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Education in the Era of IR 4.0

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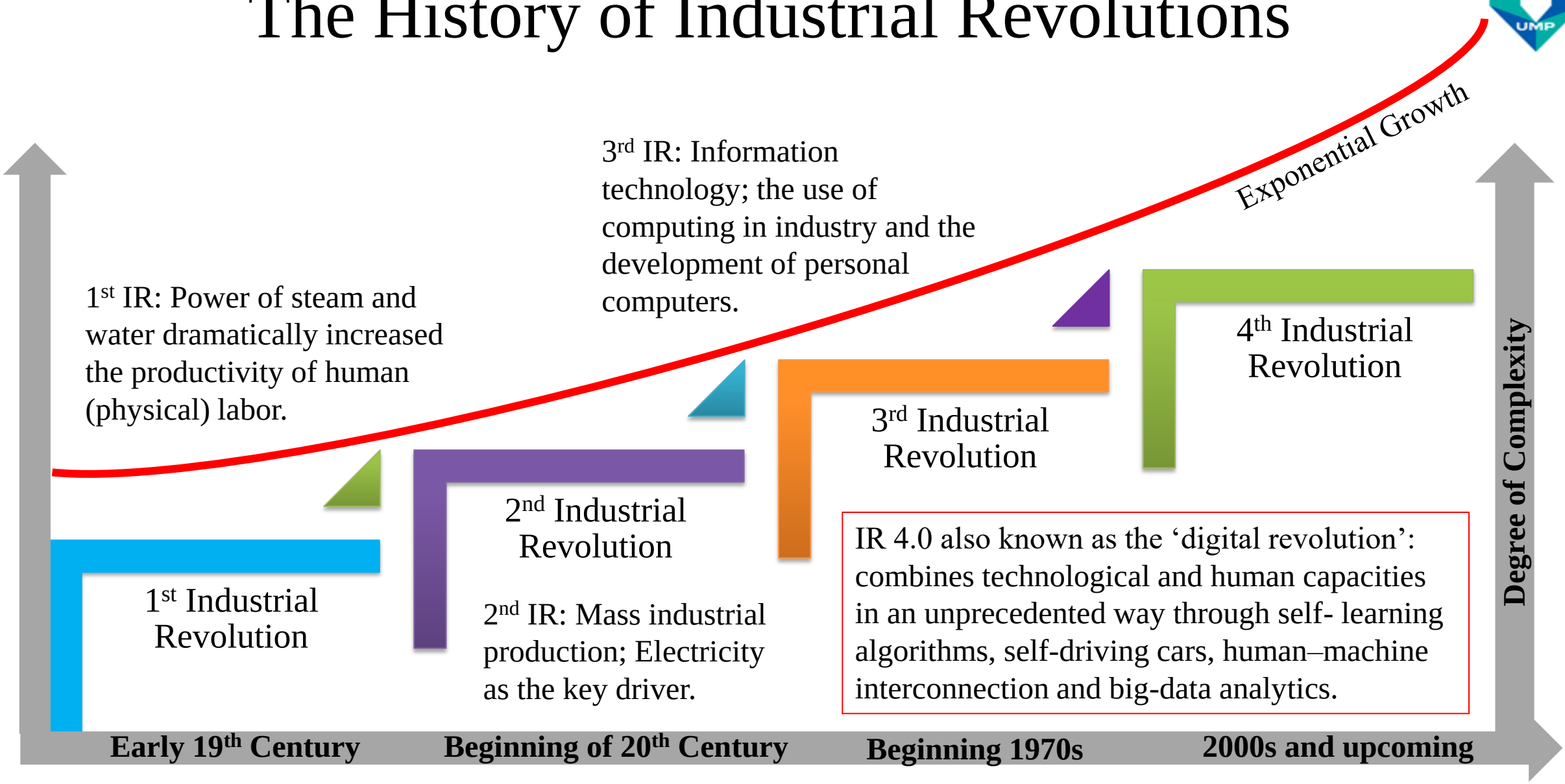
The History of Industrial Revolutions



Industrial Revolution 4.0

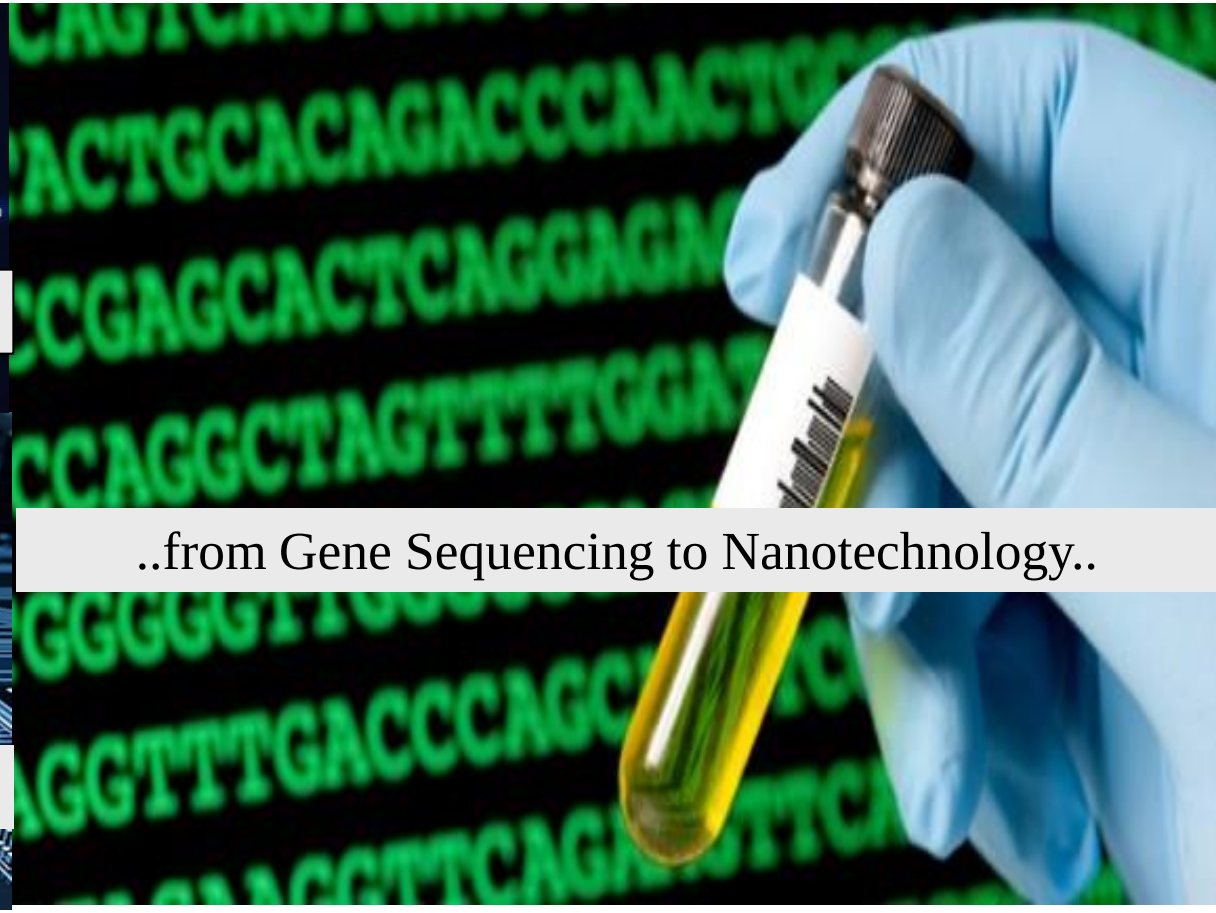
- Represents the movement towards smart industry and manufacturing goals.
- ASEAN countries are experiencing industrial transformation on an unprecedented scale with 9 interrelated pillars of IR4.0: automation, data exchanges, cloud computing, cyber-physical systems, robots, Big Data, Artificial Intelligence (AI), Internet of Things (IoT) and semi-autonomous industrial techniques.
- And, the breadth and depth of these changes herald the **transformation of entire systems** of production, management and human resources.

