data, information and knowledge then impacts on power relationships, which affects the way in which our societies operate. Business leaders, decisions makers and policy makers don’t necessarily need to know data language or to be able to manipulate data themselves in order to understand how data can be used in their business or for policy making. They have a strategic view of the role of data. This is an example of the critical kind of understanding that more people need to have.

**Q:** What is it that we need to know about data literacy, in general? What should students be learning?

**A:** We need to be able to understand the constraints, and the limitations of data. We all need to understand that to better assess any information or data that we are given that is supposed to be informing our decisions. We need to understand that the way it was collected can introduce biases. We need to understand that the quality of the data may some constraints around it that will determine the kinds of conclusions that can be drawn out. We need to understand that just comparing two sets of averages may not mean that there are any significant differences. We need to understand that just comparing two averages may not mean that there are any significant differences between populations. We need to understand these things so that we do not over-interpret data and come to conclusions that are not warranted, and therefore make decisions that are not warranted. It is this critical understanding of data that we really need to boost in the way that we generally think about data. People who do not have this level of data literacy tend to think that because a computer says something, then it must be true. Those of us who do work with data know that this is not the case, that there is messiness and there are boundaries as to what you can conclude.

**Q:** How do we distinguish between what is true data and what is false data? What is a good approach to thinking about this? Are there different guidelines for the private and public sectors?

**A:** It is best not to pretend that there is some clear line between true data and false data, because there isn’t. There is data that is fit for purpose, for the purpose that you are using it for. And then there is data that cannot support the use you want to put it to. The same data can be used in different ways. Some of those may be appropriate and therefore useful, and we consider that good data. If the data is used to draw conclusions that are not war-
ranted by the data, or the data is overstretched and therefore not representative, then that is a bad use of data. It is the match of what decisions you want to make with the data, and then how you use the data, that indicates if it is good or bad data. It is not about the data itself. This is why critical thinking about data, and understanding data, is so important. As a decision maker, you need to be able to assess the data that you are making decisions with.

**Q: How do you think universities could be working with data?**

A: Most universities have within them who know a lot about data. Any scientist knows how to run statistics over the top of data and the limits of conclusions that can be drawn from that data. In a university setting, you have academics who may know how to do this and then perhaps administrative staff who are less familiar with these issues. In those instances, it is about bringing those two groups together to ensure that the data the university has isn’t over-interpreted.

**Q: Do you think we should or could standardize an approach to data literacy? Is there any benefit to doing this in schools?**

A: At the Open Data Institute (ODI), we have developed a skills framework that lays out the skills you need to be doing different kinds of things with data, including pieces around analysis but also about the strategic deployment of data within an organization for decision making.

I think there is a benefit to teaching data literacy in schools. Data languages kill are already built into places like the mathematics curriculum or the computing curriculum. So, there is already a good basis for building on skills such as that is strong on the data language side, such as manipulating data, collecting data, knowing how to present it in various ways. Where things are not so strong, is on the data literature side which is about understanding the role of data in our societies, the critical thinking about the kinds of conclusions you can draw from data, and the biases that can be created by different collection mechanisms. How should that fit? If you think about the role that data can play in the health sector for example, then perhaps that should be part of the Social Sciences curriculum. It could be built into the way that history is taught or perhaps even a dedicated module on the history of data, which would be perfect! It’s all about teaching critical thinking about where information has come from and what that means about the conclusions that are drawn from the data.

**Q: There has been a great deal of discussion about data and ethics in recent years. With the further introduction of machine learning into our world, we are increasingly thinking about human intelligence and machine intelligence. Do we have blind spots about possible dangers of this? What is your perspective?**

A: The ODI thinks broader than just ethics. We think It’s more about trust and trustworthiness. It is not just about people doing the rights kinds of things with data, whether or not the way that you are employing data is good or bad. From an organiz-
tional and societal perspective, the thing we really need to develop is trust. You can still be doing things that are ethically good, and not be trusted. You could be doing things that are ethically bad and be trusted. Getting the match between trusting the people and organizations that are trustworthy, is the real challenge.

There are some basic hygiene factors when it comes to data and preserving trust, that are about security and holding people to the basic legal requirements that exist. If you do not do these things, then trust is broken. You can put out good data principles, but it may not mean very much to some people. There’s a piece about holding people accountable for keeping to those ethical principles, and then whom is holding people accountable. Having ethical principles without accountability does not build trust.

It is not just the people who are collecting data that make decisions about the way that data is used. It must also include the people that are affected by those decisions. If you are taking data in a technocratic way and making decisions for people that are going to affect them, there will naturally be a pushback. Effective engagement is a strong factor in getting trust, and getting trustworthiness working, when data is used in a way that is going to affect their lives.

Then there is equity. Who benefits, and who has the power from being able to see, use and manipulate data to make decisions. This is a much deeper thing that we need to address in society. There are areas to consider: empowering people, empowering communities, empowering small businesses, at a time when large organizations and government already have knowledge. Knowledge is power. Therefore, getting equity is important for building trust. When there are big scandals about the misuse of data, there is a big cry that goes out, “it’s not fair, it’s not fair” that big organizations are benefitting, and the people are not. How we address the fairness issue, is one of our big challenges today.

We do need to understand that different societies have different norms about data, regards what is and what is not acceptable. These norms will change over time. So whatever framework we put in place, for instance around data literacy, it will be important that it is able to adapt over time. There are not hard and fast boundaries everywhere about what is right, and what is wrong.

**Q:** *What kind of impact will technology be making in the next few years? How should we be thinking about data?*

**A:** While it’s hard to be a futurist as technology and organizations change so quickly, there are two considerations that I do think about. One is the fear that we become more surveilled as individuals, there is much more data collection about us, and that there are more decisions that are made about us as individuals in rapid ways with limited oversight and limited means of redress. Then there is the fear that we get nudged into particular kinds of behaviors by the algorithms that are being used to reward us, such as the way we use our smartphones, and that this will continue to reach more and
more into our lives. So, I have a fear that it could be that data becomes a fuel that suppresses people. But there is also a fear that comes from opposing that, which is that we miss big opportunities to solve the biggest problems we are facing as a society such as climate change and global hunger. The opposition would come from not trusting the organizations that have the data. I believe that data is an incredibly useful and helpful thing, especially when we use the appropriate tools that range from machine learning, to simple and yet very useful visualizations.

**Q:** What are the top things that we, as a society, should focus on when it comes to data?

**A:** The ones to think about, are the ones that really impact where we as a society may end up. This includes building trust about quality data that really can improve our lives. On a technical level, it would be how can we question datasets without revealing the content of those data sets? How could we be creating synthetic data sets? This would allow us to design our systems and applications without knowing things about individual people. How do we get really good, differential privacy techniques into APIs so that we know we are limiting access to very sensitive data?

Then, how do we build trust in algorithms and systems, to explain what is coming out of the big black box known as machine learning, so that people can trust the results? Are there ways of programmatically adjusting for bias in data and data sets? These are a few of the bigger, technical challenges that we will be seeing.

On the government and policy making level, it will be about how to properly engage people in the decisions that are being made about systems, about how data is collected, and how it is going to be used in a way that does not scare or overwhelm them. Engagement also includes giving consent, which is not working very well today. So, we will need to have a look at regulatory safety nets and balance that with individual choice.

**Q:** You mentioned Social Sciences earlier. Should we be increasing our focus on these when it comes to data?

**A:** I think we need to bring in social scientists and artists, as well as art thinking, as to the way we design systems. These are not just technical systems that computer scientists are making. From the individual interaction between a person and a computer system, to the process that is used in an organization and the way that that works, to the big societal impacts. At every single level, you need the social scientist, the psychologist, the historian, the ethicist, the philosopher. We need all these people to be deeply involved in the design of our systems.
“Live as if you were to die tomorrow. Learn as if you were to live forever”

Mahatma Gandhi

New Technologies and AI are not just powerful tools. They are urging us to question the traditional education models and to rethink our philosophical approach to teaching and learning. What should we learn and for what purpose? A whole vision of society and its values are at stake. The time has come to reinvent the future and imagine a world where humans can live better lives in an AI ecosystem. This chapter attempts to provide some avenues for reflection.
CHAPTER 3

RETHINKING THE EDUCATION APPROACH, A NEW NARRATIVE FOR OUR SOCIETY.
LEARNING IN THE DIGITAL AGE
The author insists on the value of creativity in developing the foundation of a newer society. We need to rethink how and what people should learn in order to develop more relevant skills and competencies.

“Success in the future will be based not on how much people know, but on their ability to think and act creatively”
Learning certainly is one of the most disrupted human activity by the digital revolution with the accessibility of information and knowledge anytime anywhere as pointed out by the French philosopher Michel Serres. Firstly, one of the most obvious change is the rebalance of the learning activities from the professor/teacher to the learner who takes a more active role resulting in the need for organizations to rethink how people learn. Secondly, the content of learning is likely to be deeply impacted by the digital innovations that bring a more systemic view of the skills and competences, including the soft skills, to be acquired requiring organizations to rethink what the people learn. Thirdly, the great flexibility of the digital tools allow learning activities to be implemented almost anytime anywhere on any device, therefore organizations need to rethink where and when people learn. As a conclusion, learning in the digital age may appear as the foundation of a creative society.

**RETHINK HOW PEOPLE LEARN.**

There is a need to fundamentally change how learning activities are delivered. Instead of a centralized-control model (with a trainer delivering content to a roomful of participants), a more entrepreneurial approach to learning is now possible through the use of digital tools. Participants can become more active and independent learners, with the trainer serving as coach and consultant. Instead of dividing up the learning topics into discrete and separate subjects, it is now possible to focus on themes and projects that cut across the disciplines, taking advantage of the rich connections among different domains of knowledge.

The traditional division of participants by age, status and expertise is becoming obsolete in the digital age where participants of all origins are encouraged to work together on projects, enabling them to learn from one another and to learn by teaching one another including the famous reverse mentoring situations in which juniors teach the seniors new digital skills and competences.

**RETHINK WHAT PEOPLE LEARN.**

Much of what people still learn today was designed for the pre-digital era. There is strong need to change the content of the skills and competences to be acquired and developed in the digital age. One reason is obvious: organizations must prepare participants with the new skills and ideas that are needed for living and working in a digital society and particularly the increasing importance of soft skills as pointed in recent study and represented in the following cloud of words:

There is a second, subtler reason: new technologies are changing not only what participants should learn, but also what they can learn. There are many ideas and topics that have always been important but were left out of traditional learning activities because they were too difficult to teach and learn with pre-digital learning tools. Some of these ideas are now accessible through creative use of new digital technologies. For example, participants can now use simulations to explore new ways of doing and thinking as illustrated by the increasing use of augmented and virtual realities to develop new skills and competences. Some ideas that were previously reserved to a few specialists in universities and research centers can be disseminated and learned much earlier by a lot more people through the MOOCs (Massive Online Open Courses). Finally, and perhaps most importantly, there is a strong need to transform learning curricula.

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8 Corsham Institute, Rand Europe & College of St George : Digital learning : education and skills in the digital age, 2017 (https://www.rand.org/content/dam/rand/pubs/conf_proceedings/CF300/CF369/RAND_CF369.pdf)
so that they focus less on “things to know” and more on “strategies for learning the things you don’t know.” As new technologies continue to quicken the pace of change in all parts of people’s lives, learning to become a better learner is far more important than learning, for instance, the most recent finances or marketing tools.

**RETHINK WHERE AND WHEN PEOPLE LEARN.**

In the digital age, learning can and must become a daylong and lifelong experience. Learning opportunities exist not only in the organizations, but also in homes, community centers, almost anywhere. The exponential development of the coworking spaces everywhere on the planet is a strong sign of the ubiquitous nature of new temporal and geographical learning spaces. In the same vein, the generalization of learning tools developed for the mobile devices is a clear illustration of the dramatic change of the traditional learning experience that was primarily defined by the unity of time (training session) and place (a trainer in front of participants in a classroom). In the years ahead, the Internet will open up new learning opportunities, enabling new types of “knowledge-building communities” in which people around the globe collaborate on projects and learn from one another as it happens more and more in multinational firms today.

