Indian Higher Education at the Cross roads of Technology Enabled Education

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ABSTRACT
This is probably for the first time in the history of education, that all the institutions, almost all over the world, were closed down for around 6 months i.e. March to Aug 2020, due to Covid-19 pandemic. Online education was put to acid test in all higher education institutions during the locked down period. Unpreparedness and nonavailability of contingency plan in case of conventional system collapsed became biggest hurdle when switch over to online mode was done. In this crucial Covid period it was realized that there is need to do a lot, to restructure the current higher education system by introducing greater share of online education and skill development in the curriculum. It was also realized that online education is a different cup of tea and not simply converting notes in to pdf or uploading videos or making a slide show or replicating face to face format in to online system. A great deal of learning science and digital pedagogy in needed. Unfortunately, earlier, even for conventional system in initial stages no formal training of teachers was available, and it matured with time only, but now online education is coming to stay with bigger share, is a new system, so the ***need is stronger for formal training of faculty on online pedagogy, at national and regional level, by establishing academies/training institutes.*** *The New Education Policy (NEP 20) has overlooked this critical need and left to normal FDP methodology which has not proved so successful in the past. The other weak areas are* ***standardization of format, process and technology, time and resource management*** *to overcome cost enhancement due to new norms of social distancing and expensive online systems and virtual labs.* ***The most critical area needing attention in online system is also quality of online examination and assessment.*** *This paper examines various aspects of higher education in pre Covid and post Covid period in India and provides an overview of what needs to be done.*

(***Keywords*** – Covid-19, Online Education System, NEP 20 Edn 3.0, Edn 4.0, Technology Enabled Education, Digital pedagogy)

I INTRODUCTION

Covid-19 pandemic has caused biggest disruption in the higher education sector. In India, 993 universities and over fifty one thousand colleges were closed down during the crucial academic months of March to September 2020. During this period 37.4 million students and 1.5 million teachers were confined to their homes. Edutech enthusiasts were advocating, for quite some time, to switch over to highly technology enabled system, in order to reap the benefits of online education, but efforts to cross over to online system in the regular education system of India have been made only in fits and starts, mainly for three reasons. One, the infrastructure and resources required for online education for such a huge area in a developing country like India, were quite inadequate. Second, bridging the digital gap between rural and urban, rich and poor, again demanded time and cost as well as many welfare measures. Third, the mindset of academicians has not been ready to accept online system as a better option for regular teaching learning. It remained obsessed with face to face conventional system of teaching.

Covid-19 pandemic came as blessing in disguise for higher education. It did not leave any option. On line education was the only way to meet the challenge of Covid 19. Brushing aside the inertia and excuses, the Indian Higher Education System accelerated efforts to overcome shortcomings of infrastructure, devices and internet accessibility, through equipping, reengineering and innovations. During the crucial months of Covid-19, most of the Indian Institutions of higher education switched to online system of education using innovative methods to bridge the digital divide. The biggest lesson the pandemic taught was, as regard to importance of sharing and collaborating between individuals and institutes. The fact is that despite all shortcomings of infrastructure, internet access and devices, most of the higher education institutes in India were able to complete most part of syllabus and many of them conducted exams. The government and support system also came out with many new schemes, plans and systems to facilitate online system of education. Everybody in the higher education sector has fully realized that the pre Covid-19 era in higher education may not return even after Covid-19 disappears and therefore online education has come to stay. The post Covid-19 era is likely to be of combination of conventional face to face classes and virtual classes, virtual labs, online delivery and soft content. In this hybrid system of teaching -learning also, the contribution of conventional face to face may reduce to a level of around 30 to 50%. There is strong need for standardization of infrastructure, devices, platforms and processes. **The whole effort of Indian higher education system has to be for design of a proper hybrid system, standardization, quality control, content development, design of an effective assessment and online exam system and training of teachers on new system of teaching learning methodology. Online exam proved to be the weakest area during the Covid period.**

II ONLINES VERSUS TRADITIONAL EDUCATION

Traditional teaching, where one teacher teaches a group of students at a time, in a class room face to face, has been there since ages. As technology came in to human life it brought comfort, convenience, effectiveness and efficiency. The growth in technology has been divided in to technology based era/generation. Table 1 shows the generation wise growth of technology from Tech 1.0 to Tech 4.0. Tech 5.0 is now knocking the door where AI and Robots work parallel to human and not as subservient. Education system also initially grew in parallel to Technology era as shown in the table 1.