Mustafa (2018)

Industrial Revolution 4.0

..from Traditional Supply Chain to Digital Supply Chain..

..from Conventional Computing to Quantum Computing..



..from Gene Sequencing to Nanotechnology..

Fusion of these technologies and interaction across the physical, digital and biological domains make IR 4.0 is fundamentally different from previous revolutions (SMECorp Malaysia, 2017)

Words Associated with IR 4.0

Six Building Blocks of IR4.0

- Industry 4.0 can be summarized by six building blocks
- Addressing each in appropriate complexity at progressive levels of education becomes integral to producing a career-ready individual who possesses the right combination of skills and abilities needed by today's advanced manufacturing companies.

(Kirchner, 2017)

(1)Industrial Success Skills	(2)Industrial Equipment and Technology	(3)Smart Sensors and Smart Devices	(4)Control Systems	(5)Connectivity and Networking	(6)Inform Actionable Data
• Workplace safety and safe work practices • Soft industrial skills- problem solving, discipline, time management • Familiarisation with industrial standardised quality system	• Industrial Robotics, Robotic Welding	• Monitor and control processes • Smart sensors act on data pertaining to conditions such as temparature, level of smoke and gas	• Oversee the processes • Motor and Motion Control	• Understanding of computer networks that carry the data produced by smart devices and control systems	• Skills and Knowledge necessary to analyse data and prescribe corresponding action

Definition: Industry 4.0 is the automated collection, and programmed analysis of digitised industrial data and the automated resulting action. (Kirchner, 2017)

Waves of Innovation

- The **digital consumer**, who enjoys more interactive and personalized experiences thanks to SMAC (social, mobile, analytics and cloud) technologies;
- The **digital enterprise**, which leverages SMAC technologies to optimize the cost of corporate functions and to transform enterprise collaboration for greater productivity;
- The emerging **digital operations wave** – the companies are revolutionizing their business with the use of artificial intelligence, robotics, cognitive computing and the Industrial Internet of Things (IIoT)

(Selamat, Alias, Hikmi, Puteh, & Tapsir, 2017)

Digital Disruptions

"The change that occurs when new digital technologies and business models affect the value proposition of existing goods and services"

"A transformation that is caused by emerging digital technologies and business models"

- Which can impact the value of existing products and services offered in the industry,
- And disrupts the current market and causes the need for re-evaluation.

(Selamat et al., 2017)

Example of Digital Disruptions

World's largest taxi company, Owns **NO** taxis.

World's largest accommodation provider, Owns **NO** real estate.

World's fastest growing bank, Owns **NO** actual money.

World's largest movie house, Owns **NO** cinemas.

World's valuable retailer, Owns **NO** inventory.

World's largest phone companies, Owns **NO** telco infrastructure.

Most popular media owner, Owns **NO** content.

World's largest software vendors, Owns **NO** apps.

Most of these companies DID NOT EXIST twenty years ago..!

(Selamat et al., 2017)

Challenging a Status Quo

Alvin Toffler in his book Future Shock (1970) posited that:

"The illiterate of the 21st century will not be those who cannot read and write, but those who **cannot learn, unlearn, and relearn**".

Vingthep Arthakaivalvatee, Asean Socio-Cultural Community Deputy Secretary-General in the Going Global 2018 conference: Redesigning Higher Education for 4.0 Industrial Revolution - the Asean Experience said that:

"The evident problem in the near future could not be the lack of employment, but **the shortage of skills** that new jobs will demand".

TOP 10 SKILLS in 2015 vs. 2020

2015

- 1. Complex Problem Solving
- 2. Coordinating with Others
- 3. People Management
- 4. Critical Thinking
- 5. Negotiation
- 6. Quality Control
- 7. Service Orientation
- 8. Judgment and Decision-Making
- 9. Active Listening
- 10. Creativity

2020

- 1. Complex Problem Solving
- 2. Critical Thinking
- 3. Creativity
- 4. People Management
- 5. Coordinating with Others
- 6. Emotional Intelligence
- 7. Judgement and Decision-Making
- 8. Service Orientation
- 9. Negotiation
- 10. Cognitive Flexibility

Source: Future of Jobs Reports, World Economic Forum (2016)

What will be the future ahead?