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**TOWARDS THE CREATIVE SOCIETY**

In the 1980s, there was much talk about the transition from the “Industrial Society” to the “Information Society.” No longer would natural resources and manufacturing be the driving forces in the societies. Information was the new king. In the 1990s, people began to talk about the “Knowledge Society.” They began to realize that information itself would not bring about important change. Rather, the key was how people transformed information into knowledge and managed that knowledge.

Now in the digital age, it is possible to argue that learning will be the foundation of what can be called the “Creative Society.” Success in the future will be based not on how much people know, but on their ability to think and act creatively. The proliferation of digital technologies has accentuated the need for creative thinking in all aspects of people’s lives and has also provided tools that can help them improve and reinvent themselves. Throughout the world, computing and communications technologies are sparking a new entrepreneurial spirit, the creation of innovative products and services, and increased productivity. The importance of a well-educated, creative people in organizations is greater than ever before.
HOMO LUDENS: FIELDLABS FOR LIFELONG LEARNING
More than ever, learning is becoming a lifelong endeavour. It is time to find new ways of learning the appropriate skills that will be adapted into our future world.

“Serious gaming has established itself as a field in its own to teach individuals and groups both cognitive and social skills.”
LIFELONG LEARNING IN AN ERA OF SHORTENING DIGITAL KNOWLEDGE HALF LIVES

In the romantic comedy Love, Rosie, from 2014, which was apparently aimed at the generation of thirty years and under, the lives and times of two best friends are followed for some fifteen years. The audience is informed of at what year specific events took place not so much by the style in clothing but by what kind of communication media Rosie and her counterpart Alex use. From fixed line telephone to SMS, from MSN to WhatSapp. The feel good sentiment of the young audience is also fed by the nostalgia of “Oh yes, that’s how we did it back then.” Most of these communication media of less than a decade ago are now ancient. The knowledge of how to use them has become obsolete.

This is true of most digital knowledge. It’s half live, the time it remains relevant, has always been short but is shortening still. And at the same time, more and more real-world technology becomes digital. In the Netherlands, it becomes practically impossible for consumers to deal with their banking affairs to go to a local branch office since none are there. Communication on paper is actively discouraged. Electronic banking is the only option, but this quickly moves from the desktop computer to the mobile app. And this when the IPhone is just 10 years in existence. How can generations of seventy and up cope with such fast-moving obsolescence rates?

HOMO LUDENS: ENGAGEMENT TO ENHANCE LEARNING

The idea that kids and cubs learn real-world skills by playing is well established. There are no schools for kittens. Eve much of what is learned in primary schools is not learned within school, but outside in the playground. Dutch historian Johan Huizinga argued in his 1938 book Homo Ludens that grownups also learn through play. Indeed, entire societies do so. Huizinga argued that most of civilization arises from play. This notion has a long history. The Latin word ludus not only refers to play and sport, but also to practice. One of the better-known quotes from Confucius is: I hear and I forget. I see and I remember. I do and I understand. Clearly, as any teacher will know from personal youth experience, the educational setting with one person standing in front of a room of people talking is a very ineffective means of communication. And yet that is still how the bulk of learning activities are conducted in most schools today, although we have replaced the chalkboard with a smartboard against the wall behind the teacher. Serious gaming has established itself as a field in its own to teach individuals and groups both cognitive and social skills.

Fieldlabs to bridge the gap between school and workplace If learning becomes more like continuous practice, and if the professional environment starts to ask more and more for new skills ever year, the distinctive boundaries between school and workplace start to become more and more artificial. This is true of when this boundary is first crossed, but also by whom and how. Both companies and students now see the value of multiple, short and varied internships during the early years of higher education and indeed during high school years. Both fellow students and prospective employers frown upon a CV without such experiences. So, no longer do young people make a big leap from school to work at the very end of their school career, there are multiple earlier encounters, playful and low-risk. Students are allowed to play in the real world to find out how a job
really feels like. Not just students, but also grown-ups move back and forth between college and business. Especially in fast-moving fields such as digital technology this is a must. One cannot prepare the students of today for their work in the digital economy based on experience in that economy that is two decades old. Lastly, how the boundary between school and work is crossed is changing. Students at technical universities can put in 70-80 hour “work” weeks to make sure their solar car wins the race, their team of robots excels at soccer, their rocket flies highest. Is that work or study? It is certainly play, or playful. But very serious play it is. Most importantly, it is experimenting in the real world that excites these students and makes them so intrinsically motivated. In short, they - and their teachers - learn and work in fieldlabs. The anatomy of fieldlab: CAMPIONE

The waves of digitization run very high in the industrialized world. We denote them with terms as Industrie 4.0, advanced manufacturing or smart industry. They hit the field of industrial maintenance especially hard. Present-day Europe is full of aging assets, of aging plants. The average bridge is over 40 years old, the average plant over 40. As such, there appears very little digital about these technical assets. And yet they too are now increasingly managed using data. Maintenance is usually done in two ways. Either maintenance is planned, so done at regular intervals, irrespective of the actual condition of the asset at that time, or it is done correctively, after the asset has broken down. Both are very costly and by definition inefficient. Planned maintenance is based on estimated averages of when maintenance would be needed, and so we throw away much RUL, Remaining Useful Life. This is maintenance done too early. Corrective maintenance is done too late, after the equipment has failed. It is also possible to do maintenance just in time when it is needed. One then needs data on the condition of the asset, and degradation models that can translate these data into an estimated RUL. This is less dangerous, costly, wasteful, and more durable, environment friendly. In short, this is smart maintenance. The technical term commonly used is condition-based maintenance or CBM.

And yet, despite its obvious appeal, CBM is still done for a minority of assets in industry. An entire workforce has to learn how to do CBM, and CBM systems need to be developed and installed. This requires experimentation and learning. That is best done in what is called in The Netherlands a smart industry fieldlab. Fieldlab CAMPIONE* (Condition-bAsed Maintenance In an Open Network Environment) is a successful example of such a fieldlab. Here, some 30-odd organizations collaborate to learn how this CBM technology works in practice. Industrial companies such as Tata Steel, Sitech and Fuji Film do so in their own plants, their own living labs. At a central location technologies are tested and students from all higher education levels “work” there. Students from the local ROC or intermediate vocational education community have built a test installation there, inspired and led by their teacher. Through the installation flows water, at moderate pressures and temperatures, which make it safer to “play” with that real-world chemical plans. Students and teachers of the minor in smart industry from the local higher vocational education conduct experiments there to analyze the data. Nearby, Ph.D. students from Tilburg University evaluate the training effectiveness of different forms of virtual and augmented reality. Entrepreneurs experiment with new tools for “smart maintenance. On a regular basis, professionals from the various firms and teachers and students convene to share insights and learn. Outside vendors and other industrial companies love to showcase their work in this area. The whole project feels like a beehive, full of activity and learning. Everyone shares the feeling: this is how learning should be like - and this is how work should be like.
ARTIFICIAL INTELLIGENCE, NEW TECHNOLOGIES AND EDUCATION: SUNNY SPELL OR PERFECT STORM?
PIERRE BALLOFFET:

PHD, Professor at HEC Montréal

Why we must reconsider the whole learning process.

“The arrival of AI in the world of education (and, beyond that, in the field of training as a whole) will have significant impact that will go way beyond merely renewing outdated teaching approaches.”
CONFLUENCE

The world of education has always been a melting pot, a crucible of change. It is in fact in direct contact with developments in our societies, whether they be demographic, economic, social, cultural or environmental. The same phenomenon applies to the influence of technological and scientific innovation on learning methods and on the tools these methods increasingly use. If we consider the last 25 years, in particular, the contribution of technological and digital innovation to education methods can be described as very significant. Today, after a phase involving inclusion of many technological solutions, it would appear that we are again in a phase involving acceleration of a trend, pushed by the constantly greater presence of artificial intelligence (AI). In this way, new tools are created and older tools take on new life or benefit from significantly increased power. Given that the set of theories and techniques making up the vast scope of AI has itself reached a phase of accelerated maturing, we can legitimately expect an extended and deeper impact of this field on education in the years to come. From a comprehensive viewpoint and a dynamic perspective, the objective of this brief reflection is to look forward to extract some contours of the future, with the signs we already see today giving us an idea of the potentially disruptive force involved.

TOWARDS US

For many of our contemporaries, AI is little more than a diffuse set of technological and scientific developments expressed in the form of digital programmes used by machines which are, to their great satisfaction, far away from them. When they think of the dangers of AI, these essentially cover two aspects: The fear of replacement (machines performing more and more tasks that only humans could carry out before) and the fear of losing control, involving access by AI to a certain form of self-sufficiency and therefore to independence which could be detrimental to life as we conceive it. But in fact, if we observe the first breakthroughs of AI in the field of education, the first thing that strikes us is the extent to which AI, on the contrary, is coming closer to us, to the point where it gradually becomes a companion in our learning process, in particular driving an increasing number of educational interfaces, whether or not in the framework of teaching institutions. This AI boom related to the world of education should come as no surprise. Three major challenges in education have always been: The significant number of individuals in training, first of all; then the ever-increasing scope of knowledge; and finally the need to think of learning not as a mere stage of life but as a continuing programme, throughout active life. Through the totally novel customisation and empowerment opportunities offered by current progress in AI, it would appear that each of these challenges can be met even more effectively in the future. Again, AI is not (or is no longer) a set of theories and techniques far removed from us, confined to the industrial universe or to the world of machines. Today, AI lights up screens that our eyes watch, is held in our hands when they interact with the interface of educational applications that have increased in number and in performance levels, enters our ears throughout headsets, etc. This means that AI is closer to us, recognises our individual specificity and makes the best use of it.

BETWEEN US

Not only are AI and its applications no longer realities far removed from our lives, they also substantially change our relationship to a group, a community, to each other. This involves far-reaching change in the world of education. Irrespective of the AI-driven tool considered, the tool blends into training systems rather than replacing them, in manifold forms. Even if a tool can to a certain extent be self-sufficient (for example replacing a conventional classroom situation), in most use situations, what we observe is by no means a mere subtraction effect. It is therefore likely that the AI boom will not coincide with gradual disappearance of more conventional teaching methods: One-way, interactive,
reverse teaching, classroom time or distance learning will continue to co-exist, and each of these methods is likely to benefit from the contributions of AI. Given that education systems have become more complex, combining several learning methods will certainly become a major challenge and it is likely that AI will play a role in the possibility of effective integration of these multiple approaches. This contribution of AI is not yet sufficiently recognised. It is important because it directly involves the relational interaction between teachers and learners (and even among learners themselves). AI not only comes towards us, it also slips in between us, changing the connections among the many players in an education system, first and foremost: The teacher and the learner. It is therefore clear that AI must be seen as much more than a mere substitute for conventional teaching methods. Its relational impact is major; it is now up to us to ensure that the impact is positive.

**AGAINST US?**

When it comes to education, AI comes closer to us and slips in between us, as we have just emphasised figuratively. This movement certainly has a significant impact on many of our practices, methods and habits. The learning relationship itself, at the very heart of education systems, is not immune. On the contrary, in light of rapid advances in AI application, we can expect even faster change in the decades to come. What strikes us increasingly as an inevitable “new norm” sometimes gives rise to a great deal of concern. The concern is rooted in well-founded and rather precise fears related to unwise use of tools or methods, but also, more vaguely, in uncertainty related to a development whose contours we cannot yet clearly define. This uncertainty is clearly present and is linked first and foremost to the relative performance of AI and the disruptive effects it could have by “disqualifying” teaching staff in at least part of their traditional assignments. Secondly, it is also linked to more qualitative factors, such as the risk of loss of control, ethical issues linked to monitoring of information, as well as challenging the very relevance of the current forms of many education systems or institutions with structures inherited from history, based on strong centralisation and hierarchy. Although the objective in the long term is to allow complete rollout of the countless opportunities offered by AI in the field of education, so that we can enjoy the full potential of the new uses involved, it would be unwise to ignore these fears. Even if they correspond to a certain form of inertia, the first step to overcome them is to recognise their very real nature and to understand their sources. AI experts will also have no choice but to show empathy and teaching skills!