Table 1
Eras/Generation of Technology and Education

Industry	Tech 1.0 (Mech)	Tech 2.0 (Eectt, Elec)	Tech 3.0 (Digital)	Tech 4.0 (Adv Dig)	Tech 5.0 (AI parallel to Human)
Education	Edn 1.0 (Dictation) (Guru – Shisya)	Edn 2.0 (Socially Constructed) Interactive	Edn 3.0 (Use of Technology in class room)	Edn 4.0 (Virtual Class Simulation gaming)	Edn 5.0 —
Interaction	Face to Face	Face to Face	Hybrid (80:20)	Hybrid (20:80)	—

With Tech 4.0, Education system also should have been upgraded to Edn 4.0 with maximum share of tech mediated system using advanced digital technology for online delivery, taking benefits of virtual system, simulation, gaming and artificial intelligence. Edn 4.0 faced many barriers and could not replace traditional face to face teaching system in right ratio. This is also a fact that there are many advantages of face to face system and it cannot be rejected all together. On line learning on other hand has many advantages eg. it permits flexibility (pace of learning, schedule of learning, balance between work and study) for both teacher and student, accessibility from home reducing travel and cost, cost effectiveness, possibility of customization as per ability of learner, use of effective power of video, virtual field trips etc. The online learning has some disadvantages like possibility of distraction for student in non class environment, current virtual system's inability to replace totally, labs and workshops and high cost of infrastructure and devices, poor availability of internet in rural areas, missing face to face interaction and team spirit which promotes all round development. However these disadvantages and barriers will disappear gradually when all the potential of online technology is used and the current rate of high growth is indication of this. Online education market in 2016 was of 247 Million $ which has grown to 1.9 Billion $. Number of lease lines has grown from 1.6 million in 2016 to 9.5 million in 2020. The penetration of internet and its speed are improving at unprecedented pace. Costs of devices are coming down and infrastructure is growing. Cost of data is also reducing day by day. Problems and reasons for online education being not able to take its due share in teaching – learning pedagogy is shown in table 2.

Table 2
Online Education Problem & Reasons

Why Online	Barriers	Reasons
• Efficiency	Teacher's Non Acceptability	Mind Set of academicians
• Accessibility	Internet Reach	Cost & Time for system
• Flexibility	Distraction of Student	Work Culture
• Quality Edn	Training of Faculty	Trg Resources
• Overall cost low	Initial Infra Cost high	Reluctance of academicians
• Convenience	Discipline/Attendance	Counselling in proper
• Wide Choice	Curriculum Development	Redesign Required
• Customization	Time & Effort needed	Collaboration

III PRE COVID ERA – GETTING READY FOR UNSEEN

In mid nineties computers gained a strong foot hold in the Indian higher education class rooms and since then digital journey commenced. The journey had to face many hurdles. In 2010 the internet penetration was merely 8% against neighboring China's 34%. Around 66% of student strength in India comes from rural sector, which suffers from archaic methods of teaching, shortage of teachers, poor teacher to students' ratio and out dated teaching material. It was realized at policy level that these problems could be addressed to quite some extent through online education. Technology enabled education could provide educational access to rural sector which urban sector was enjoying and that is how the playing field could be leveled. However it was easier said than done. The major challenge was non-availability/inadequacy of electricity, internet connectivity and nonavailability or unaffordability of costly devices like computers, smart phones and tablets in rural sector. It involved huge cost and infrastructure. Large numbers of initiatives were therefore initiated at the level of Government of India. Some of these initiatives/programmes which have helped in technology enabled higher education are:-

(a) **Bharat Net-** This is world's largest rural broad band network being completed in 2 phases under **Make in India** initiative, by laying 10 million km of optical fiber cable covering 6.2 Lakh villages, 25.0 Lakh Govt Institutes and 50.0 Lakh households, designed for a minimum of 100 M bit/s broad band connectivity. Cables have been laid at a breath taking speed of 30 thousand km per month. The project is being completed by 2020 end.

(b) **Digital India** – Launched in 2015, it is a massive programme aimed at taking digital revolution to masses from city to villages adopting, Public Private Participation mode (PPP) with initial outlay of Rs. 1 Lakh Crore. E-education, digital lockers etc were some important programmes. Two to five hot spots per village are being created in 6.25 Lakh villages. This has helped in providing 276.5 million wire line and wireless broad band connections to internet users in 2014 and by 2020 just before Covid-19 it grew to 681.1 million at annual growth rate of 14%. Internet users in India now account for about 17% of world internet users.