"65% of children entering primary school today will ultimately end up working in completely new job types that don't yet exist.." (World Economic Forum, 2016)

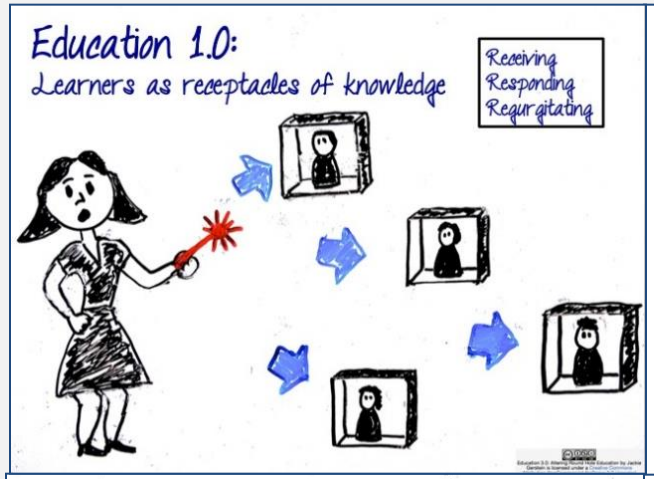
"A key step towards preparing individuals for the economy of the future is **providing quality education** opportunities for all.." (U.S. Government, 2017)

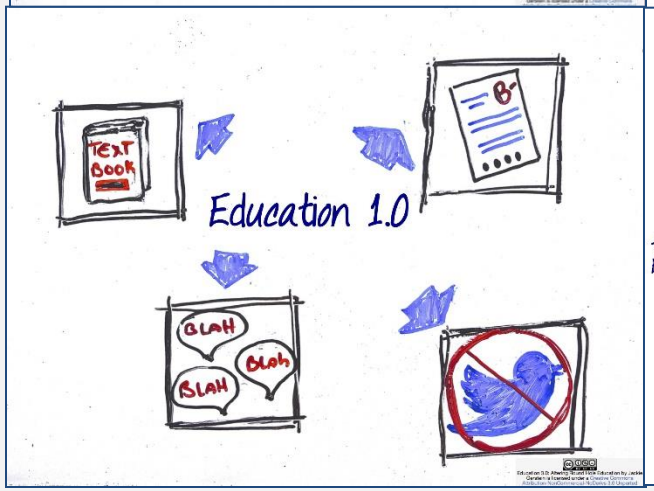
Revolutions in Education

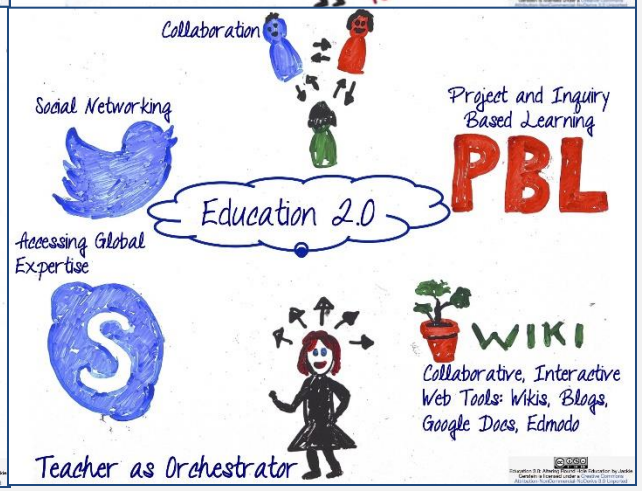
IR 1.0:
Receiving, Responding, Regurgitating (Teacher as Orchestrator)

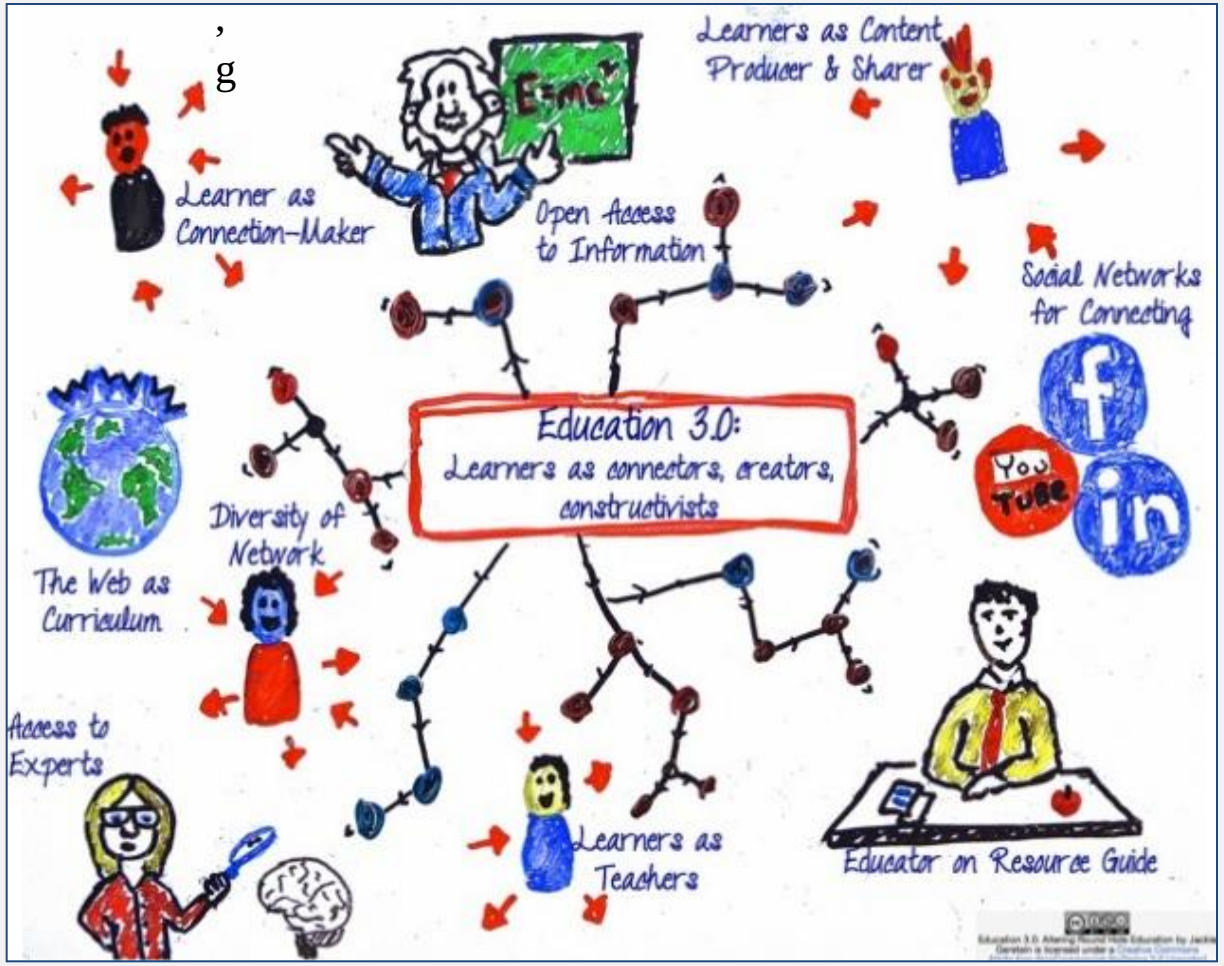
IR 2.0:
Communicating, Connecting, Collaborating (Teacher as Orchestrator)