**NEW MINDS**

At the end of this short prospective reflection, there is one undeniable conclusion. The arrival of AI in the world of education (and, beyond that, in the field of training as a whole) will have significant impact that will go way beyond merely renewing outdated teaching approaches. The changes we can foresee also concern the generally complex organisation of these education systems, their material reality and their educational cultures which are often deep-rooted. From the first years of learning to the end of life, the term “learning” will perhaps take on new meaning. In terms of governance, for public or private institutions with an education or training remit, this is not just an issue of new strategies to be implemented but new minds we need to use!
EDUCATING MILLENNIALS
LEARNING TO TEACH
DIFFERENTLY
The difficulties for teaching in today’s world creates an urgent need to invent a new pedagogy. The issue of a professor’s overall intellectual dominance is now totally in question.

“Helping people to find direction, guiding or supporting them in an uncertain, complex world is one of the finest vocations there is.”
Over their career, lecturers are surprised to see their students getting younger and younger. Or at least that’s how it seems.

It’s not just the result of a widening age gap. With time, teachers and pupils inevitably belong to increasingly different generations.

**THE GENERATIONAL FACTOR**

Being 20 in 2019 isn’t the same as it was in 1989. 30 years ago, we grew up without mobile phones, the internet or social media, in a world still divided by the aftereffects of the cold war. 20-year-olds in 2019 live in a post-Berlin Wall universe, transformed by ubiquitous digital tech.

Millennials (born c. 1975 - 1994) or the younger Digital Natives (born c. 1995 - 2004) are now attending lectures.

This generation has been immersed in tech, the decline of mass media and multiculturalism.

Their experience has been shaped by an addiction to smartphones that are always on anywhere, as well as their social media habits.

Their reference points are online, not on TV. With millions of others, they follow online celebrities who are often the same age. But this generation likes to create and co-produce content - whether educational or cultural - rather than passively consume it.

In their world, books have less status as, unlike online resources, they’re not instantly available anywhere.

But this generation’s approach to learning is also shaped by the intensive use of online tutorials - in other words, video. Many of us observe that these students spontaneously turn to online learning, usually outside their own university. In they run into a problem, they update their knowledge online, as needed.

The gradual obsolescence of lecturers’ teaching methods

To say that millennials are a challenge for Generation X lecturers is an understatement.

Lecturers today talk to laptop lids. If the terraces are steep, they can’t see their students’ faces. And they struggle to keep their students’ attention: lecturers have to be more riveting than a wealth host of resources a few clicks away. Moreover, outside of their narrow field of research, lecturers’ expertise can’t always compete with the best online content.

Coercive operating methods (difficult exams, close monitoring) give students less leeway, of course. And experienced adults show more discipline. But it’s undeniable: just as Millennials and Generation Z are moving into the workplace, speeding up their companies’ digital transformation, in higher education they are accelerating the breakdown of conventional teaching.
WHAT KIND OF TEACHING FOR DIGITAL NATIVES?

Academic institutions accept the need to innovate for many reasons: economic issues, activism by MOOC platforms like Coursera that are enrolling conventional universities, and competition from online training for non-diploma courses.

But the biggest factor is pressure from customers, i.e. students and continuous learners. It’s depressing for educators to see that their classes are less and less of a hit.

To adapt to the digital native audience, one principle is to give students an active role in their training. In other words, it means reducing the time spent in lectures, unless you’re lucky enough to work in a field where online resources are rare (cutting-edge or new expertise), and increasing student’s activity, which necessarily retains their attention.

Putting classroom teaching online means flexibility for students and economies of scale for institutions.

However, the great hope generated by online classes soon began to fade. The format is often disappointing, especially for endless videos of filmed lectures. The social experience cannot compete with a live class, despite the obligatory chatrooms. The dropout rate is high, unless students are extremely motivated or coerced by online behaviour tracking through to voluntary progress confirmed by a final exam.

To make up for these shortcomings, richer, more varied content is needed (videos, animations, interactivity, etc.), with more complex educational methods than a linear presentation, calling for substantial resources and specific know-how.

In response to the limitations of a fully online approach, blended learning is an attractive compromise. By mixing online and on-site, we lost the flexibility of a fully digital course by make up for many of its drawbacks. Passive time in the classroom is reduced or even cut out completely to focus solely on student activities.

Universities are starting to adopt two types of blended learning.

Hybrid learning consists of replacing 30-70% of classroom time with online training. The fundamentals are taught online before going into greater depth in person. The aim is for students to arrive in the class with a minimum common foundation. They then build on that base with more advanced concepts that call for more interaction.

Flipped learning turns the conventional roles on their head. Classroom time is given over to exercises and conceptual content is acquired online beforehand.

Within these formats, of course, there are many possible variations. The online part can be original or sophisticated to varying degrees. Micro-learning, made up of short units that can be consumed on a smartphone, is generating great interest for example. Online education remains an innovative field that has caught institutions off balance as they usually put little time and resources into pedagogy. They are working by trial and error for want of more systematic, sophisticated measuring tools.
WHY LEARN?

It’s very tempting to use new resources that are better suited to a younger audience without first asking what the end purpose of the training is. Restricting the question to Business Schools, what’s the point of enrolling in one?

Putting the purely pedagogical question aside for a moment, a diploma is a social asset. It gives graduates access to jobs, a certain salary level, increases their attractiveness and lets them into networks.

For employers, a diploma is like a guarantee founded on the institution’s reputation. The Business School is like an applicant-sorting machine. It is a signifier of competence or even a tool for social selection, proving that graduates have the cultural codes to the sphere they aspire to). France, which operates on a meritocratic model, is especially keen on selective diplomas, to the extent that doors are closed to candidates who are self-taught or from unusual backgrounds.

But a diploma’s worth as a social asset depends on the knowledge and skills acquired. The graduate must know things or how to do them.

Conceptual teaching has been more prestigious than practical teaching ever since the Greeks made the distinction between episteme (knowledge) and techne (know-how). Higher education has always favoured knowledge, leaving know-how to shorter courses.

Is this hierarchy still relevant at a time when technology makes access to knowledge extremely easy?
Being able to call on knowledge is very useful. It’s better to know how to read an income statement whenever you need to than to have to read a book on accounting. Knowing what you’re talking about and giving a well-argued opinion is a major benefit of knowledge acquisition. In economic activity, we need managerial “general knowledge” as well as a specialised knowledge base to be able to analyse a situation, dialog with others and take part in decisions.

But the business world is increasingly uncertain, and a manager’s skills must evolve accordingly.

The skills needed for routine work and for complex, changing tasks are different. “Meta-cognitive” skills involve learning to learn, processing knowledge, problematizing a subject, developing innovation and managing a project.

But these aren’t skills that you learn online. You can become familiar with the concepts on the net, but not acquire the skills. This is why approaches like learning by doing or design thinking are becoming so popular.

In a design thinking approach, it’s not about finding a solution for a given problem. First you have to find the problem. And you can’t do this by consulting online information or by sifting through databases, but by observing and questioning real people, through work that combines analysis and empathy. Once we’ve defined the problem, we explore solutions with no guarantee of being right, trusting experimentation rather than just thinking. Reiterating - acknowledging we were wrong - is an integral part of the process.

Lecturers long thought that their work consisted of passing on knowledge. Today this role is largely assigned to the online library called Internet, as well as the new formats for online teaching.

However, the fundamental mission of the educator has evolved little since the Greeks. The word pedagogue comes from ago (ἄγω), meaning lead or guide. Helping people to find direction, guiding or supporting them in an uncertain, complex world is one of the finest vocations there is. But its purpose and methods need rethinking.
EDUCATION RECONSIDERED
In her interview, Claire Boonstra shares her vision of the future of education in the digital era. She explains how the development of AI and related technologies are forcing us to reconsider our approach to education. We must be better prepared to face tomorrow’s challenges. She believes that we must focus on the purpose of education. With great enthusiasm, she considers the great opportunity for humans to unleash their potential and discover who they really are.

“My mission is to unleash the infinite potential of humanity”
With Layar, you have been involved in the digital world since the early stage of the digital revolution. More recently, you have been focusing your activity on the field of education, can you please tell us exactly what you doing now and why?

I started 6 years ago with a Ted talk where, based on my own experience, I announce my vision and came to the conclusion that we had to question our education system.

One of the most important problem is that we don’t know anymore (we lost track of) what is the purpose of education. Actually, the implicit purpose, which is never spoken of, is that we should achieve higher. Higher is always better, higher grading, higher score, higher ranking. Pisa Ranking is a perfect example of the pressure put on students, on professors, and on schools, to score better. Therefore, although we identify among students, a large spectrum of talents and motivations, we narrow down their capacities to a limited amount of subjects or specific skills. As a result of that implicit pressure, we observe a high rate of burn out among young people and this phenomenon now even reaches adolescents who drop out of schools.

The second aspect of that problem is that because of the development of new technologies, we know that AI and robots will take over so much of what was previously done by humans, that we need to figure out what makes us unique as humans. And yet, we keep educating people to be well behaved people who simply obey to rules. They might not be equipped to solve tomorrow’s challenges that we’ll be facing.

So, to the question, “What is the purpose of education” I found 3 answers:

- Become who you are and who you want to be. Unleash each person unique and full potential.
- Learn life together, and learn how to live together
- Take ownership of your own life and of the world we strive for: peaceful, happy, healthy and sustainable

When asking people whether they agree on the purpose and the leading principles, the overwhelming majority (95%) say yes.

These answers are essential because we need an answer in order to assess what is quality in education.

When we ask people what, according to them, stands in the way to achieve these goals, they come up with four reasons:

1- The rules, the regulations, the way the system works
2- People do not understand these goals, others
3- Our habits, our way of doing things,
4- Educators don’t dare doing things differently, they need to change themselves.

Transforming Education into something we need, therefore implies addressing these four levels of understanding.
The question is to examine one by one, these four layers and understand what lays behind or beneath the Education system as it is. How to do differently inside the system. If we want to change the rules, we need to find what are the alternatives. When we try to understand why we do things one way instead of another way, we find no logical reasons. For example, we know that long summer break is a disaster for underprivileged children, because it increases the inequality gap. When we tried to understand what was the history of such an organization, we realized that the summer break corresponded to the agriculture rhythm and to the necessity to have young people in the field at the time of the harvest; Another reason was, for the rich people to move to their summer houses. These reasons have no relation with the educational efficiency.

My conclusion is that it all starts with School leaders. Transformation of Education relies on the capacity of lead such a transformation.

Agora Schools which are focused on personal development are organized like a mini society, students, professors, parents are involved. It’s an ecosystem.

*According to you, with the emergence of the digital revolution and the development of AI what are the specific skills, humans need to preserve, in order to keep innovating?*

What skills, what knowledge enable humans to take their own life at hands? Any curriculum vitae will always be outdated because society changes so fast. What is eternal? What is sustainable? In order to take ownership of your life, you need an immense amount of knowledge, but not necessary the amount of knowledge you learn at school. You only need part of it. You need basic knowledge but what is basic knowledge? The answer, because is the ability to take care of yourself and someone else’s. This is sustainable knowledge. It is life attitude.

You need to understand your life, how to deal with society, with the planet. This is the only sustainable basic knowledge. Until now, there has been an order of priorities:

- Education is about acquiring knowledge
- the second level is to acquire skills
- The third level is the personal attitude.

Now we observe that the most successful schools, where the children are the happiest, no matter what their social background is, are the school where they start with the life attitude. They turned it around, they twisted around the complete approach of education and this, because life expectancy is extended to a hundred years, because technology is considering old age and death as a disease.
Considering that technology has created new needs for Education, do you see latest technology as part of the solution, do you think that we should integrate new technology into schools more?

The answer is yes. The only way we can unleash every talent, his unique potential is to have a decentralized organized environment. Big data analysis can help tremendously. It can analyse each specific potential. Data platform can help education to be fully personalized. In order to make that potential visible, we need standardized tests. Right now, technology such as Blockchain enables to have personal assessment. It also allows a decentralized assessment system based on deeper knowledge. In the past, it used to be very difficult to assess what skills were needed to become a marketing manager for example, today, with such a technology, it is possible.

Knowledge delivery process. Do you think that there are some areas where Technology can play a specific role?

