Higher Education 4.0:

Smart Pathways For Smart Future

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Abstract:

Higher education sector is going through the unprecedented upheavals & transformations, which is technology driven. This sector is in its transition state, where in HEIs are compelled to convert themselves to proactive partners of knowledge economy & knowledge society through innovation R & D. The world is entering in to the IR 4.0 (Industrial Revolution 4.0) & the higher education sector has to adopt itself to this challenging time through its preparedness to future ready higher education, which is going to be 'Higher Education 4.0'. This trend is dismantling existing structures and constructing new once, which demands for engineering the system and human capital and all stakeholders. There are smart pathways & pitfalls for reaching to smart future of higher education, youth and society at large.

Key Words: IR 4.0, Higher Education 4.0, Smart Pathways, Future Ready Higher Education, Knowledge Society, Knowledge Economy.

"My agenda here is global. I look at the major forces that shape societies all over the world, and that are likely to influence the future of our planet as a whole. Climate change may be far beyond the concerns of people in the midst of a life-and-death emergency, but it might eventually make the Mumbai slums uninhabitable, send enormous new waves of refugees across the Mediterranean, and lead to a worldwide crisis in healthcare.

The world is changing fast with an unimaginable speed, content and design. The future of humanity and nature too is being re -engineered and re-shaped in most unpredictable manners and methods. The heart of change at present and future has two threads: one is technology - driven and other one is nature or environment -driven. The heart of change is disruptive, dismantling existing mainstreams and creating new ones. The life of disruptive technologies is too short. The many marriages of innovations and disruptions, divorces and remarriages are posing many challenges and even opportunities. In this most unpredictable times of humanity, how to get ready to face future and its unimaginable challenges and unexpected opportunities

Knocking at our door steps.

Unpredictable and Challenging Times Ahead

This Paradigm shift is opening floodgates for innovations and courageous change makers with workable ideas and yes the delivery too. In this brand new world, Innovative and disruptive Ideas are going to be the real capital. The capital is no more capital. Ideas and knowledge have become true source of capital. Human brain is fertile land of idea germination and knowledge generation. One monetizing idea can create millions of jobs and billions of dollars. In this superfast "Age of Ideas", we have to live and sustain. The higher education sector has to cope up to meet these challenging times and future. We have to revamp and redesign every micro element of our system of higher education. The conventional structures and practices of higher education will not survive in this change-driven environment. As Prof. Raghunath Mashelkar has rightly said "Education is Future and Future is education". Are we, our universities and our colleges really prepared for that? Have we changed our mindset and outdated systems? Do we have futuristic approaches and policies in place? Are we competent enough to demonstrate and lead the society towards predicable and unpredictable future of our human society? Are our brains engaged in brainstorming? Are we going to think of ourselves as "always good doers "? Then you be ready to become a Nokia or Blackberry. In Indian higher education context Takshshila or Nalanda universities have been a part of our proud history. Do we have the passion to rewrite new history? Or we want to submerge ourselves in the pages of history by simply ignoring to understand the ground realities and build our future in the true sense? All these are relevant questions which will test our mettle in terms of our sustainability and future readiness. The observation of Bert van der Zwaan (2017) has relevance to the present situation of global higher education:

"…there are also challenges for the future. Information technology is leading to rapid changes in teaching and research. Across the world, it seems that university teaching is gradually being privatized and governments are no longer automatically funding research. The labor market is set to change fundamentally, and with this, education for students. What is more, the world faces major problems when it comes to distributing dwindling supplies of food, energy, water and raw materials across a growing global population. This, too, means that the university faces new questions and, no doubt, new responsibilities. How is the university tackling the existing problems and how is it preparing for the future? Where will the pressures and opportunities lie in the coming 25 years? Or, to put it differently: how can the university best survive?"[2] ("Higher Education In 2040: A Global Approach" page 5, 6)