IR 3.0:
Connectors, Creators, Constructivists (learners create their own learning journey, lecturers as facilitators- fb, tweeter, instagram)









Student should be CENTRAL to education- not the content, not the standards, not the tests, not what we think student should know and do

(Gerstein, 2014)

Teachers need to change

Challenges to change:

- Not enough time to cover the syllabus
- Must teach them as much as I can so that they pass the test
- I might lose control
- I am comfortable teaching this way
- I need to refer to the textbook as much as I can
- I need more training
- Not familiar with IT

(Gerstein, 2014)

Education Near Future

- Traditional education has contributed greatly to the current levels of industrial evolution and technological advancement.
- Role of university: shaping future technology by being the test-beds for innovation and educating future generations.
- As of now, education is being connected to mobile devices through applications in the cloud and is no longer limited to knowledge but extended to skills acquisition.
- With the expansion in networking services nationally and globally, **physical boundaries are no longer barriers to education**.

(AbuMezied, 2016)

The Challenge

- Everybody has **too many sources of distractions**.
- **New generation of students**, constantly changing.
- Indeed, **our brains are constantly being rewired**; as a result of reduced attention spans.
- What will **we learn during our education won't last** for our entire career (since progress is accelerating).
- **Schools are often not very helpful** in choosing a career path.

(Selamat, Alias, Hikmi, Puteh, & Tapsir, 2017)

What Needs to Change in Education?

1) Connecting Education and Employment

Employers need to collaborate with schools and universities on the development of curricula and a shared practical knowledge of the market. The education system also needs to change to allow a focus on lifelong learning.

2) Improving Forecasts

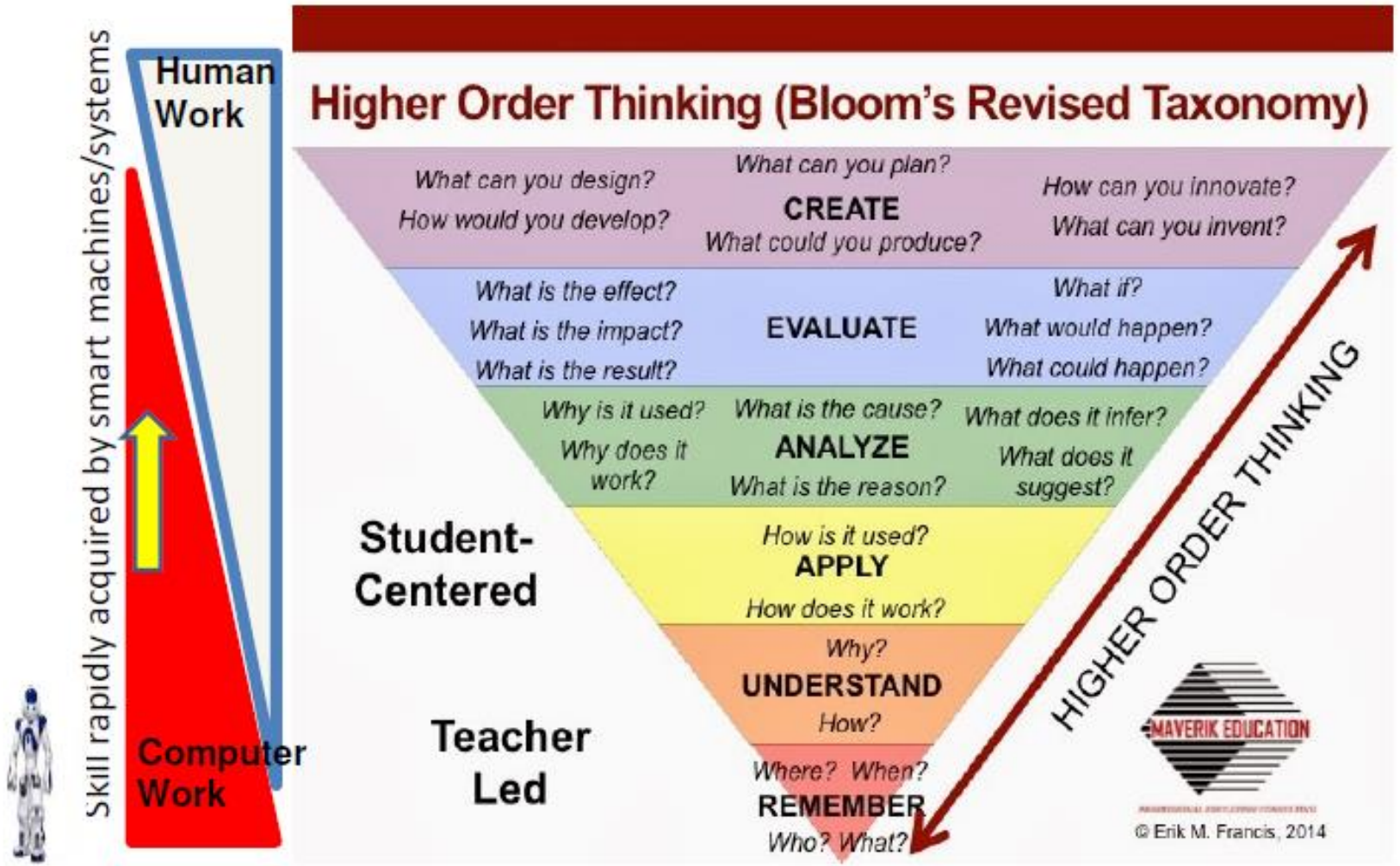
Better forecasting of industry and labour-market trends is vital to allow governments, businesses and individuals to react quickly to change. Big data is likely to prove pivotal in developing more accurate predictions of where the jobs market is moving and where the skills shortages are expected to lay.

3) Disrupting Education and Labour Policy

While there has been impressive progress in improving access to education, the quality and relevance of learning has rarely been improved on any scale. Government's policy has lagged behind when it comes to skilling the national workforce. Education and labour policy need to be re-examined to make them more proactive and relevant to the ever-changing market realities.