Internet has made knowledge accessible to everyone everywhere. We see it with Tedex, with Massive Online Open Courses (MOOC), and skype exchanges. Anybody with a mobile, even living in the slums, can access to Harvard quality knowledge. So, it is clear that thanks to internet, the distribution of knowledge has gone gigantically forward. We can now exchange very interesting knowledge across the globe.

However, what is also happening and which I am very afraid of, is that, in our quest to enable underdeveloped countries to access to knowledge and massively acquire new skills, philanthropists as well as tech entrepreneurs have developed standardized learning environments.

In these programs, the teaching process is controlled with very detailed instructions which leaves no room for improvisation. The problem is that, this process reduces teachers to become robots. That is a very scary development because we don’t know what actually students do learn when there is no connection with the teacher?

We all know that what makes a good teacher is when he can trust his instinct, when there is a deep connection with him and other humans, with children and with students. There are so many evidences that real learning only happens when there is deep connection with the student, when the teacher is actually seeing the other person. Here the teachers are turned into robots and therefore, cannot do what they are supposed to do.
And that’s where the technology is doing the wrong thing.

And yet, it is massively adopted because it is a concept that is proved to be working, because philanthropists and tech entrepreneurs see it as being a way to massively provide quality education across the globe in a controlled and safe environment.

But if we train children to operate as robots and there will be nothing unique about them, particularly at the time when robots are taking over. We will turn children who are being taught this way, into workers with skills that we soon won’t need in the society and economically and that will soon become obsolete.

Have you looked at the Neurosciences side of things, what do you think of the developments of neuro sciences? Is there a potential there to improve learning and education?

Yes, Neurosciences are a very new subject which is improving very rapidly and which helps us learn quickly how the brain works and how brain connections work. By the way, like neurosciences, learning is about making better connections and we know now better and better how this works.

Neurosciences are indeed improving the process of education and of acquiring knowledge. For example, the implantation of chips in people’s brain that can in the next decade, be implemented and that potentially enhance brain capacity, is very interesting but also very scary, because we know that it probably won’t be accessible to everybody.

However, I am not an expert in the delivery process of education or how the teaching has to be done. My field is rather to focus on questioning the purpose of education and the assessing of quality of education.

In conclusion, what I really want is to transform the Education system, to create schools or learning environment which is putting purpose into practice. I also believe that assessing the quality education system is
PART II

NETEXPLO’S PERSPECTIVE

BY SANDRINE CATHELAT.
LEARNING TODAY
AND THE DIGITAL (RE)
LEARNING OF TOMORROW
In this essay, Sandrine Cathelat provides the big picture of how the cutting-edge of digital innovation is impacting education and training. She examines the wide spectrum of challenges that society and humans must now face in the digital era.
INTRODUCTION

We live in remarkable times! For the past twenty years, we have been absorbing a digital revolution that is completely transforming our lives as citizens, as consumers and in the workplace. Some have embraced these changes more easily than others. But as we take part in it, we see the extent to which this digitalization is reinventing behaviours, cultures and societies. **In the business world, managing this transformation is a major challenge. It represents an opportunity to rethink our organisations and forms of governance**, by going further than the already complex process of digitalizing existing processes and methods.

**Similarly, the world of education should also take advantage of these new possibilities to challenge and reinvent itself.** Incredible opportunities to make education more widely available in regions with little or infrastructure have already been seized. With digital technology, classes can be offered anywhere in the world and reach more people, at a lower cost, thereby making it possible to educate women and men, the young and the not so young. Students and teachers are changing their habits and the ways they interact to experiment with new styles of teaching (flipped classrooms, reverse mentoring, experiential boot camps, etc.). **Above all, it is an opportunity to question the orientation and objectives of our education system and ongoing training.** What is the purpose of studying? Or more precisely, what purpose does it serve?

The future that we face now is more uncertain than ever. The digital revolution is one of the causes of this uncertainty: how will it shape tomorrow’s world? There are numerous other factors, such as the fragile state of the environment, rampant obscurantism, the defiance of institutions, and health crises. We have to deal with this uncertain future, and our education system, designed twenty years ago, is not preparing us. If anything, it is doing the opposite.

We need to show daring, a spirit of adventure and creativity, and yet we seem to stifle the diverse and singular talents that would enable us to invent the future. What changes must take place in the world of education that would enable us to imagine and construct our future?
We have all seen young children learning, revising, and doing exercises. And we have all seen to what extent training has been disrupted by digital practices over the last ten to fifteen years.

What now seems normal to an increasing number of learners, has not in fact been around very long, perhaps only a few years. And this is a real revolution. A revolution that is taking place both in rich, developed countries and in poor, emerging countries. Education in the wider sense, i.e. its organisation, governance and culture, is changing everywhere. And while these changes are often for the better, they are sometimes for the worse.

What are the key points?

A great deal of content is available, and much of it is free (although the business of online courses is expanding, offering subscriptions to distance learning programmes and direct chats with teachers). It is up to the student to find them (which is not always easy). It is up to the student to make a selection (with the help of scores and recommendations for example). It is up to the student to choose teachers that they like, on the basis of their profile or their teaching style. It is even possible to choose several!

These courses are created online by teachers, pupils, and parents, that is to say essentially by peers, often without any expectation of payment. The community shares its knowledge on the web. And this can be a highly interactive process, for example with groups of students keeping up an ongoing discussion of what they are learning via instant messaging.

They are available for unlimited consumption, so users can review content as many times as they like, at their own pace. This also means that people can find exactly what they need in terms of level and areas of interest: there is no longer any requirement to follow a programme, or to start at “A” in order to reach “B” or “C”. The user makes up their own programme and can start at the end if they like, skip entire sections, and come back to previous topics.

People can access content wherever they are and at any time of day or night. There is no longer any need to be part of a class, to have reached a certain level (unless, obviously, this is necessary in order to understand a concept or method), to have been selected on a competitive basis, or to join a school. No need for any timetables either! You can learn during the day or night, at your own pace.

Everyone, therefore; is in control of their own training. And this, without doubt, is the main source of disruption! The use of digital technology that has been intensifying for nearly fifteen years at a global level (and for much longer in developed countries) means tremendous individual empowerment.
**POWER FOR THE PEOPLE**

The internet has enabled us to do a great many things, three of which are real social revolutions. While in developed countries we have come to take them for granted, in emerging countries they are being enthusiastically embraced.

**First, we have free access to vast amounts of information.** To such an extent that we are often submerged in information that we do not even want! This information, available by simply clicking on a link, is usually free and available to anyone.

**Second, we have a means of expressing our opinions** on any subject and whenever we like! Simply create a blog, a Facebook page, open an account on Twitter, Instagram, Pinterest, WeChat, or Snapchat, or start an instant messaging group. Or even easier, give your opinion on a platform or website of a product or service that you have used. Once again, it is free and open to all. Approval, or disapproval, will come from your peers. If your posts contain incorrect, uninteresting or out of date information then they are likely to disappear into the ether, the victim of insufficient likes or views.

**Third, we have the means to communicate with others.** Again, it is free and very efficient. One can join a community, or create one, remain a spectator or be active, join numerous communities and come and go as one pleases.

This multifaceted empowerment helps to give individuals a richer existence, greater freedom and more means of taking action. It reshuffles the cards in terms of power, and has made things more difficult for the elite. It has brought about fundamental changes in balance, obliging public and private institutions to be more transparent, more interactive, and more “co-creative”. **As can be imagined, these three levers of individual empowerment have also impacted the world of education and training, playing an active role in its evolution.**
Keen to Learn?

The elite in the world of learning have had to reposition themselves now that they are in competition (for better or worse) with the Internet. Places of learning need to be organized differently, governed differently, and make use of digital technology. All the more so as they must respond to a strong demand for knowledge or at least information, and access to knowledge. This pressure for ever more education exists all over the planet.

In the poorest countries, the education of citizens, especially women, is a powerful lever for the development of democracy, health and the economy.

Initially then, it is a matter of giving pupils a basic level of general knowledge, a common foundation, so that they have a better understanding of their own world, and that beyond. This opens up many more possibilities in their lives, and enables them to live together, to imagine different futures and trajectories, and to come up with new ingenious solutions to local or long-standing problems.

In rich, industrialized countries, education stimulates growth and the work market.

Will the digitalization of the workplace accelerate the depreciation of diplomas in skills that digital assistants will also be able to acquire?

Individuals equipped with full digital powers will still have the means to learn. In fact, there will be substantial pressure to learn, from which we will be unable to escape, now that we are so well equipped! And people are generally keen to learn, as is clear from their Google searches and their calls for help on social media during a conversation with friends.
ARE WE REALLY KEEN TO LEARN?

With the arrival of search engines, it is now almost impossible to broach a subject without someone looking something up on the web. Thanks to Google, we are now never caught off-guard: all the facts we need are at our fingertips.

The process has since accelerated with apps that have an answer for everything: translating languages, route planning, history of a location, significance of a date, the films an actor has been in, what a novel is about, what music is popular, the chemical formula of a medicine. Everything has become “Googlized” or “Googlable”. Everything is on Wikipedia, or a blog. Everything is said and shared.

The Internet may have helped quench our thirst for knowledge and learning, but above all it has enabled people to satisfy their informational needs “on the spot”. Provided we have a reasonable connection, within milliseconds, the desired information is displayed, we can listen to, or watch whatever we like. As a result, our attitude to knowledge, to its acquisition, and the evaluation of skills (many of which have now been reduced to the possession of an Internet connection) is undergoing profound change.

Is the ease with which we find information and knowledge on the web comparable to learning, does it signal a desire to learn? Does the fact that all this potential knowledge is within reach imply that everyone has a desire to access it? Opinions diverge on these points.

While MOOCs (Massive Open Online Courses) are popular, it also has to be said that few students finish them. Short-term, opportunist consumption of content informs us, and increases our knowledge, but it does not correspond to learning. Google Translate resolves a problem but is not a lesson in a foreign language.

Empowerment is an undeniable opportunity that also creates duties. As the right to learn becomes more widespread, so the expectation of knowledge increases.

This has caused a few problems, in the corporate world for example. Many companies offer online training on internal networks, and expect employees to train themselves. This often ends up being unsatisfactory. Unless they are obliged to, few employees make the effort. Education does not just consist of offering useful, well-organized content, it is also the art of motivating the students.

After all, traditional educational systems push us to learn things, develop skills and acquire knowledge that do not necessarily correspond to our talents or personal desires. This is the issue raised by the British university professor Sir Ken Robinson, who argues in favour of bringing creative skills back to the heart of the public education system.
According to Robinson, to deal with an uncertain future, we need to call all our creativity into play. And this should be possible, since we are all naturally equipped with creative talent. For proof, simply watch children playing, drawing, telling stories, making up a dance, a song, or a “one-man show” without any fears or reserve. Their unbridled creativity gives them strength and they are not afraid of failure or being judged. They express their originality. This special, creative intelligence, that we all have within us, is diverse and dynamic. It takes very varied forms and is nourished through interaction with others.

However, Robinson says, it is stifled by educational systems, as they currently operate all over the world. As we grow-up we become afraid of making mistakes and being different. Schools assess us, and then select us on the basis of a narrow set of skills, which are those required in the workplace, and on our compliance with the processes and rules of the world of business. Creativity is outside the scope of education. Education is more likely to discourage it. As Picasso said, “we are all born artists, the problem is to remain an artist as we grow up”.

Robinson has sounded the alarm: we cannot afford to snuff out creativity and diversity if we want to invent the future. We need to reconsider the whole variety of human skills, to celebrate our creativity in all its forms and shape tomorrow’s world.

All the more so since it takes less and less effort or skill to be able to use digital tools. Until relatively recently, any technological tool required some sort of training: familiarity with a computer language, with procedures, etc., but now they are designed to be intuitive, and as simple and easy to use as a smartphone, a laptop, a game console, and even a game itself. You learn how to use it simply by using it!

As a result, in companies, this new form of learning fulfils two objectives. The first is to combine training with immediate satisfaction. One learns by playing! The second enables training to be reconciled with productivity: One learns by doing! This second objective is valuable for businesses. It implies that learning no longer involves time away: it is possible to learn at the same time as working, without an employee leaving their station. All that remains is for them to improve their productivity (which no doubt will quickly be accomplished).
CHAPTER 2

DIGITAL TECHNOLOGY FOR FUNCTIONAL EDUCATION
THE WORLD OF EDUCATION IS UNDERGOING A DIGITAL TRANSFORMATION.