(c) **Schemes, Apps, Platforms & Facilities** – Large number of schemes have been launched by the government to promote online system at very low and affordable cost. This includes free access to higher education study material, 32 channels launched by MHRD providing, digital platform at low cost for rendering academic services, SWAYAM platform making 500 courses available free of cost through Video lectures, reading material tests and interactive session free of cost by 1000 chosen faculty, NPTEL project of 7 IITs providing free courses and effort to develop content under MOOCS India etc.

(d) **National e-Governance Plan (NeGP)** – With 31 Mission Mode Projects in which computerization and e-service have helped Digital India in a big way and build infrastructure for on line delivery.

(e) **Subsidies** – Government of India has highly subsidized the digital services to make services and devices available to users at affordable cost e.g. 76% subsidy to private operators for 4G broad band.

(f) **Make in India** – Launched in 2014, under Make in India, has 25 sectors including electronics, IT and renewable energy to promote design, development and innovations by investors from abroad also there by bringing cost down and add to economy. This has helped improving reach of online system to rural area and makes it affordable.

(g) **Swach Bharat Abhiyan-** This helped in improving environmental condition to mitigate suffering due to Covid 19

All these initiatives/programmes came handy to higher education sectors and made grounds to move towards technology enabled education. Owing to this ground work it was possible to cross over to online education system, when the Covid 19 pandemic set in, by most of the institution.

IV UNLOCKING ONLINE EDUCATION DURING LOCKDOWN

On 9th Jan 2020, the WHO announced that coronavirus SARS Cov-2 could cause Covid-19. On 11th March 2020 it declared spread of Covid-19 as pandemic. On 25th March 2020 India clamped country wide lock down. Confinement and social distancing became norms. Higher Education sector of 185 countries was adversely affected by coronavirus, where most of the institutions of higher education were closed down during crucial months of March to August 2020. A survey taken by International Association of Universities (IAU) and some other organizations like IIE of USA and EAIE in Europe revealed the pandemic has resulted in; closer of institutions during crucial academic months, 45% international admissions affected, forced move to distance learning, adverse affect on research and examination etc. Most of the institutions did not have an effective contingency plan. In India also all higher education institutions are closed down from Feb/March 2020. Most of the institutions did not have plan for such contingency in India also. It was realized at all levels that there are many difficulties and some disadvantages in switching to online system. The difficulty was in terms of inadequacy of infrastructure, many rural students not having access to internet and smart phones, teachers not having soft

content readily available with them etc. The disadvantages of online system sited by academicians were mainly related to quality of delivery, quality of audio and video in non standard format and student's distraction and being unable to adjust to new format of learning. Surprisingly all the stake holders joined to gather to reorganise and reengineer available resources with innovative approach to initiate on line teaching-learning system in a big way, when no other way was left for continuing education. It took about a month's time to stabilize and develop an effective and adequate system by exploiting available resources in most of the places. Following resources/plans came handy:-

(a) **Government Resources-** Various initiatives taken by the Indian Government to promote Digital India in terms of providing open sources in form of e- Books, education media files and repository for higher educational institutions helped to switch to on line mode. NPTEL is the largest single repository of around 1500 technical courses using Googal's open source platform. SWAYAM launched in 2016, MOOKIT, IITBx etc provided large number of soft content free of cost. Education and Research Network (ERNET) connecting colleges and universities libraries, EDUSAT satellite for education, Consortium for Education Communication (CEC) to use power of TV for education - all these resources were exploited to initiate online system of learning.

(b) **MOOCs-** Many institutions and universities have developed Massive Open Online Courses (MOOCS) within the resources available with them. All libraries have their own stock of e-Books, Video Lectures, e- content which were also used extensively for online delivery. Students also used MOOCs available on various platforms by various agencies like Udacity, Coursera edx and Udemy – etc to complete some of the courses within their programmes of studies.

(c) **Online Delivery-** Teachers used various methods of conducting online classes. Teachers, who could reach their institutions, used formal infrastructure available there, including LMS platforms to conduct the online classes making them interactive. Many teachers used camera/mobile phones and normal white board to conduct the classes from their home. Due to restrictions and limitations imposed by lock down, most of the institutions gave free hand to their teachers to use synchronous and asynchronous methods for online delivery of courses as per their convenience.

(d) **Innovative Methods-** Many students during critical Covid-19 period were locked up in areas where network was not available or speed was problem. In such cases teachers used innovative methods of asynchronous mode, social network and tools. Googal Class room whats app, webinar, skype, Ever note, Drop box were skill fully used by both faculty and students. Flexibility was stretched to maximum limit to achieve the target of reaching maximum students.