(Lodder, 2016)

Higher Order Thinking

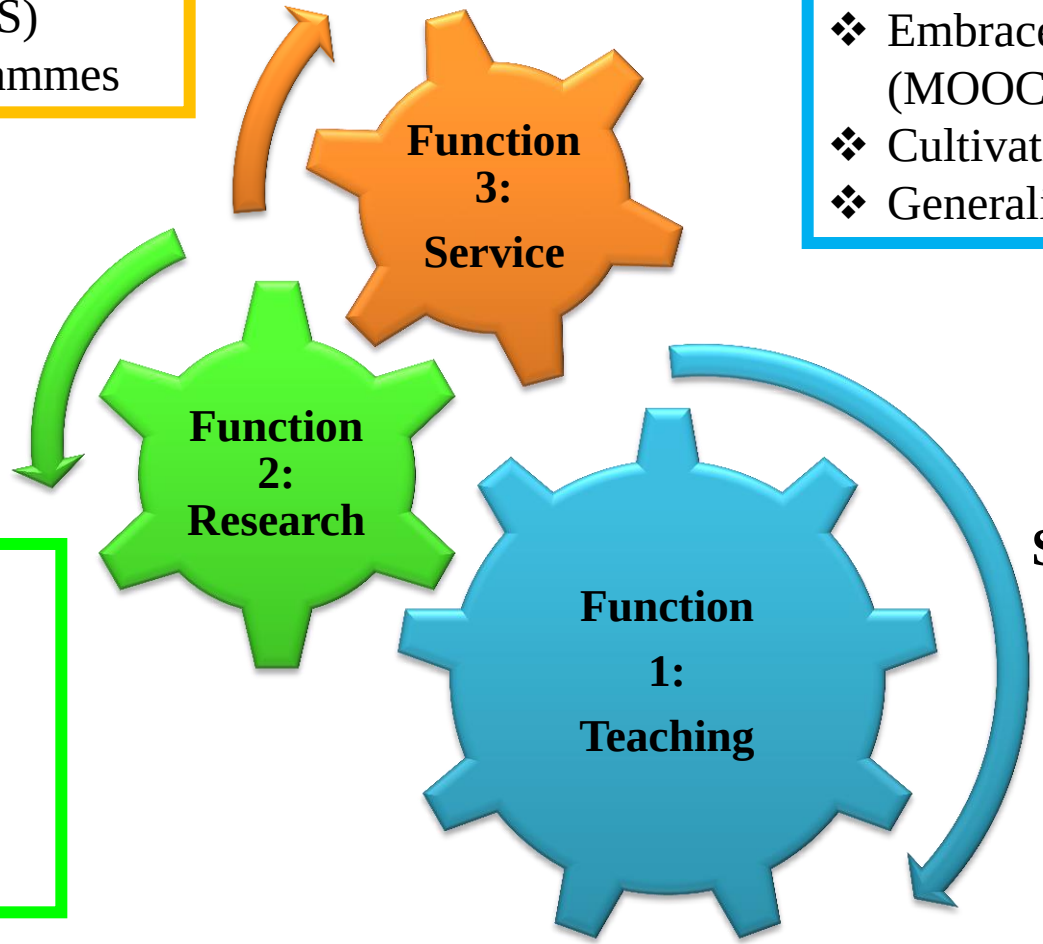


(Tapsir, 2017)

Teaching in the IR4.0

- University-as-a-Platform (UaaP)
- Education-as-a-Service (EaaS)
- Internationally-linked Programmes

- Wearables Assisted Teaching, Learning, and Training
- Embrace massive open online courses (MOOCs)
- Cultivating Innovative Talent
- Generalize Blended Learning



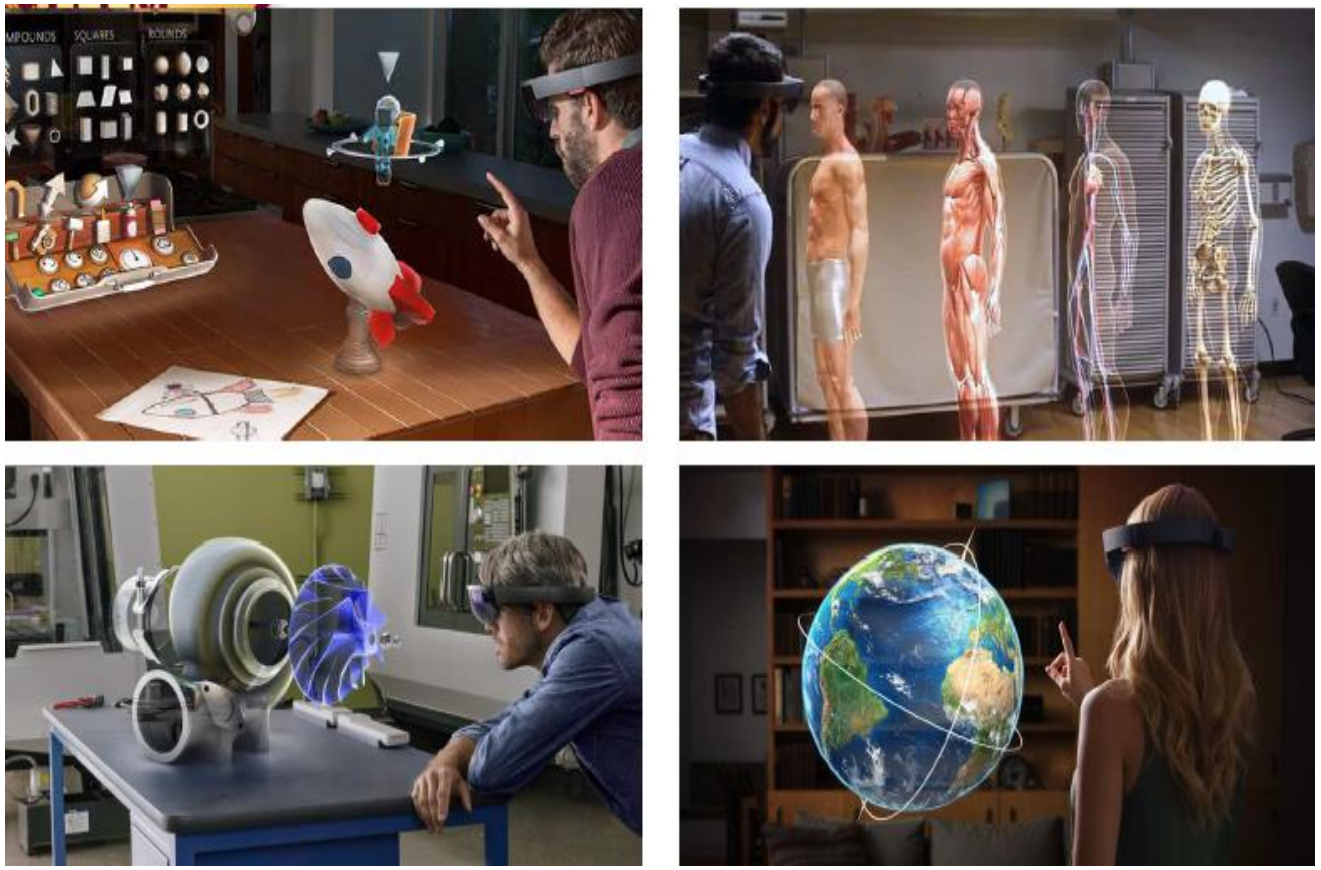
- Open Innovation
- Evolutionary & Revolutionary Innovations
- New Technological Advancement Driven Research and Development
- Shorten Innovation Cycles