We have seen that the digital era invites us to conceive of another way of passing on knowledge, with the promise (or myth) of facilitating learning for everyone in any situation (to the point that it becomes obsolete). Or even the connection of the entire store of online knowledge to anyone who has an Internet connection!

How can we resist such a temptation? Laziness (tempered fortunately by curiosity) and our digital objects tend to lead us to connect to knowledge rather than to assimilate it. The pressure to always be productive also pushes us to choose the online knowledge path. Businesses, like society, are constantly moving faster, requiring better performance, and taking less and less time for reflection and for learning, preferring instead to adopt efficient, short-term processes. “Pop-up” knowledge is all the rage. It’s too early to know what the long-term consequences will be.

For now, education is already evolving, changing its content, its tools and motivational levers. There is no alternative. As in the corporate and political worlds, education is changing under pressure from “pupils” whose culture is itself undergoing change and whose behaviours are becoming digitalized.

DIGITAL TOOLS HAVE ENTERED THE CLASSROOM, BRINGING CONVENIENCE AND FRUGALITY)

Pupils have started to bring their laptops, tablets and smartphones into classes in order to take notes (the best-case scenario!), record the lesson, seek additional information about whatever the teacher is talking about - or go on Facebook.

Teachers have also digitalized their teaching methods: personal spaces on Internet sites enable them to put exercises or courses online, and they can communicate quickly and easily with their students via email.

Schools are also embracing digital technology by offering online courses. These could be MOOCs, or more simply an internal YouTube channel. Teachers now have videochats with students, and produce podcasts.

It is clear that this digitalization of the teaching process is still somewhat anarchic, and that this anarchy tends to be livelier in developed countries with well-established, functioning education infrastructures than in countries where there is nothing!

While rich countries struggle with their elite institutions to construct a mixed digital/face-to-face educational programme, in developing countries the digitalization of education is not so much a challenge, as a welcome solution.

An effective solution to two major problems: a population that needs to be educated whose volume continues to grow and non-existent infrastructure, especially in rural areas. The educational desert (often on top of a healthcare desert) in these poor, isolated regions constitutes an emergency because young people live there who want to learn. It is also a way of escaping from the religious and social obscurantism that exists in some regions. Fundamental issues are at stake here that go beyond the economy. We are talking about such things as women’s access to education, democracy, health, religious extremism, and environmental awareness.

For a mass education program, digital methods can solve some problems quickly and inexpensively.
360ED
Enhancing education through frugal innovation and virtual reality

What is it? To boost the education system in Myanmar that had fallen decades behind, 360ed uses virtual and augmented reality, combining smartphones with cardboard headsets that cost about four euros. For students, 360ed supplements their school textbooks with interactive content and enables them, for example, to visit the places they are studying in geography using virtual reality. This immersion gives them a personal experience of what they are learning. Teachers can learn new techniques by observing other teachers around the world, for example by visiting classrooms in Finland or Japan.

What is the benefit? Thanks to this “frugal innovation”, technology offers a way of making high-quality education more widely available. A source of stimulation and evasion for the pupils, and a training tool for teachers, virtual reality is used here to enable a disadvantaged population to gain access to the wider world and to increase its capacities for teaching and learning.

DOTLEARN
The use of compression technology to make video training more widely available

What is it? The cost of Internet data is the main obstacle to the dissemination of video training in emerging countries. For students in regions without a high-speed Internet connection, DotLearn offers a compression technology that enables the viewing of videos at very low bitrates. Students can watch five hours of video on a basic smartphone for the same cost as the sending of a single SMS message. The encoding process was developed by the founder of the start-up during his studies at MIT.

What is the benefit? The edtech start-up based in Nigeria offers a simple, effective technological tool to make online education more accessible to the populations most in need. It has since launched an app to help Ghanaian students prepare for their WASSCE, the African version of the school leaving certificate.

LOKOLE
A digitalized school that is available to everyone

What is it? Lokole is a small device that allows communities that are not connected to access an electronic messaging service and offline web applications. Lokole creates a Wi-Fi network with a radius of 25 metres enabling access to a dedicated messaging application and minimizes bandwidth use and therefore the associated costs. One device can be shared by a community of about a hundred people, enabling a pooled investment, thereby reducing the cost even further.

What is the benefit? While mobile Internet offers new perspectives for education with new applications being created each day, nearly half of the world’s population does not have the technical or financial means to access these online educational services. It is precisely for the inhabitants of developing countries that the digitalization of education presents the greatest potential. In regions where a child sometimes has to walk ten kilometres to get to school, using Lokole, pupils and teachers can exchange online messages and educational documents at a distance, and at a relatively low cost.
This frugal, effective edtech reflects the objective currently pursued by the digitalization of learning processes: ease of access. Or in other words, convenience. Most digital tech in recent years promises this as a benefit, and education is no exception.

**WHY DIGITALIZE LEARNING? FOR THE SAKE OF CONVENIENCE**

Currently, the accelerating digitalisation of education has focused on learning tools. For this reason, the main benefit pursued has been of a functional, utilitarian and pragmatic nature. The key issue is to increase convenience. **This convenience applies to everyone: teachers and students, and ultimately the society or business that harvests the fruits of all these efforts!**

But the transformation of education and training does not stop with the evolution of learning tools. **If we seek a transformation then we need to ask questions about the direction of learning, about the purpose that it serves on an individual basis, but also of course collectively, and for the whole of society.**

We need to ask what the education model of the last few decades prepares us for before asking how it should go about it. And we must observe that we are educated and trained in a way that corresponds to the requirements of the labour market. It is therefore on the one hand to develop our functional skills and on the other to develop standardized skills. We give preference to rational, scientific minds and treat creative, emotional, or irrational minds less favourably.

According to Robinson, whatever education system you look at in the world, the emphasis is on developing academic skills, while other equally important skills are largely ignored, yet these are surely just as valuable, especially when you consider that we have no idea what the future holds!

These academic skills are promptly prioritized: at the top is mathematics and the sciences, and then the mastery of languages (first our mother tongue and then foreign ones), literature, the humanities and, finally, right at the bottom, the arts (and yet this is where creativity and diversity really flourish!). There are two reasons for this.

First, the public education system began with the industrialization of the 19th century. It therefore evolved to meet the requirements of the workplace. These are very pragmatic, functional, utilitarian, standardised requirements. Today, students do not develop the talents that they possess, they develop the talents required by the labour market. And if yours are not required, you will be discouraged. Education thus produces students that conform and are conformist. In other words, the opposite of the diversity that is necessary to create innovation.

Second, universities have designed the education system and its programmes in their own image. Academic talents are therefore favoured, again at the risk of producing students that are brilliant but standardized. If you do not correspond to the model, then you do not receive a diploma, you are declassified, and have no value for the system. And yet these diplomas, the key to entry to the world of work, are clearly losing value, as we witness “academic inflation” all over the world. Companies that require such and such diploma, or such or such university, are becoming increasingly demanding. While a bachelor’s degree may have sufficed in the past for a certain job, now you need a master’s. And where a master’s used to be enough, you now need a PhD!

This observation by Robinson undermines what we have previously taken for granted. Are we in the process of reducing ourselves to functional, standardized skills that no longer have any value, and which do not prepare us in any way for the future?

All the more so since we are successfully creating digital assistants with these same functional skills! Robots and software operate perfectly in an environment of standardized talents and functional processes! The endless search by businesses for greater efficiency (in terms
of performance, productivity, return on investment, annual growth, lower production costs) has led to an education that favours functional skills and which propels us into direct competition with the abilities of machines.

The choice of education model depends on what our goals as humans should be. If we want to evolve in the same way as machines, then our current education system is good. However, if this is not the right path, then education needs to change at a fundamental level with a view to developing human abilities that until now have been largely ignored (intuition, desire, a taste for risk, accountability and independence, relational and emotional capacities, empathy, creativity, individuality, etc.).

The issue here is that currently, when the question of transformation in education arises, we think in terms of educational tools and we still see tomorrow’s skills as being purely functional. Is this the wrong path?

Thanks to digital technology, we can organize schools differently. And when we talk about schools or a classroom, this also applies to other places that offer vocational and ongoing training, talks and lectures. We could talk about all the places that currently deliver content on a top-down basis. The question being not so much should we continue to pass on information in this top-down fashion, but rather in what proportion? And on what subject? According to what broader educational mechanism?

Using digital tools “in class”

Not to take notes, which would amount to simply replacing paper and pencil with keyboard and screen, but to be more active and interactive, to be less isolated and egocentric: seeking more in-depth information about the subjects that we find the most interesting or relevant, interacting with other students and teachers, trying out community learning with challenges, pooling ideas and reactions, expressing both your points of view and the things you do not understand, etc.

Using digital tools to prepare “a class”

Not to put the same material online that would be presented in a “real classroom”, but to optimize the experience in both the virtual and real dimensions. The online classroom is good for passing on information, introducing concepts, or experiencing situations via mixed reality for example; the “real classroom” can then be used to ask more specific questions, raise misunderstandings, go into more depth; but also to share one’s ideas, reactions, and feelings with the teacher and other students; and to have an authentic, tangible experience of one’s choices, in real life, in a group.

Using digital tools to manage “a class”.

Beyond the comments or questions asked via the equivalent of a Twitter feed, beyond the occasional games and organized via smartphones or tablets, digital technology can also enable better interaction between the teacher and their students. It can help to manage a learning community. In the past, teachers stood on a pedestal and unilaterally shared their knowledge with a community that they considered as one body (or mind). While questions could be asked, they would be relatively few. Today, intelligent apps can assist teachers by giving them information about the community and the individuals of which it is composed. Are they interested? Are they lost? Are they comfortable with a particular concept, who is not? And in what proportion? Who liked a particular exercise, example, or part of the lesson? In what proportion? Should I teach faster, or more slowly? Should I split the group into several sub-groups? Essentially, there are numerous parameters that can enable a teacher to manage a lesson in a less standardized, top-down fashion.
ALFS

Augmented teaching

What is it? In 2014, scientists at Madrid’s University Carlos III developed a prototype for “smart glasses”, using augmented reality and Kinect technology; the glasses are connected to an app downloaded by the students. The students fill in their profiles and scan their faces so that they can be recognized by the Kinect camera when in class. Each student can then indicate to the teacher via coloured symbols if they do not understand an explanation, ask them to go more slowly, or tell them that they did, or did not, know the answer to a question asked to the whole class. In this way the “augmented teacher” can see if students are following or if they are having difficulties.

What is the benefit? The proposed system (Augmented Lecture Feedback System) aims to improve student–teacher communication during the lectures frequently given to large numbers of students at universities. Students thus have a new way to communicate with the teacher, that is immediate and private, without interrupting the lecture.

SMART EYE

Class room surveillance

What is it? After being tested by the Chinese police as a means of maintaining security in public spaces, facial recognition is now being used in a high school to monitor if children are following in class. Three cameras have been installed above the blackboard in a classroom at the Number 11 High School in Hangzhou, in east China. The system is able to identify seven different facial expressions – joy, sadness, disappointment, anger, fear, surprise and the absence of any expression – to determine if the children are paying attention, and if not, to inform the teacher.

What is the benefit? Unlike the ALFs, the interaction here is passive, or rather the students are subjected to it and their reactions and behaviour are continuously scrutinized. Digital surveillance has effectively replaced empathy between teachers and students, with a view to more efficient performance. This technology is currently only used in one classroom but will be deployed throughout the school during 2019.
AV1

A telepresence robot to combat the social isolation of children with long-term illnesses

What is it? Designed by No Isolation, a Norwegian start-up, AV1 is a small telepresence robot which allows sick or hospitalized children to stay in contact with their class and their school mates. The robot sits on a student’s table or the teacher’s desk and, most importantly, is totally mobile, so it can also for example be taken to the playground. Equipped with a loudspeaker, a microphone and a camera, the robot is controlled at a distance by the child, who can participate in the class by making a light flash on the robot’s head, as if they were raising their hand, or even chat with their neighbour using “whisper” mode!