(e) **Student Attendance and Discipline.** The pandemic taught a good lesson on discipline and time resource management to both faculty and students. It also revealed short comings of online education and also innovative methods to deal with them. Also it revealed the importance of plans for such contingency.

(f) **Examination and Assessment-** For most of the institutions this was the grayest area. Only some institutes had the resources in terms of question bank, hardware and software system to take exam on line. Most of the institutions, however, developed online examination system during Covid period but quality of examination and assessment was quite not up to the mark.

V THE WAY AHEAD

In all probability, pre Covid days in education sector may not return for three reasons. First, online education system has proved itself adequately during crucial pandemic period. Second, it will be very difficult to do away with the infrastructure, equipment, work culture and processes developed for online education. Thirdly, even after conquering coronavirus, fear will always loom large of similar virus attack in future. So the only option now is to restructure higher education system efficiently with major role for technology enabled education. Covid-19 pandemic has taught another crucial lesson, that no sector can progress in isolation. Each sector of national economy including education sector, will have to restructure itself for national goals for sustainable development and work in collaboration with others. The goal of 5 trillion dollar economy by 2024 and self reliant India have already been set by the Government. All the sectors will have to deduce their own goals to support the national goals. Obviously for higher education sector the agenda for sustainable development is to ensure inclusive, equitable uninterrupted quality education and promote lifelong learning opportunities to produce competent human resources. The whole economic framework of the nation can be divided broadly in three Es i.e. Economic Sector, Education Sector and Environment Sector. Economic Sector covers all sectors related to production, maintenance and services and Environment sector covers all units engaged in building and maintaining ecological and environmental support. The road ahead for higher Education Sector in post Covid-19 era need to focus on following aspects:-

(a) **Interface with Economic and Environmental Sectors –** The New Education Policy (NEP-20) emphasizes on skill and employability oriented choice based system with multidisciplinary approach liberal education and technology enabled option for New India. For sustained

development and achieving goals set by NEP-20 following initiatives could be thought of in post Covid period:-

(i) **Establishing a Vibrant Interface: -** A vibrant interface between Industry/Corporate/Services and Education and between Education and Environmental Sectors will need to be established across all the disciplines. The role of existing Industry Academia Cell in institution could be modified to discharge this function. This interface should be part of all BoS/Academic Council and advise them to include new topics and subjects related to Economic and Environmental sectors in syllabus across all disciplines to build awareness on all govt programs and build ground for active participation by students and faculty in nation building.

(ii) **Skill Development and Virtual labs: -** Syllabus needs to be modified and percentage of practical and hands need to be increased Skill training need to be made compulsory across all disciplines. In light of NEP 20, curriculum development will be biggest task. NEP calls for inclusion of liberal education with science and arts subject curricular activities and cocurricular activities as part of all syllabus. To ensure that core subjects are not diluted and student is not overburdened, the curriculum has to be skillfully designed. Initiatives need to be taken to develop virtual labs. These being expensive could be established jointly by more than 2-3 institutions.

(iii) **Research Orientation: -** Greater portion of research effort need to be devoted on existing problems of society, economy, industry, service sector and ecology with target/result orientation with online approach.

(iv) **Multi disciplinary Projects & Internship: -** Institutes need to develop labs with advanced digital technologies and take up multidisciplinary projects with feasibility of partly work from home if need arises. Project should be related to problems of the society and support theme of vocal for local.

(b) **Infrastructure and Equipment for Technology Enabled System: -** There are various issues as related to quality and standards of technology enabled system which need to be addressed :-

(i) **Online Technology –** There are two issues; the **internet speed** and **internet penetration,** especially in rural sector. India ranks 89th among 149 countries as per Akamai ranking with average internet speed of 6.5 M bit/sec against Singapore's 150 Mbps and USA's 75 Mbps. There is need to improve the speed in existing system. There has been lot of progress made in internet accessibility in last 5 years with 718.74 million internet users now, which is 54.29% of population, still penetration in rural area needs further improvement. Govt initiatives like e-Kranti, e-learning in rural, e-Vidya lok are quite effective.

(ii) **ICT devices-** Current cost of broad band access in India is 5% of average national income against 1% in developed countries. Programmes like Make in India, Digital India and Start up India may help reduce the cost. Very recently 22 companies have made bid to manufacture smart phones, laptop and components in India under Make in India and Atma Nirbhar Bharat initiatives.