Fundamental Functions of a Higher Education Institution versus the Solutions of Teaching in the Industrial Revolution 4.0

(Xing & Marwala, 2017)

❖ Wearables Assisted Teaching, Learning, & Training

- With the advancement of some wearable technologies, say **augmented reality** (AR), a user's sense and interaction with the physical world can be enhanced thereby creating a **virtual laboratory**.
- AR can supplement reality via superimposing computer-generated information over the physical context in real time which can facilitate results exploration and interpretation.



(Xing & Marwala, 2017)

❖ Massive Open Online Courses (MOOCs)

- In 2015, the number of MOOCs participants has doubled in from 16-18 million students to 35 million students across all MOOC providers; even universities are digitizing some of their courses.
- The number is increasing exponentially across the globe, making **learning more accessible to people**.
- Combining the strength of the traditional higher education with the increasing trend of MOOCs represents necessary steps to scale quality education.

(AbuMezied, 2016)

Example: UMP MOOCS https://www.openlearning.com/UMPMOOC

❖ Cultivating Innovative Talent

- Most developing or under-developed countries lack innovative talent, especially at the high end.
- To fully grasp the opportunity of another wave of industrialization, a country's higher education system **should not only focus on training knowledge-based skilled person**, but have a good look at cultivating innovative talent, especially high-level scientists and technologists.
- These scientists must be trained in an **interdisciplinary environment** where technologists should understand humanities and social science and vice versa.

(Xing & Marwala, 2017)

❖ Education for You

- An alternative to the standardization of teaching is the "**customization**" of educational practices, which **focuses on the specific needs, talents and interests of each student** (Groupe Media TFO, 2017).
- Embracing **data mining** in order to gain better understanding of student performance and deliver "Education for you" that is tailored to meet the demand of the job markets while considering the students' needs.
- Data regarding student performance, behavior, development, and interaction inside classrooms and on the online platforms of MOOCs as well as data from smart campus would create diverse and fast-changing data.
- The ability of Higher Education institutions to integrate this information into **smart data** would result in intelligent decisions in regards to the delivery of customized education and personalized learning experience for students. (AbuMezied, 2016)

❖ Generalize Blended Learning

- Generalized blended learning is a mixed of e-learning and face-to-face learning methodology.
- Virtual environments offer great educational value in the process of information transmission and interactive participation, either in real time (e.g., video conferences), or non-simultaneous participants involvement (e.g., forums and chats).
- Rather than fighting against these new technologies and the associated novel teaching patterns, higher education systems need to look at how they can accept them and transform the teaching and learning environment to the benefit of both students and academics.

(Xing & Marwala, 2017)

University-as-a-Platform (UaaP)

- Higher education institutions need to reconceive their business ecosystems, re-identify their competitive edges, reshuffle their customer pools, reshape themselves as orchestrators, and rebuild service architecture.
- University-as-a-Platform gives the current higher education system an opportunity to steer their bread-and-butter businesses towards platform businesses for a better service performance.
- **Key drivers for a successful UaaP** include:
  - a) deliver inter-, multi-, and across- disciplinary degrees;
  - b) an appropriate blend of service models (e.g., blended learning, MOOCs, etc.);
  - c) the emergence of Internet of everything;
  - d) the integration of routine education activities into software across a plethora of institution system;
  - e) up-to-date digital infrastructure; and
  - f) enhanced connectivity among all parties residing in higher education value chain.

(Xing & Marwala, 2017)

Education-as-a-Service (EaaS)

- The massive proliferation of affordable mobile devices, Internet broadband connectivity and rich education content start a trend of transforming how education is delivered.
- **Cloud computing**, amongst other techniques, creates a new way of educating people that might eventually disrupts the existing higher education systems.
- With the support of education cloud, government decision makers and business practitioners can answer some key strategic questions comprehensively: deliver education in the quickest, most efficient and best affordability form; develop 21st century students' skills and prepare students for the new job market in the most appropriate way; encourage native innovation with the strongest incentives; and share resources across institutions, districts, regions, or the entire country in the smoothest fashion.
- Higher education institutions are **accountable to a host of stakeholders** such as governments, accrediting agencies, the public and private funding sources, academics, management, support staff, and students.

(Xing & Marwala, 2017)

Internationally-linked Programmes

- Forging various kinds of institutional linkages, both domestically and internationally, to offer more versatile degree programmes and professional qualifications becomes a must.
- First, **twinning programmes** where a local education provider collaborates with a foreign education provider to develop a connected system allowing course credits to be taken in different locations. On completion of the twining programme, foreign education provider awards a qualification.
- Second, **franchise programmes** is a scenario where foreign education provider authorizes a local education provider to deliver their courses / programmes, and the qualification is awarded by the foreign education provider.
- Third, **double or joint degree** is an arrangement where local and foreign education providers cooperate to offer a programme for a qualification that is awarded jointly or from each of them.
- Fourth, **blended learning** where local and foreign education providers deliver programmes to enrol students in various mixed forms, e.g., e-learning, online learning or on-site learning.