What is the benefit? AV1 aims to combat the social isolation that often comes with the physical suffering experienced by sick children. The robot has been designed to allow children and young adults to continue to benefit from their education, and social activities, despite their illness.

SPATIAL

The Slack of the future?

What is it? Spatial is a mixed reality coworking tool that uses the environment to create an augmented, immersive, shareable work space. Remote users can collaborate, share, create ideas and share content as if they were in the same room. Spatial has been designed for HoloLens and Magic Leap headsets but can be used with any virtual reality device.

What is the benefit? While Spatial is without doubt the first successful mixed reality distance-collaboration solution, it could also be a powerful, stimulating tool for real-time schooling or training for geographically remote students or employees.
**USING DIGITAL TOOLS TO “TAKE A CLASS”**

Pushing the classroom walls, or even no longer having walls at all! This is the use of digital technology to take a class in a different location or at a different time from the original class. We are thus no longer limited by space or time and can benefit from other’s knowledge at a distance (for example, telemedicine, bomb-disposal expertise or piloting a spacecraft); we can also travel through space and time to experience history, geography, the future, the infinitely large or the infinitely small; we can finally go beyond our own skills, by simulating situations.

MOOCs, microlearning and video-conferencing are all examples, enabling us to learn the skills that we choose, on a daily basis and at our own pace.

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**DUOLINGO**

*Open-learning of languages*

What is it? Duolingo is a platform for learning languages. Via its Internet site, Duolingo allows anyone to learn or practice the use of a new language for free. It is an educational service that is open to everyone. Duolingo uses a participatory business model similar to crowdsourcing.

What is the benefit? In exchange for this possibility of free learning, the student agrees to translate digital content from the Internet and thereby participates in the dissemination of large amounts of data. Duolingo is therefore also a collective translation platform, which generates content through crowdsourcing.

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**PETER**

*My teacher is a chatbot*

What is it? Peter is a chatbot that helps students do their homework. Peter uses a database of previously answered questions, created by qualified teachers and artificial intelligence, to provide appropriate answers to questions asked by the students.

What is the benefit? If teaching is reduced to the ability to provide the student with answers that are found in a vast FAQ, the chatbot is without doubt an effective tutor! But what learning are we talking about? The aim here is not to replace teachers with robots, but rather to understand how they can work together by complementing each other. One part of the learning can be done online, remotely and on a personalized basis, while another part is done in the presence of a teacher, and other students, to benefit from interactivity, emulation, collective intelligence, or in other words, human energy.
Distance training can be taken further, with the learning of procedures and techniques from a flesh and bones expert or a robot.

**WBNS**

*When augmented reality gives you the skills of an expert*

What is it? Invented in 2012, the “Wearable Behaviour Navigation System” enables an expert to guide a non-expert in the execution of a wide range of tasks using augmented reality. Thanks to WBNS, someone in direct physical contact with an injured or sick person can follow the instructions and reproduce the movements in real time of a first aid expert, by “wearing their skin”.

What is the benefit? The system enables the accelerated learning by mimicry of complicated tasks or of work in a hostile environment, for example in difficult or dangerous conditions, such as in factories, on construction sites and in areas struck by natural disasters.

**GOOCUS**

*For a “social” consultation of Wikipedia content*

What is it? Launched in 2013, Goocus is an application available for iPhone and Android which enables users to consult Wikipedia content on a social basis. The app transforms the use of Wikipedia into a social, geolocated learning experience. Users can also leave notes or comments on the articles.

What is the benefit? The Goocus home page displays a timeline of recent searches made by subscribers, that you have chosen to “follow”, in the same way as Twitter. Goocus thus enables you to create a learning experience on Wikipedia, personalized through the selection of your favourite “teachers”.

**BEMYEYES**

*An app to provide help at a distance*

What is it? By Me Eyes is an iPhone application that connects blind and partially-sighted people with a community of sighted people. Both parties install the app and when a blind or partially sighted person needs help, they use the app to contact the network of volunteers. A live video of the visually impaired person’s environment is displayed on the sighted person’s smartphone which allows the two parties to solve practical problems in real time.

What is the benefit? This app intended for visually impaired people could also be useful for sighted people, such as business employees and ordinary citizens, requiring help or instruction in real time.
We can also use immersive technologies that completely remove temporal and spatial boundaries as in mixed reality and gaming.

**FUNDAMENTALVR**

*A “flight simulator” for surgeons*

What is it? FundamentalVR is a company that has developed a virtual reality environment that allows trainee surgeons to perform ultra-realistic operations. Using a haptic (touch) interface, the simulator enables surgeons to experience the sensations and sounds of a real operation. FundamentalVR collaborated with the Royal London Hospital to design an immersive experience based on an operation on a cerebral aneurysm, a very complicated procedure, with a view to then developing a virtual training tool.

What is the benefit? Virtual reality interfaces, especially when they are enhanced with haptic technology, present numerous commercial opportunities (notably for video games and marketing) but also enable promising training and research tools, that could be used in the workplace as well as at universities. In this example, virtual reality allows the costs of training surgeons to be reduced, giving them the possibility to train for as long as necessary, thereby improving their efficiency and the safety of operations.

**BRIDGE**

*A mixed reality headset that combines the real and the imaginary*

What is it? Bridge is a mixed reality headset that was created by the start-up Occipital. Using Bridge Engine software technology, Bridge allows you to move in a real environment and a virtual one simultaneously. For example, the headset can scan the room and display it on the screen, adding virtual elements with which the user can interact using a joystick similar to the Wiimote. Conversely, by going through a dimensional door opened by Bridge in their living room, the user can be projected into a virtual environment that they are then free to explore by moving around their living room.

What is the benefit? Bridge is an interface that creates, as its name indicates, bridges between the real world and virtual worlds and blurs the boundaries between the two. Mixed reality, at the crossroads between virtual reality and augmented reality, appears to offer innovative prospects beyond the world of entertainment. For the in-house training in a company for example, with a learning experience based on the simulation of real situations.

As we have seen, all these technologies can also be used to create a different type of learning experience with greater convenience. In the future, they will no doubt be able to educate more people in less time at a lower cost. This functional digitalization of teaching methods and places of learning is being driven by the general trend towards “zero interface” environments.
SOCIAL LEARNING

With digital tools, education and training have the power (and the duty?) to become a collective experience.

Even if “pupils”, large and small, are frequently gathered in the same classroom (or even an amphitheatre), at the same time (or over several days for a course), to all learn the same thing, we cannot really talk about a community which is interacting and “learning together”. In these cases, we are learning side by side. In fact, we are learning by ourselves, surrounded by other individuals. We learn for ourselves.

This approach does not exclude mutual assistance, but it does not encourage it either. Training is still too often a case of a monologue between someone who “knows” and a student, and of course it is the one “who knows” who speaks! With digital technology, we learn together. We learn from others, who in turn learn things from us.

A prime example: Kahoot!

Kahoot is a tool that allows you to create fun learning games and quizzes, that can be used by teachers as an assessment tool, and by students to help with revision. The interface has been designed for social learning, learners are grouped around a shared screen, such as an interactive whiteboard or a projector and can participate simultaneously via the dedicated app.

With digital tools, education and training become a genuine group experience

Peer to peer learning enables everyone to pass on their knowledge and to request help in return. On the web, in their community, someone that they know or don’t know, will answer them. You are simultaneously a student and an expert, and on this basis, you have the right to learn and to teach. To some extent this dilutes, and so undermines the power of the “knowing person” and the expert. There may also be problems with the quality of this sharing of knowledge and experience. The person advising you is not necessarily the expert they claim to be! A questioning of the quality of the teaching thus comes with P2P learning. Previously it was unthinkable to cast doubt on the words of one’s teacher, but now it is a planetary sport, even a duty.

A prime example: Goocus

Launched in 2013, Goocus is an app that enables users to consult Wikipedia content on a social basis, in a similar manner to Twitter. The app transforms the use of Wikipedia into a social learning experience, personalized through the selection of your favourite “teachers”.

A BRIEF REVIEW OF NEW WAYS OF LEARNING IN THE DIGITAL ERA
CUSTOMIZED LEARNING

With digital tools, education and training have the power (and the duty?) to be experienced on a customized basis.

The “one fits all” approach of education systems all over the world is being replaced by customized learning. Digital technologies enable profiling, and can enrich it with context, delivering content on a personalized, localized basis. You are no longer one student among others, receiving the same treatment as your classmates. You are “you” and your programme fits you like a glove.

The gains in efficiency seem immediate: no need to go over concepts that you have already mastered, and this saved time can then be used to work on areas where you still have weaknesses!

Education is thus focused on the individual. These services, like so many digital services, are designed for the individual user and cultivates their egocentrism by providing a customized solution. A programme that is used once, for a single student, in a particular situation. And the end result is that they are considered to have acquired the skill or knowledge.

Nevertheless, a question arises in this world of personalized training programmes. In addition to the fact that it cultivates self-absorption and self-indulgence (which we already seem to have quite enough of), it no longer creates any opportunities for collective learning, that help to convey the values and skills that have been learned, understood and shared by everyone. Do we not need a shared foundation of learning on which to build a group that can survive in the long-term, and is able in some matters to transcend our individual natures?

A prime example: Hackaball

A programmable toy in the form of ball that enables children to learn coding while being physically active. This connected ball is mobile and personalized for each user. It accompanies you everywhere, is intimately familiar with your profile and assesses your learning needs in real time.

BLENDED LEARNING

With digital tools, education and training have the power (and the duty?) to offer rich and varied content

Influenced by the personalization of training programs, education programmes vary their transmission models to offer a customized experience. And this experience, in our digital culture, is at the heart of users’ expectations. The presentation of content for training programmes is therefore essential. The concept of blended learning meets this requirement in terms of user experience.

Having become fickle, compulsive channel hoppers, learners tire quickly and expect a learning adventure that will capture their attention. Their training therefore needs to be varied, a mixture of online and offline, of ultra-personalized individual moments and group exercises, of concepts and experiments, of meetings with experts and peer-to-peer discussion. Beyond this benefit of providing a lively, varied learning programme, blended learning has the advantage of mobilizing different approaches and types of material and therefore offering multiple ways of understanding or absorbing skills and ideas.

In this way, MOOCs need to accompany the exponential number of videos that ultimately discourage the learner who is left in a totally passive role, with deep linking, quizzes, immersive exercises, contacts, without leaving the platform, or even the video.

A prime example: Speexx

Speexx is a multimodal language training solution for businesses. Through a single portal it offers online exercises, mobile and social learning, coaches present all over the world and customized learning activities all seamlessly blended together.
INTERACTIVE LEARNING

With digital tools, education and training have the power (and the duty?) to offer a more interactive experience.

Interaction is at the heart of a more engaging form of learning. This means dialogue with other humans or with machines, thanks to edtech that facilitates contact, and interactive use. The teacher, whether human or virtual, has the means to pass on their knowledge by personalizing their speech... During the training, constant adjustments are made for real-time personalization. For the teacher providing training, again in real time, they can adjust their programme, thanks to collective data (how the group or class reacts) and individual data (how a particular student reacts). This implies more flexibility and responsiveness, more adaptation to the real-time situation on the part of the teacher, the lesson may go more quickly or more slowly, take a detour, or do planned sections in a different order. In the digital age, the teacher and their digital aids are agile.

A prime example: ALFs
ALFs are augmented reality glasses that are connected to an app downloaded by the students. The students scan their faces so that they can be recognized by the Kinect camera when in class. Each student can then indicate to the teacher via symbols if they do not understand an explanation, ask them to go more slowly, or tell them if they know the answer to a question.

With digital tools, education and training can be more engaging

Influenced by the trend for personalization, training in the digital era aims to be less top-down and more interactive. The issue here is to engage learners as well as offering increased efficiency. Interactivity implies that the “conversation” between the expert and the learner or between the training material and the learner, takes place with more intensity. The expert must accept to be spoken to, and even challenged. As for the learner, they must be less passive and take an active role in their learning experience. The legacy of a digital culture that gives power to all (in particular, the power to obtain information and to express one’s opinions), training is taking the form of discussion between those who “know” and those who “learn”.