Many Problems: Many Solutions

Humanity across the world is facing many problems , many of them are man- made and some of them born out of nature's fury (for that too we human beings are responsible to greater extent) such as floods, cyclones, earthquakes, volcanos, climate change and green house effects, deforestation, extreme exploitation of natural resources. In terms of man - made calamities we have wars, caste-cultural -religious violent conflicts, acute poverty condition of about 1 billion people, jobless growth, deterioration of human values, encroachments in forests, urbanization and diminishing fertile land, severe challenges humanity is going to face in near future for providing Food For All, Water For All, Employment For All, Education For All, Health For All, eradication of all kinds of discriminations such as lack of social and gender justice, remove divides such as economic, social and digital divide. Therefore, global community promotes "Inclusive Green Growth"(IGG), growth and prosperity with an inclusive & environment-

friendly approach. Which system will provide many solutions to these many problems? In my opinion only higher education sector and its bright and well -trained brilliant brains are capable of providing solutions. Is our higher education system is competent and equipped enough to undertake these tasks? Do we have our commitments for these lager missions of our planet? Are we not driven by business and profit goals rather than the global goals of sustainability of humanity and biodiversity, which are ingredients of Sustainable Development Goals (SDGs) of United Nations? Do higher education sector possess the vision and mission in this direction? These are the questions posed by present times before global higher education community. Global Coordinator of Tertiary Education and Lead Education Specialist of India of World Bank Group Francisco Marmolejo (2018) says in this context:

"Worldwide, the higher education landscape is complex. Equity and access issues, demographic trends, and technological changes are all affecting the way colleges and universities deliver education. The higher education environment globally is fertile for positive changes and developments. However, institutions must find ways to innovate. Higher education must transition to more flexible access and retention models that meet the changing needs of a new type of students, as well as employers"[3] (Marmolejo Fransisco: (2018), " Uncertainty and Promising Prospects: The Global Landscape of Higher Education", AACRAO, Bulls Eye Resources, World Bank, p. 1) Education expert Francisco gives higher education sector a mandate as follows:

"We must think about preparing globally minded, internationally able, and locally engaged citizen. Higher education institutions must become role models as corporate and local citizens"[4] (Marmolejo Francisco: 2018). This type of mindset and institutional change is required. For that we must understand and analyze the present status and design future pathways to provide solutions, in words of scientist Prof. Raghunath Mashelkar what we need is "Solution Engineering". The essence of this discussion is are we nurturing students / youth, who are going become problem-Creators or Solution Providers? We have to choose right pathway for the future, otherwise our future is going to be dark and bleak. Hence, we need to break away from conventional paths and develop new paths soothing to changing times, technologies and societies. Here, it is apt to mention views of Duryck Schreuder, General Editor of Universities For A New World, from Faculty of Education and Social Work, The University of Sydney: "Much of the fate of their [developing] societies will be determined by the missions and work of higher education institutions. Universities will be central to the building of "**Knowledge Nations**", they will also be critical for the less developed countries in which skills and professionals are still in short supply. A special concern has been a reflection on issues of human empowerment through higher education-involving both generic disciplines and professional and research programmes, as well as equity considerations (access, gender, inclusivity, and lifelong learning)"[5] (Schreuder Deryck: 2013, p. xxvii) (Schreuder Deryck: 2013 in the book "Universities For A New World" editor, Preface, Sage Publications, New Delhi)

Global Higher Education: Dimensions & Deformities

Global higher education scenario is very complex and full of contradictions. Unless we understand this scenario it becomes very difficult to design a specific roadmap for concerned countries. The projections of future enrolments in tertiary sector explicitly proves that, the higher education sector is ready for quantum jump in terms of student population and international studentship.