(Xing & Marwala, 2017)

Worldwide Responses to Education 4.0

- **United States** has been at the forefront of foundational research in artificial intelligent (AI), primarily supported for most of the field's history by Federal research funding and work at government laboratories.
- The Federal Government's support for unclassified AI R&D is managed through the Networking and Information Technology Research and Development (NITRD) program, and supported primarily by the Defense Advanced Research Projects Agency (DARPA), the National Science Foundation (NSF), the National Institutes of Health (NIH), the Office of Naval Research (ONR), and the Intelligence Advanced Research Projects Activity (IARPA).
- Major national research efforts such as the National Strategic Computing Initiative, the Big Data Initiative, and the Brain Research through Advancing Innovative Neurotechnologies (BRAIN) Initiative also contribute indirectly to the progress of AI research.
- The current and projected benefits of AI technology are large, adding to the Nation's economic vitality and to the productivity and well-being of its people. A companion document lays out a strategic plan for Federally-funded research and development in AI.

(U.S. Government, 2017)

Worldwide Responses to Education 4.0

- Canada as a global education superpower. They spends more per tertiary student than almost all of the OECD countries.
- The Conference Board of Canada in its report, Learning in the Digital Age , also noted that as evolved from a specialized niche to a mass-produced service, the standard model has come under strain as **post-secondary education** (PSE). It suggested that digital learning may, in fact, be more engaging, less passive, and more customized to different learning styles than traditional lecture-based learning (transmission).
- **Canada's Centre for Digital and Media Literacy**, digital literacy is that next step which gives students the adaptive abilities they need to participate fully in the global digital society. It guarantees they will benefit from the digital economy and derive new opportunities for employment, innovation, creative expression, and social inclusion.
- A report published by the **Canadian Teachers' Federation** in 2013 highlighted 3 key challenges for the government in regard to education; early childhood, new technologies, and research support.

(Brown-Martin, 2017)

Worldwide Responses to Education 4.0

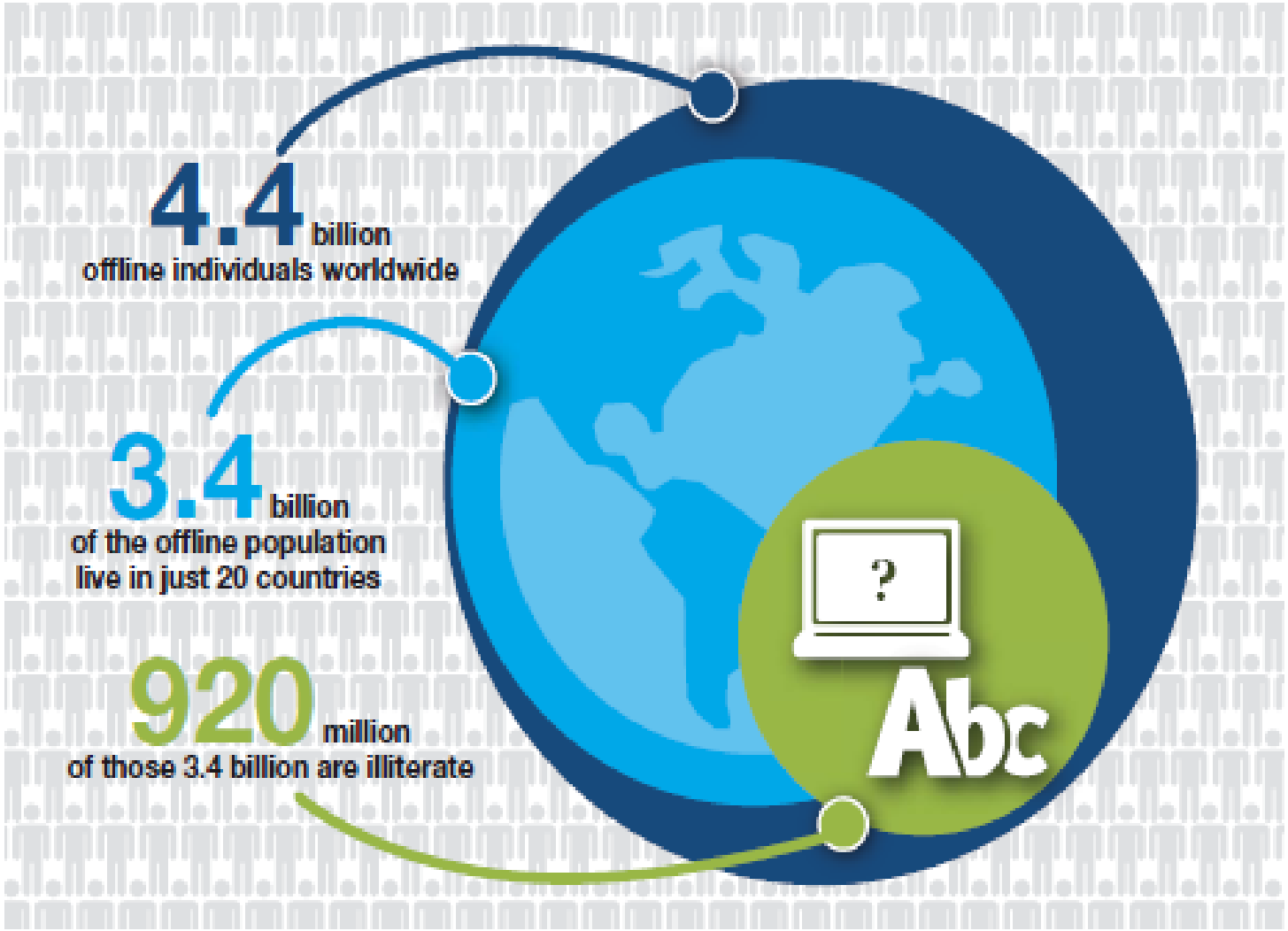
- **Asean Work Plan on Education 2016-2020** included relevant priorities, such as strengthening the use of ICT through the expansion of Asean Cyber University (ACU). Among them are advancing Asean Studies Programme and courses at the higher education level through online and cross-border mobility, as well as preparing ICT-ready teachers through the enhancement of teachers' competency to address specific needs of vulnerable groups (Mustafa, 2018).
- **Singapore**, the current highest achiever in the Programme for International Student Assessment (PISA: a worldwide study by the OECD in member and non-member nations of 15-year-old school pupils' scholastic performance for maths, science and reading) has been seen as a **model of systematic progress**, with each part of the education system integrated into an overarching national strategy (Brown-Martin, 2017).
- **Myanmar** Education Ministry's Basic and Alternative Education director-general Dr Khine Mye said four phases — foundation building, interdisciplinary institutions, mainstreaming 21st century skills and interdisciplinary collaborations — have been undertaken by the country to redesign higher education for IR 4.0 (Mustafa, 2018).