(iii) **Infrastructure -** Creation of soft content in audio and video needs quality equipment, devices and environment which are expensive. Covid -19 has forced new cultural and working norms, like social distancing, frequent sanitization, class rooms with online facilities and reduced seating capacity, good audio visual studios etc. All these new needs will obviously enhance cost. There will be need to reduce effective cost by better time management; innovative methods of utilization, sharing of resources and skill fully designed home assignments and projects.

(iv) **Electric Power Adequacy: -** There is need to improve quality and duration of power supply by better grid management and reduction of losses.

(c) **Standardization and Quality –** It took decades to develop existing system of conventional face to face system of education. In order to make technology enabled system, there is need to standardize technology, devices, infrastructure and process and also ensure minimum quality level. This will be an uphill task. **Problem will multiply with new NEP-20 which calls for inclusion of cocurricular, extracurricular activities and science/arts/liberal education subjects also in curriculum even with professional and technical programmes.**

(d) **Training of Teachers and Supporting Staff –** A recent survey raises questions as regard to quality of online education as compared to face to face system. Online teaching is just not converting notes in to PDF nor is it library of video and audio lectures. Blind replication of conventional class room to an online affair defeats the very purpose. To bring in quality, it needs

great deal of learning science and digital pedagogy. How to keep students engaged and attentive and make session interesting and interactive is also a matter of skill and home work by teacher. Supporting staff also have a different role now. **There will be need for professional training of teachers and supporting staff at state and national level in institutionalized manner and should not be diluted like current Faculty Development Programmes.**

(e) **Curriculum and Content Development-** This will be most crucial area. Main aspects on which, work need to be done by BoS, Academic Council and Policy makers may fall in to following seven categories. **One, deciding on each subject ratio of online to conventional delivery. Two, how to enhance skill and hands on part of curriculum effectively for each programme. Three, ratio of virtual and actual labs/projects. Four, system of inclusion of subject topics of ongoing government programme initiative on Economy, Environment and National Development in to syllabus/curriculum. Five, how to include choice based liberal and non professional subjects, extra/cocurricular in curricular without diluting core subjects and overloading students. Six, making participative activities, with industry/corporate/society/rural grass root mass, as a part of syllabus/curriculum. Seven, introducing at least one multidisciplinary project every year as part of syllabus in order to keep student in touch with ongoing development in technology/industry/society with research orientation. In addition Virtual Field Trips and Adaptive courses through web apps also need to be made part of curriculum. Gaming and simulation need to be made part of maximum syllabus.**

(f) **Examination and Assessment – This is the grayest area of online education system. There is a big question mark on quality of question bank. Most of the questions are objective type and test only memory and not knowledge. If online education has to achieve its objectives then most important areas in which academicians need to work on are examination and assessment system in addition to training of teachers.**

VI CONCLUSION

Post Covid-19, the online education has taken center stage in higher education. The share of online delivery and conventional face to face teaching in universities and colleges is likely to be in ratio around 50: 50 to 70: 30. During the Covid period online system of education has proved its edge and value which no one can deny. At the same time in areas like, practicals, team work, interactive methodology and human touch, conventional method has its importance reminding the importance of face to face teaching. Covid period has revealed the weakness and inadequacies in many areas of technology enabled online system. Unless all the stake holders of higher education accept the fact whole heartedly that online system of education has to be adopted in colleges and universities for normal curriculum also and not only in distance education, it will be difficult to reap the benefits of technology enabled higher education. Following are the critical areas needing immediate attention:-

(a) **Examination and Assessment –** This is the most critical area due to which in many institutes during Covid period general promotion was resorted to. Wherever online examination was taken also, the quality of questions, process and assessment were very poor.

(b) **Training of Teachers –** This is a very weak area as currently quality and content of on line teaching is found to be poor. Mostly conventional lectures are being replicated in on line format. Formal training is a strong need not by technology expert alone but also by digital pedagogy experts and learning science experts.

(c) **Curriculum Development –** For better resource management and for following new culture of social distancing, curriculum has to be developed for skillful division of on line and face to face sharing assignments and home work by students and teachers.

(d) **Standardization & Quality –** Adhoc methods, system and process need to be replaced with standard ones with proper bench marks.

(e) **Virtual Labs, Gaming & Simulation-** This area needs lot of work in terms of cost effectiveness and sharing.

(f) **Virtual Events –** Virtual events like webinar, workshops expert lecture can be very cost effective with better reach globally. Issues as regard to technology, process security and reliability; need to be addressed. One example is Zoom app which was found to be doubtful on security aspect by the Government was mostly used and need to be replaced.

It can be easily concluded that coming era is of highly technology enabled higher education with very vital role for online systems and virtual world for regular programmes also in colleges and universities.