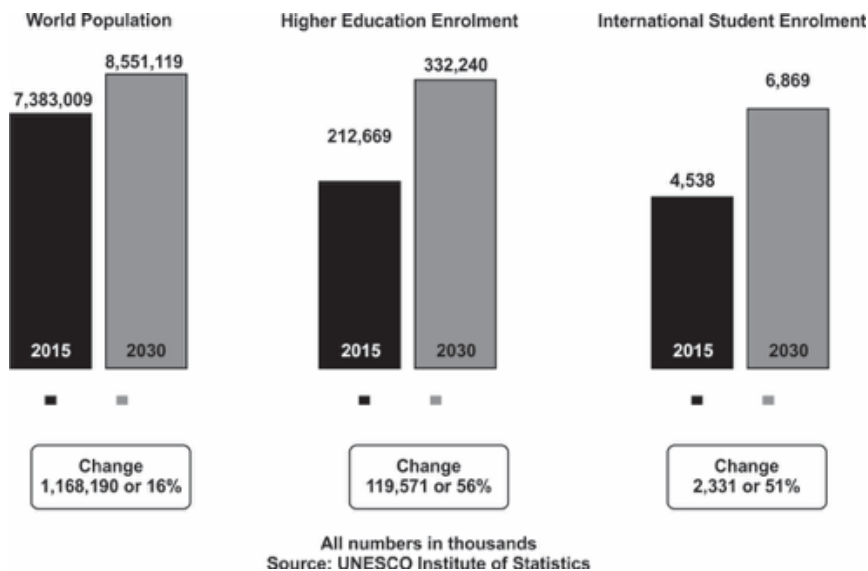## G-1: Global Higher Education Market

(2015-2019)
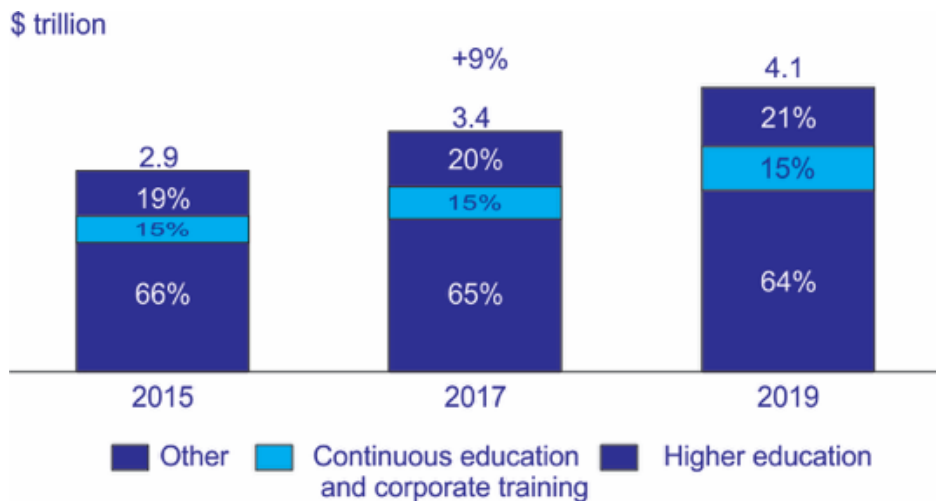
$ trillion

Source: (The Future of Higher Education "Transforming The Students of Tomorrow, Adina

Raetzsch, Ben Thuriaux-Aleman, Stephen Rogers, Morsi Berguiga, Ingrid af Sandeberg, Dr. Vincent Bricout, 2012, p.5)[6]

G-1 shows that, over the recent years the Global Higher Education Market (GHEM) is growing CAGR (Compounded Annual Growth Rate) of 9%. The Global Higher Education Market was of $2.9 trillion in the year 2015 with 66% mainstream market of higher education and corporate training, 15% market of Continuous education and 19% of other programs of higher education. In the year 2019, the overall market of global higher education will reach up to $4.1 trillion with 64% share of mainstream market of higher education and corporate training (going down by 2% than 2015) and increase of 2% in the other allied programs from 19% in 2015 to 21% in 2019. The global higher education market is huge at present and expecting exponential growth in coming two decades, therefore competition is cut-throat one.

G-2: Future of Global Population and Higher Education Enrollment

(2015-2030)

World Population

7,383,009 (2015)
8,551,119 (2030)

2015 · 2030

Change
1,168,190 or 16%

Higher Education Enrolment

212,669 (2015)
332,240 (2030)

2015 · 2030

Change
119,571 or 56%

International Student Enrolment

4,538 (2015)
6,869 (2030)

2015 · 2030

Change
2,331 or 51%

All numbers in thousands
Source: UNESCO Institute of Statistics

Source: (Reformulated from Envisioning Pathways to 2030: Megatrends Shaping the future of Global Higher Education and International Student Mobility, p.6)[7]

G-2 states us the projections of the global population 7.38 billion (2015) to 8.55 billion (2030). As the population is increasing the enrolment is also going to grow remarkably. In 2015 the higher education enrolment was 212.6 million and that is expected to reach 332.2 million by 2030 and the change is 56%, which will be remarkably high. As we are moving towards internationalization of higher education the international student enrollment is also predicted to increase by 51% from 4538000 (4.5 million in 2015) to 6869000 (6.8 million in 2030). Though the number of students in tertiary education is predicted to grow above 50% in next 15 years till 2030 and the higher education market is all sure to grow exponentially in coming decades, there are many deformities in the sector of higher education. We can list them as follows:

1. International students' mobility mostly will be concentrated in developed countries.

2. The quality and ranking competition will reach to peak and the established & high ranked

   'Higher education Brands (HEBs)' shall garner the market by spreading their wings across the world by developing technologies.

3. The upcoming and upgrading universities in the world from Asia and other parts strive there hand to create a space in the global ranking to attract international students.