A prime example: VIPKid
VIPKid offers immersive learning experience in English for Chinese children aged 4 to 12 years-old. The courses are provided online by qualified teachers and based on a “flipped classroom” approach (the student studies their lesson at home and the teacher is there to guide them in the resolution of complex issues) with a view to encouraging creativity and developing critical judgement.
IMMERSIVE LEARNING

With digital tools, education and training have the power (and the duty?) to simulate real life situations

With digital innovations, training can mimic reality down to the minutest of details. The skill acquired in training eventually merges with the real-life skill, thereby enabling ever greater efficiency. But of course, there are no real risks involved, and no real failure. Mixed reality (augmented plus virtual reality) places the learner in a real-life situation (or almost real) and allows them to train in a particular skill or technique, and to be able to perform it in multiple environments, including stressful ones.

This immersion is naturally more engaging for the learner. It is not only a matter of understanding and retaining concepts, but also of applying what has been learned in scripted situations. It is also the mobilization of several types of learning: the mind, the senses, the body, the individual is fully engaged in multisensory experiences. “Understanding” accompanies “doing”, almost simultaneously. The essential thing here is the experience, a key word in the Internet age. The individual with their digital accomplices feels less of a spectator and more of player in their life, their choices, their movements (rightly or wrongly). The logical result of this feeling of empowerment is this appetite for learning through experience, especially if it is virtual (and therefore without any real fear).

This learning by “virtual experience” also enables training to be more widely available. Once again, wherever you are and whoever you are, you can transport yourself into a virtual environment and learn how to deal with a certain situation or challenge. It saves time and it is accessible to more people!

A prime example: FundamentalVR

FundamentalVR is a virtual reality environment that allows trainee surgeons to perform ultra-realistic operations. Using a haptic (touch) interface, the simulator enables surgeons to experience the sensations and sounds of a real operation.
ADAPTIVE LEARNING

Learning that is controlled and delivered by A.I.

This has already been mentioned with customized learning; adaptive learning, in its basic form, is learning that adapts to the learner. Controlled by A.I. and supplied with a rich variety of data, adaptive learning gives the digital ecosystem the task of creating training programmes and presenting them at the right time to the right person. It can be frighteningly effective. While adaptive learning enables customized lessons to be offered to each learner, it also places individuals under permanent surveillance and scrutinizes rational, simple, identifiable, codable skills. Are all human skills eligible?

How does the system actually operate? An intelligent algorithm establishes a predictive analysis of the learner’s behaviour and then adapts the modules proposed depending on their needs, their level and the rate at which they learn, essentially constructing private online courses. Adaptive learning is based on several principles: the collection of data in real time; the analysis of the learner’s behaviour in order to continuously adapt the content that is proposed; the analysis of results that enable the learner’s level to be established and the adjustment, if necessary, of the difficulty of their training sequences.

A prime example: Coursera Skills Benchmarking

Coursera, a MOOC platform, offers businesses an artificial intelligence-based tool to track and assess their employees’ digital skills compared to those of other companies. The objective is then to offer them a training programme tailored to their specific requirements.

Adaptive learning, evaluation, monitoring, surveillance?

If today adaptive learning uses data collected about the individual and their environment, then tomorrow our living and work spaces, public spaces, our objects, even our clothes and our bodies, will also be connected, providing information in real time to be fed into the ecosystem and used to create training services. To receive such services, we have to submit to observation: either through training, or through interaction with experts, or through connected skills. As long as the ecosystem is considered as a benevolent accomplice, its insistent gaze on our decisions and actions is acceptable, but when it becomes some kind of Big Brother operated by a third party, where will we be? Or will it be too late? Furthermore, will this innovative, high-tech training be available to everyone? To ensure that it operates on a truly customized basis, it will be necessary to live in connected environments and to be connected to the Cloud with a fast, high-quality service. This rather goes against the idea of a form of education and training that is universally available!

A prime example: Smart Eye

Facial recognition is used in a Chinese high school to check if pupils are following in class. Three cameras have been installed at the front of the class. The system is able to identify seven facial expressions (joy, sadness, disappointment, anger, etc.) to determine if the children are paying attention, and if not, to inform the teacher.
CONTINUOUS LEARNING

Learning to learn throughout one’s life: an obligation

Since digital technologies are capable of monitoring us so closely, they are constantly able to propose appropriate training and the acquisition of new skills. And we should surely always be ready to learn new things. This seems obvious and yet relatively few people aspire to continuing training throughout their lives. **We are educated and trained up to adulthood, and then we work (or not), and we occasionally receive on-the-job training (if we are lucky) throughout our professional and private lives.**

While training is sometimes offered by companies, it is ultimately up to the individual, and it is not always easy to keep motivating oneself. Not because we are lazy or stupid, but because we don’t always have enough time or the necessary freedom.

**Yet we are living longer, and will no doubt work for longer; we desire interesting, fulfilling jobs, which implies more mobility, more diversity, and more complex career paths.** We therefore need to train ourselves for these cycles in our professional and private lives that follow from one to another, or accumulate over the years. Digital technologies offer businesses a major advantage: increased efficiency. But if we think in more social and ethical terms, **these same edtech solutions should enable an alternative way of living and working, i.e. one that does not lock us into one job, or one task, or a particular set of skills. It is also an undeniable promise of freedom and mobility.** Some might find such change scary, while others see it as synonymous with a richer, more interesting life, offering more opportunities and not leaving us stuck in the same role for our entire careers!

**A prime example: FutureFit**

*Developed by TeacherVision, this platform of educational resources for FutureFit teachers is a training programme devised to equip students with a set of “future-proof” skills that will be useful throughout their lives, whatever careers they pursue. The programme is based on developing capacities such as creativity, problem-solving, collaboration, showing initiative, etc.*
CHAPTER 3

WILL WE STILL NEED TO LEARN?
WILL ZERO-INTERFACE TECHNOLOGIES ULTIMATELY LEAD TO ZERO CLASSES?

The zero-interface trend pushes the limits of technology, enabling ever more convenient forms of learning. “Zero Interface” consists of all the technologies that facilitate dialogue between humans and machines, and which make massive efforts for this dialogue to be as simple, natural, intuitive, and immediate as possible. Digital interfaces should not be foreign languages, they must be accessible to the young and old, geeks and non-geeks, educated and uneducated! Everyone should be able to benefit from digital services.

Interfaces are already becoming lighter and less visible This includes the interfaces that use mixed reality (augmented and virtual reality), robotics and holography.

Tomorrow, conversations between humans and machines will be increasingly immediate and personal.

Yesterday humans and machines communicated via keyboards and screens, and touch screens. Tomorrow humans and machines will communicate through biometric language, based on brain waves and emotional states. It will be enough to simply be, think or react for the machine to understand and respond!
REAL-TIME ROBOT MISTAKE

CORRECTION

*Correcting robots in real time by thought*

What is it? Researchers at the University of Boston and MIT developed a brain–computer interface that allows humans to correct robots in real time by brain waves. Using an EEG, the device follows the signals emitted by the brain of an individual when they look at a robot carrying out a task. When it detects a signal indicating that the individual thought there was an error, the system can change the robot’s actions in real time. When we are confronted with an error, we generate brain waves called “error-related potentials.” During a test with five volunteers, the system correctly detected these waves in 70% of cases.

What is the benefit? This system allows a human collaborator to interact with a robot and to teach it in a fast, natural manner. It could for example allow the passengers of self-driving cars to signal an anomaly that was not detected by the vehicle’s sensors. Communication by brain waves is intuitive and unconscious, and therefore precedes the conscious formulation of human intention. Humans could thus almost become passive intermediaries in the teaching of robots.

STENTRODE

*A stent to control an exoskeleton by thought*

What is it? Like a vascular stent, this device equipped with electrodes is placed in a blood vessel close to the cerebral cortex. It is then able to detect the electrical signals normally sent by the brain to initiate movements. These signals are relayed to a computer that can direct a robot. In this way, a paralysed person could control an exoskeleton (or simply a robotic limb) by thought. This is an example of a fluid, almost immediate collaboration between human intention and the actions of a digital machine.

What is the benefit? Imagine what becomes of the “ghost in the machine” with this type of intra-corporal technology. The human brain in cooperation with (or dependent on) an implanted artificial brain. A future means of guiding movement, accelerating decision-making, and muting emotions. What kind of cooperation do we want to create between humans and machines? The more we are augmented by digital skills, the more we will be controllable, or at least able to be influenced, and the more we risk appearing incompetent, dull and insipid if we present ourselves in our simpler biological forms!
Digital intelligence will be very close and personal, to the point that it will be able to witness our learning experiences and be a vector in these experiences. Connected objects, digital assistants, robots that help with daily life at home or at work will be able to diagnose our needs and provide “in situ” training. Training (and even education) entrusted to these digital auxiliaries will be carried out during the actions being taken, or during a situation being experienced. \textbf{Has education signed its own death warrant?}

Again, the change is fundamental, for two main reasons.

\textbf{On the one hand, learning time is reduced with the use of digital technology: we learn how to use something by using it.} Currently we are accustomed to training and learning for months or even years, will this become unnecessary in the future? We already evoked this transformation in the first part, in which digital technologies are so user-friendly that they enable us to learn just by using them. With zero interfaces, do we risk going even further and eliminating the need to learn?

For businesses it is a completely different conception of training, that once again makes convenience the priority. \textbf{There is no longer any need to take an employee away from their work station or to take time out to send them somewhere for training with a view to improving their performance}, decision-making skills or dexterity. Augmented by digital accomplices that diagnose requirements and simultaneously provide relevant training, the employee is instantly more efficient.

\textbf{On the other hand, our main teachers will be digital. The world of education is confronted with its obsolescence.} What if tomorrow robots, connected objects, and complex algorithms replace the teaching profession? After all, from a purely functional point of view, they will soon be able to assess needs, establish a personalized training program, and then follow and adapt it in real time based on “in situ” assessments that they will carry out. Apart from a few designers of these education programmes and the bodies that commission them, will we be trained by humans in the future?

Will a surgeon be trained by a robot colleague?

Will plumbers, electricians and engineers be trained by their peers or by machines?

What about traders, journalists and lawyers?

\textbf{All professions are faced with the same question. Will there still be any need to train to do a job? Or will we be able to do any job, provided we are equipped with the appropriate digital aids? ≈ Pero,\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈\textnormal{ }≈}\textnormal{\smaller{ Perhaps in the future we will list our digital equipment on our CVs. If I possess instantaneous translation earpieces, do I still need to specify which foreign languages I can speak (if I still speak them)?\textnormal{\smaller{}}}
**PROGLOVE**

**Connected tools that have become a natural accessory in the workplace**

What is it? ProGlove develops intelligent gloves to enable operators to work more safely, quickly and easily. Equipped with sensors, a monitor and a processor, they can sense, analyse, and scan the environment. The uses are numerous and scalable: picking, quality control, assembly, integrated documentation...

What is the benefit? Equipped with these intelligent gloves, professionals are better informed about their environment, and better protected against risks; these “wearable devices” provide useful digital tools that can be operated in an increasingly natural fashion (voice commands and movement). The worker, packer, or installer is more efficient, more comfortable and safer. They are also more closely monitored by this connected tool that is worn against the skin. We therefore need to discuss the objectives pursued with these digital services, and the collaboration model that we wish to see between humans and these digital assistants. What will be their place? On what basis will they cooperate with us?

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**THE PILOT**

**What if learning foreign languages was no longer useful?**

What is it? The Pilot is a simultaneous translation earpiece that can translate 5 languages. The earpiece records the speaker’s voice, filtering out ambient noise. The associated app on a smartphone translates in real time and sends the translation to the other earpiece using a synthetic voice.

What is the benefit? Digital culture is linked to the myth (or reality) of free Information for all (thanks to an Internet connection), without borders and ideally without linguistic constraints. Here a discreet connected object enables dialogue between two people who do not speak the same language: instant translation allows everyone to express themselves in their own language! This raises the issue of the learning of languages, but also resolves relational barriers as if by magic. We might imagine that the time saved by not having to learn foreign grammar and vocabulary could then be used to learn more about other cultures and customs. When carrying out a transaction with a Chinese person, could familiarity with social norms and accepted behaviour be just as important, if not more important, than vocabulary? The debate is open.