Worldwide Responses to Education 4.0

- In **Thailand**, Education Minister Dr Teerakiat Jareonsettasin said the ministry had to abandon central planning for a redesign of its higher education for IR 4.0 in Thailand. The ministry has offered funding to any universities that want to re-design their curriculum. 20 universities took the offer and the government has approved the budget to redesign the curriculum.
- In Malaysia, **Higher Education Framework 4.0 (MyHE 4.0)** was established to address the issues and challenges of IR 4.0. Under the framework, universities have to change their curriculum and delivery to ensure that their graduates have jobs. One of the measures being taken is to produce holistic, balanced and entrepreneurial graduates who can adapt and fill in jobs that are yet to exist.

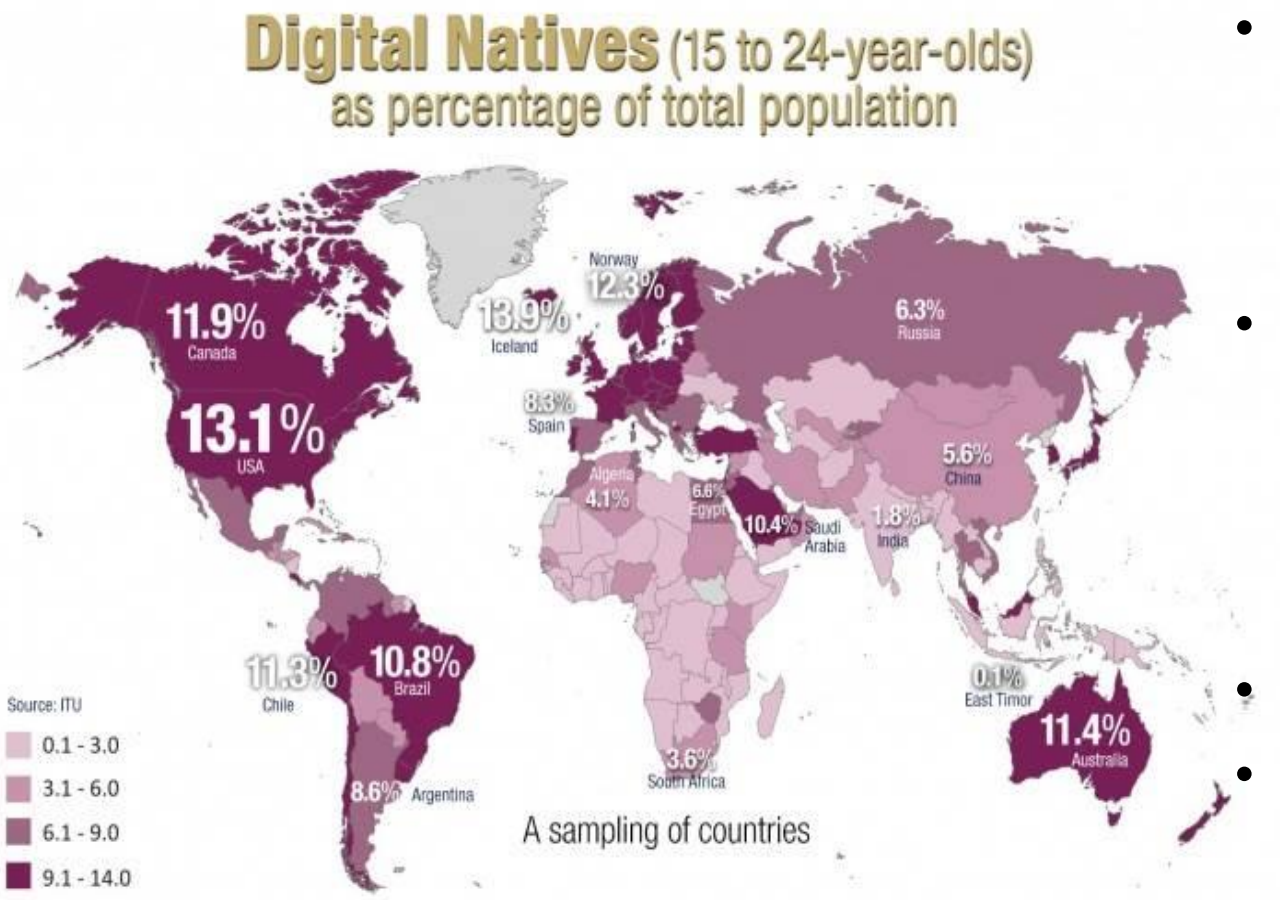
(Mustafa, 2018)

Biggest Stumbling Block



- **Inequality** would still be a concern for digital higher education since more than 4 billion people are still offline without access to the internet (McKinsey & Company, 2014)
- Although digital higher education can be more affordable compared to other education options, **higher education institutions need to consider the best ways to reaching underserved populations** where education can serve as a strong empowerment and change tool (AbuMezied, 2016).

Millennial as Digital Natives



- **Countries with a high proportion of young people who are already online are positioned to define and lead the digital age of tomorrow**.
- While it may seem like young people are always using the Internet, it's perhaps surprising that only **30%** of people ages 15 to 24 worldwide are "**digital natives**," meaning they've been active on the Internet for at least five years.
- Malaysia comes in fourth with 13.4 percent.
- All of the bottom 10 countries are Asian or African nations, many of which are in the midst of conflict and/or have low Internet availability and thus low Internet usage.

(Main, 2013)

Conclusion Remarks

Teacher Mindset: Barriers to Change

- A mental shift occurs when a fixed mindset, which often leads to learned helplessness, is changed to a growth and positive mindset, where one believes that there are options: that one can grow, change, and be significant.
- The bottom line, though, is not is what is in the best interests of the teacher, the administration, or the politicians. It is what is in the best interests of the learner.
- **The student should be central to education**.

(Gerstein, 2014)

Conclusion

- After healthcare, the market for global education is the largest in the world valued, according to a report from Global Silicon Valley, at US$6.3 trillion by 2020. With the global population continuing to grow this is a sustainable industry with new students arriving every day (Brown-Martin, 2017).
- Though the business of higher education remains unchanged since the times of Aristotle, today students still assemble at a scheduled time and venue to listen to the wisdom of scholars.
- Given the fourth industrial revolution, a new form of a university is emerging that does teaching, research and service in a different manner. This university is interdisciplinary, has virtual classrooms and laboratories, virtual libraries and virtual teachers. It does, however, not degrade educational experience but augment it (Xing & Marvala, 2017).

"**Your education today is your economy tomorrow**,"

– Andreas Schleicher (PISA)

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