4. In decades to come, the top 200 universities in the world will grow faster than other 'lagging behind' universities & remaining most will face financial crunch, crisis of inducting 'world class teacher', competition & challenges to retain existing and gaining domestic & international students.

5. The quality of higher education depends on the contribution of universities in terms of Research & Development (R & D), innovations. The universities which leapfrog only can sustain.

Times of Knowledge Abundance

In today's world, the quantum and speed of knowledge generation is amazing, never seen before. Therefore, we call present society as the "Knowledge Society', the economy based on it as the "Knowledge Economy" and the ubiquitous digital technology is transforming it into the Digital Economy". According to Google's former CEO Eric Schmidt, author of the brilliant book

" The New Digital Age', observes that, " Between the birth of the world and early 2000s, 5 exabytes or 5 terabytes of information was created. We now creates five exabytes every two

days." According to APJ Abdul Kalam and Srijan Pal Singh (2015) , who have stated in their book " Advantage India: From Challenge To Opportunity " that , " In the new century, knowledge creation is not a simple affair as different types of knowledge have different rate of growth. For instance, new biological data, such as knowledge about stem cells, genetics and bioengineering, doubles every nine months. Nanotechnology knowledge is doubling every two years and clinical knowledge every 18 months. Overall, on average human knowledge is doubling every 13 months. What about the future? According to IBM, in the next decade, in the world most humans and gadgets will be connected to internet, the doubling of knowledge of knowledge will occur every 12 hours. Nations which invest in knowledge management and technologies stand to be the leaders in global manufacturing and services. (APJ Abdul Kalam & Srijan Pal Singh: 2015:p. 57)[8]. We must understand that, we are in the times of "Knowledge Abundance ", also learn to deal it with and apply it with the theory of aggregation.

IR 4.0 to Higher Education 4.0:

Knowledge-driven Pathways of Progress

We have entered in to the 'smart digital century' as described by Frederic Martel (2018)[13]. In the words Google's former CEO Eric Schmidt it's 'Digital Age'. The IR 4.0 is its name now in terms of its impact on the industries. IR 4.0 (Industrial Revolution 4.0) has become a popular buzzword in the sector of manufacturing and industry in the recent years. The IR 4.0 is the transformational change driven by digital technologies encompassing internet of things (IOTs), Artificial Intelligence (AI), Augmented Reality (AR), Virtual Reality (VR), Intelligent Robotics, 3D Printing, Big Data Analytics and Cloud Computing many such disruptive innovations impacting and changing very structure & process of the industry. IR 4.0 is digitally driven & technologically lead revolution taking place in the industrial and manufacturing sector.

IR 1.0: Industrial Revolution 1.0, come in to existence, when in 1784 first mechanical weaving loom came in to use. It is the time, when mechanical production facilities were invented and deployed based on water & steam power.

IR 2.0: Industrial Revolution 2.0, emerged when first assembly line was developed in the year 1870. IR 2.0 is known for mass production facilities with power of electrical energy. This can be called as the age of mass production supported by electrical power generation.

IR 3.0: Industrial Revolution 3.0, come into consideration with the emergence of electronics and Information Technology, where computer applications were deployed in the industrial sector. In this aspect, the beginning started when Programmable Logic Control (PLC) system come into existence in the year 1969.

IR 4.0: Industrial Revolution 4.0, come into existence, when on the basis of Cyber - Physical Production System (CPPS) being utilized for industrial production, by unification of physical and virtual world, as an revolutionary impact of higher digitization, (Diwan P., 2017)[10], many authors such as Shwab K. (2016)[9], Frederic Martel (2018)[13], Fisk P. (2017)[11], Soffel J. (2016)[12] have discussed these revolutionary changes that have occurred in the present century in industry and other sectors , compelled to reshape re-engineer the structure and process of the present ever changing industry and market.

Higher Education 4.0: What it is?

Now let's discuss, what exactly is the education or higher education 4.0. We are going to live in the 'smart' time. What exactly is that? Martel Frederic (2018) has described it in these words: "The term 'Smart' is simply becoming a synonym of the word internet and can be used for the world's digital sector by including smart phones, applications, technology and the digital in general." (Frederic Martel, 2018: p. xviii, xix) He further remarks that "smart indicates a fundamental mutation of the web, the one which is coming: the passage from information to communication and now, to the internet of knowledge" (Frederic Martel, 2018: p. xix).