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**SMART NEEDLE**

**A connected needle to make neurosurgery safer**

What is it? The slightest error in any neurosurgery can have irreversible consequences: inadvertently damaging a blood vessel may cause a fatal haemorrhage. The University of Adelaide has developed a connected needle which guides surgeons and helps them to detect and avoid vulnerable blood vessels. A micro-camera is implanted in a biopsy needle which emits infrared light. It is connected to a computer capable of analysing the images and identifying blood vessels and tissues. After a pilot test with twelve volunteer patients, the intelligent needle is planned to undergo clinical trials in 2018.

What is the benefit? Neurosurgeons currently rely on scanner images carried out before the operation to identify and avoid all contact with blood vessels. The connected needle offers a more efficient alternative by enabling access to more precise information, updated in real time. Here the IoT makes surgery safer and opens the field for other new operating techniques, through close collaboration between neurosurgeons and digital intelligence.
SO, IN THE FUTURE, SHOULD WE OPT FOR TRAINING OR FOR “AUGMENTED HUMANS”?

These connected skills are efficient. They significantly increase productivity and the comfort of employees and students, who become “masters” if only momentarily. They flatter our egos and improve our comfort.

These connected skills are opportunistic and take a short-term view. They are an externalisation of skills that only have value during connection. They are ad hoc, ephemeral, mobilized when they are required. Through repeated use, these skills are internalized by their users, but this is not the same as the more complex process of learning. This is an immediate response to an unproductive discomfort.

ARE AUGMENTED HUMANS DIMINISHED IN THE LONG-TERM?

What we have here is a completely new conception of the cooperation between humans and machines. We refer to augmented humans rather than trained humans.

Thanks to connected objects and intelligent algorithms, we are able to accomplish certain tasks more quickly, and more efficiently. By being guided towards the right actions, we also comply more with what is expected of us, especially in the professional world. The goal of training here is to increase our immediate productivity, through the execution of tasks in accordance with a standard agreed in advance. The goal is not so much to equip us think better, decide, act and create new solutions. The goal is also not so much to develop individuality.

On the one hand, the augmented human is excused thankless, repetitive tasks and even forgets how they are carried out. On the other hand, “driving augmented by an onboard computer” is a way of standardizing individual behaviour for the collective good. The individual will make fewer mistakes, suffer less fatigue, less stress, there is less risky, marginal behaviour, fewer eccentric, incongruous, or unexpected decisions. Such convenience!
POP-UP SKILLS: TAKE YOUR PICK! BUT HOW MUCH DO THEY COST?

“Connected skills” are a convenience acquired at a price. Training at school or later in work life has a cost that is borne by families, or by the collective solidarity of a nation, or by a company. But apps, connected objects, or robots are more likely to be acquired on an individual basis. Connected skills may increase social inequalities. Whereas education is a social elevator, the augmentation of humans may prove to be an aggravating factor in social division.

In tomorrow’s world will some individuals be able to go “full tech” while others remain “naked”? Will some individuals only have version 1 while others have version 10?

An uncomfortable thought, especially at a time where we need to educate the whole planet, and all its students, wherever and whoever they are. And yet we would not want to completely ditch connected skills either!

Beyond the issue of a socio-economic divide due to disparities in resources, another question arises. What will Emma, who no longer needs to learn foreign languages thanks to her connected earpieces, do with all her spare learning time? Can she just shrug, say “who needs training?” and get on with her life? Or will she, for example, rather than conjugating Japanese verbs, study Japanese culture and learn about the customs that are so important in human relations?

The time gained thanks to digital technology enabling us to learn faster, or not to have to learn some things, should be used to learn other things. In our conception of the pragmatic skills that we now need to acquire, this issue is ignored, and risks impoverishing us.

Less trained, more assisted by digital tools, we lose independence and may gradually lose the ability to question, create, and innovate. For someone born and raised in Europe who then goes to Japan to manage a team, it is just as important to understand the language as to understand the customs which are related to general culture, history, and psychology. The same applies to a lawyer, a caregiver, an educator, a journalist, or people working in marketing and public relations.

Once again, the question we must collectively ask ourselves is: how should we use these digital skills? What ultimate purpose should they serve? And how far should we go in using them? Can we do without them? Or will/has this digital ecosystem become essential?
CHAPTER 4

ZERO KNOWLEDGE = ZERO DECISION
TRAINING OR AUGMENTED HUMANS WITH POP-UP SKILLS? THE REAL QUESTION IS WHAT STATUS AND PLACE HUMANS WILL HAVE IN TOMORROW’S SOCIETY.

Emerging digital technology opens the door to a second trend, one with zero decisions. **AI devices are appearing that are more predictive, more capable of decisions, more autonomous, and more able to fulfil numerous roles.** The question is: will they fill these roles in our place? Today, we should ask: what have we already entrusted (given up) to the machines in our daily lives, no doubt for good reasons, without considering some of the long-term consequences?

With the trend for self-driving cars, it seems unlikely that we will need to take driving tests in the future. Just as some people today are no longer able to read a map, having become used to delegating the task to Waze or Citymapper on a daily basis. Writing messages on Facebook Messenger, our spelling is automatically corrected, and once the software “knows us” it will suggest words or even whole sentences for us to text. In the future, will we even need to learn to write if we can send texts just by thinking? Will we still need to train journalists, lawyers, accountants, radiologists, and musicians, if an algorithm is able to do all the associated tasks more quickly and at lower cost?

Factories have increased productivity with the use of augmented employees, operators can work with more mobility in a greater variety of roles. However, **are they really trained in all these different roles or professions, for which they seem to be taking responsibility?** Or are they puppets, obediently following virtual instructions, for ever greater comfort, safety and productivity? And tomorrow, as their actions become increasingly assisted, guided by machines and software, will they even be present?

Currently, the use of connected skills is controlled, so that individuals continue to make progress as they train, and also so that we do not become vulnerable in the event of disconnection. **If tomorrow all our skills reside in the Cloud, companies will be dependent on having a connection and the right to access the Cloud, which they consider to be a considerably greater risk than having employees whose skills are occasionally compromised.**

**IMMEDIATELY OPERATIONAL CONNECTED SKILLS COME WITH THE REQUIREMENT OF A CONNECTION!**

An intelligent ecosystem that can diagnose skill requirements and provide appropriate responses represents incredible potential. Those who control such systems will have immense power. Today AI and the infrastructures that support it are in the hands of the web giants, who largely control the networks and the Cloud. Which amounts to saying that they have a significant presence in the connected knowledge stakes.

**So, to whom should we go to obtain a skill?** Will individuals and companies still be free to access this externalized knowledge? Again, the question of a socio-economic divide arises. As well as the issue of power and influence being held by a few.

**CONNECTED SKILLS WILL BE NECESSARY IF HUMANS HAVE NOT BEEN COMPLETELY REPLACED BY MACHINES!**

The Zero Decision trend raises the spectre of a world in which humans no longer have a long-term productive role. And in the short term, no longer make decisions. So, what then will our role be? To what are we going to dedicate our remaining time? **Of course, we have not yet been relegated to the status of being useless and the Zero Decision trend which suggests the dawn of a Zero Human world is essentially a pretext for ques-
tioning once again the status, role and usefulness of humans in society and the economy (and the production systems that go with it).

It seems likely that digital innovation, like all the technological revolutions that have preceded it, requires us to think carefully about our vision of the future.

In any case, in the 21st century, having experienced several technological revolutions, we can no longer ignore it. There can be no doubt that we did not sufficiently analyse the question of what we wanted to do with electricity, steam, or penicillin. We did not question cars when they first appeared, and yet they have impacted our way of life, our behaviour as consumers, our modes of production, the geopolitical balance of power, and today are presented as a major threat to the environment (among other threats: cars cannot be blamed for everything!). So, we must ask ourselves, what we want to do with digital technology? What ultimate purpose should it serve?

This is an urgent question because digital technology is moving very fast and concerns the entire planet. And surely it is all the more urgent if we are considering the training and education of our children? Let us remember that until now, training and education programmes in the wider sense were planned over the long term. School and university together can take twenty years, graduate studies can continue for five or even ten years. And with the current trend for ever longer, more advanced diplomas we are constructing programmes that are likely to be partially obsolete by the time the student has graduated. Who can say today what skills we will need in ten or twenty years? Possibly those associated with highly technical fields in computing? Does this mean that everyone should focus on computer-related skills (code, AI, robotics, etc.)?

How should we educate children when we must prepare for unprecedented change and an uncertain future? This is one of the questions raised by Yuval Harari, professor at the Hebrew University of Jerusalem.

For him, we live in a period of extreme uncertainty and have no idea what our future will be: it is impossible for us to imagine how we will be. How then should we approach education? Harari proposes abandoning our obsession with technical skills that become obsolete within a few years, and instead focus on:

- knowing how to process information, even as, or particularly as, data is accumulating at exponential rates.
- “Learning how to make sense of information and to build a picture of the world from it” should be one of the first things we teach children. Rather than giving children more and more information we must teach them how to assimilate it and so achieve a “comprehensive view of the Cosmos”, if the future is not to be created by machines, or left purely to chance.
- “In order to keep up in a world in which we cannot predict anything we must learn to constantly reinvent ourselves”. Our technical skills, like our processes, will be of little use when it comes to inventing what being human will mean in the future. Probably augmented by various intra-corporal devices, it seems likely that this will be significantly different from what it means today. If digital implants can change my sex, my age, my skills, then my private and professional life will surely be less linear and predestined.
- “Cultivate one’s capacity to change, at 50 years-old being ready to embrace change and deal with completely new ideas”. And to achieve this, “we do not need technological solutions, but rather an understanding of what we are and of the world that surrounds us”.
- “Learn to know oneself, better than we know the digital machines and ecosystems that accompany us”. For Yuval Harari, knowing “one’s own operating system” is the only way not to be manipulated by machines.
CONCLUSION

Before even thinking about code and the data, we have to think about the aim pursued by this intelligent, independent, decision-making digital ecosystem intelligent of tomorrow. How far are we going to go? And where are we going? In the longer term, one of the challenges of education will without doubt be training ourselves to imagine the future and the relationship that we want to have with the digital ecosystem.

If we are not careful, we will live in a world where work no longer offers any employment, according to a piece written by Ariel Kyrou for the Diderot Institute in March 2017. In imagining the education and training of tomorrow, and therefore imagining the society and work place of the future, we attempt to project ourselves into the future, and this is often a dystopic, stressful exercise. Some cry science-fiction, and yet we are already on this path. If we are not careful, if humanity does not reflect and possibly put safeguards in place, then we are rapidly heading, on the back of digital innovation, towards a future in which everything will be operated by machines whose intelligence is omniscient and omnipresent. In such an environment, what utility, status or skills will we have? Will we still work? On what tasks?

"2180. We are in New York, in the underground structure where the Earth’s largest “homeostatic daily newspaper”, the New York Times, used to be printed without the need for any biologically human journalists. Until the nuclear disaster which devastated the world, this totally automated newspaper was operated by its “cephalon”, or in other words, its electronic brain, and its sensors and other terminals scattered all over the planet. Ten years after the cataclysm, Earthlings and officials from the Centaurus Urban Renewal Bureau, arrive from Proxima Centauri, and resuscitate the machine with disconcerting ease. Once again, this robotic version of the New York Times, from a distant future prints its “thousands of different editions every day”, accessible via a myriad of automatic distributors all over what remains of the United States.”

Philip K. Dick, “If there were no Benny Cemoli”, 1963.
In memory of Dr Indrajit Banerjee
Former Director of the Knowledge Societies Division,
Communication and Information Sector
HUMAN LEARNING IN THE DIGITAL ERA

Netexplo is an independent Observatory that studies the impact of digital tech on society and businesses.

Since 2010, Netexplo and UNESCO have built an informal partnership based on knowledge sharing, particularly through the organisation of an annual event, the Netexplo Forum.

In 2013, Netexplo and UNESCO also created the UNESCO/Netexplo Advisory Board (UNAB), a network of lecturers in digital and business fields from the world’s leading universities, with the aim of spotting and analysing significant innovations worldwide.

Netexplo’s goal is to foster a fairer, more open world that creates more value and wellbeing for women and men. This goal is fully in line with UNESCO’s mission to promote and support international cooperation in education, science, culture and communication and information.