Higher Education 4.0: H.E. Architecture
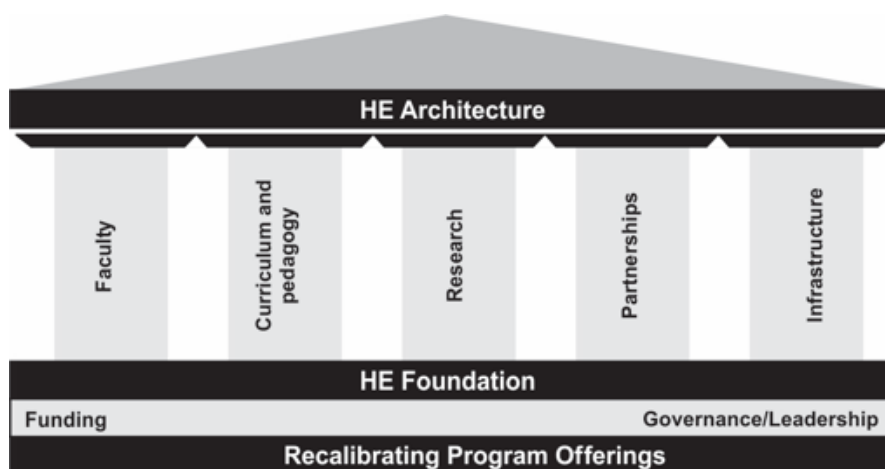
In the lights if these revolutionary developments in regards to knowledge creation, knowledge dissemination, knowledge retrivation, knowledge application. We have to understand Higher Education 4.0. Let's understand the four stages of education:

1) **Higher Education 1.0:**

Education 1.0 is the manner and method of imparting instructions during ancient and middle ages. The process of teaching that time was personalized and in close contact with teacher. Ancient education process was limited to few students from elite class. What is being called in India as the 'Guru-Shishya Parampara' (Teacher-Student radition). It was informal education. It was not structured syllabus. 'Guru' or teacher use to share his knowledge to students of his choice depending on his will and wish. This informal education system was existing in India, China, Israel, Rome & Greece also even in tribal societies. Though there was no formal system of curriculum during this time education 1.0 gradually changed itself from basic of informal education to beginning of higher education, resulted on founding of few universities such as Nalanda, Takshashila, Ujjain,

Viramshila in India and Heian-kyo in Japan during the 9th century. During this time religious & spiritual education was prominent.

2) **Higher Education 2.0:**

The education or higher education 2.0 emerged, when during mid-15th century, the invention of printing press changed the dynamics of knowledge reproduction & sharing system if knowledge. During this time, the books became the verticals if knowledge dissemination. During higher education 2.0 the process of knowledge transmission changed and concept of one to one (0 to 0) become one to many (0 to M). In this period only specific revolution, renaissance, reforms occurred and universities were established

as the center of higher learning. In the 14th and 18th century in Europe and many other countries universities were established and the opened doors of higher education for common people. It was journey of elite education to mass education, women's education.

The informal education become formal and disciplines were borned.

3) Higher Education 3.0:

The Higher Education 3.0 means the present day education in the age of internet & information technology and it can be called as the period of democratization of higher education which increased the accessibility of higher education to otherwise deprived

classes in mass scale. This is the phase of 20th century, which replaced chalkboard to ICT bored education. It's a beginning of digital age, consisting of technology, computer use, improved administration and better learning & research & development in all disciplines dominated by Science and technologies. It includes social changes such as an advent of postal system, radio technology, television lectures and internet revolution.

4) Higher Education 4.0: Future is here

On the ground & backbone of higher education 3.0, the new age of higher education 4.0 has emerged. The higher education 4.0 puts the learner at the center & it enables the student to choose his/her mode of higher education by structuring individual path to achieve individual goals. It's collaborative & personalized learning. Now on can learn at campus, at home and even at work place.
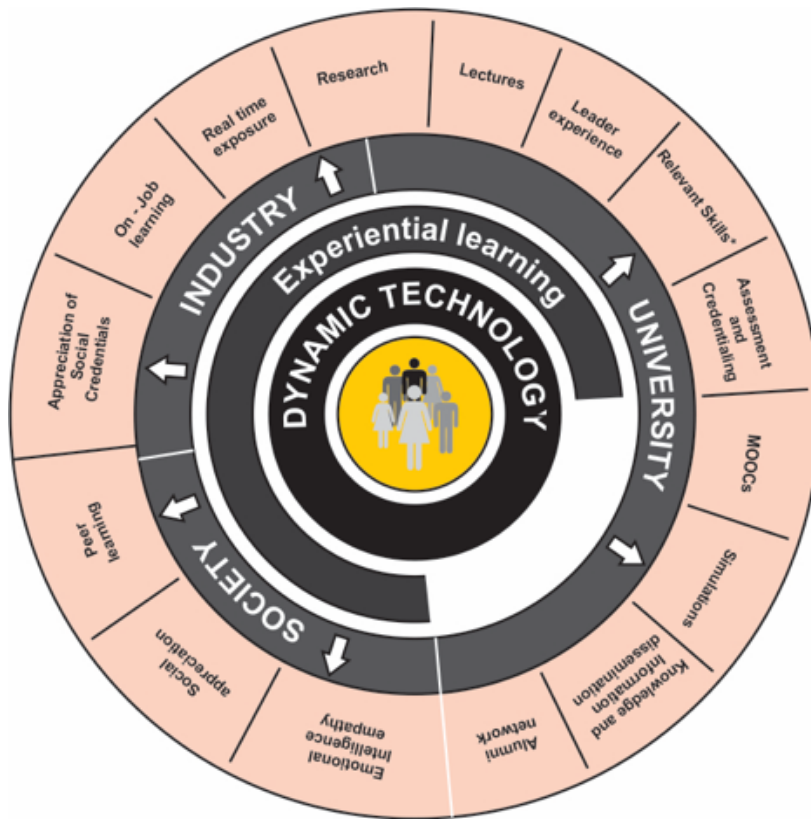
Preparedness of Universities towards Education 4.0
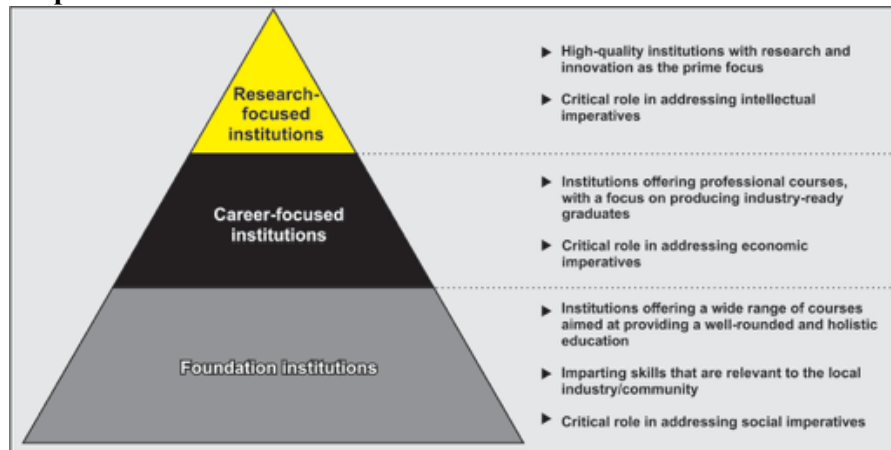
Source: (Leapfrogging to Education 4.0: Student at the core, report of the Ernest and Young prepared for FICCI, November 2017, p.54)

This is all together different learning environment then the traditional centers for learning such as college and universities campuses. The higher education 4.0 is beyond boundaries, beyond higher education institutions and transnational in real sense. This method of learning is transforming conventional students into an active learner. The learner of 4.0 has full freedom to choose courses, knowledge and skills.

Higher education: 4.0 Learners' Knowledge

Source: (Leapfrogging to Education 4.0: Student at the core, report of the Ernest and Young prepared for FICCI, November 2017, p.34)

That is anywhere & anytime higher education. The boundaries of disciplines are collapsing. The higher education 4.0 is self-paced & flexible. The role of a teacher has changed dramatically and teachers will be facilitate and inspirators. The teachers have to play a role of guiding force, instead of educator imparting knowledge. The Higher Education 4.0 shall eradicate the distance between cultures and societies, thus student can learn from multiple universities persuading choice based courses & acquiring degrees of their choice. The H.E. 4.0 will be outcome based education. Let me end this paper with the quote of noted contemporary thinker Harari Yual Noah from his latest book "21 Lessons for the 21st Century":

"A global world puts unprecedented pressure on our personal conduct and morality. Each of us is ensnared within numerous all-encompassing spider webs, which on the one hand restrict our movements, but at the same time transmit our tiniest jiggle to faraway destinations. Our daily routines influence the lives of people and animals halfway across the world."

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