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Commonwealth Educational Media Centre for Asia

Technology and Flexible Pathways for Higher Learning

DISCUSSION PAPER

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TECHNOLOGY AND FLEXIBLE PATHWAYS FOR HIGHER LEARNING

A DISCUSSION PAPER

The Commonwealth Educational Media Centre for Asia (COL-CEMCA) is an international organisation established by the Commonwealth of Learning (COL), Vancouver, Canada, to promote the meaningful, relevant and appropriate use of ICTs to serve the educational and training needs of Commonwealth member states of Asia. COL-CEMCA receives diplomatic privileges and immunities in India under Section 3 of the United Nations (Privileges and Immunities) Act, 1947.

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Over the years, the surge in demand for higher education has resulted in a significant expansion of this sector, marked by diversification of institutions, funding sources, and curricula. Against this backdrop, distance education and open universities emerged as key players, offering flexible and scalable learning options. In addition, the past two decades have seen a dramatic rise in digital technology's role in education with the advent of Massive Open Online Courses (MOOCs), and Artificial Intelligence, which has significantly altered the educational landscape.

We invite you to share your valuable insights on "Technology and Flexible Pathways for Higher Learning: A Discussion Paper," which explores the impact of technology integration on teaching and learning in higher education and enriches the existing knowledge resources on technology-enabled learning. Your feedback would be crucial for shaping the future of education. We look forward to hearing from you.

Please send your comments to admin@cemca.org.

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Contents

Acronyms

ABC	Academic Bank of Credits
ADDIE	Analyse, Design, Develop, Implement and Evaluate
AI	Artificial intelligence
AICTE	All India Council of Technical Education
AISHE	All India Survey of Higher Education
APOU	Andhra Pradesh Open University
ARPIT	Annual Refresher Programme in Teaching
BCA	Bachelor of Computer Application
BEd	Bachelor of Education
CBCS	Choice-Based Credit System
CBSE	Central Board of Secondary Education
CD-ROM	Compact Disc Read-Only Memory
CEC	Consortium for Education Communication
CIET	Central Institute of Educational Technology
CMS	Content Management System
CPD	Continuous Professional Development
CPU	Central Processing Unit
DAISY	Digitally Accessible Information System
DEIs	Distance Education Institutes
DigComp	Digital Competence Framework for Citizens
DIKSHA	Digital Infrastructure for Knowledge Sharing.
DLGF	Digital Literacy Global Framework
Dr BRAOU	Dr Bhim Rao Ambedkar Open University
DTH	Direct-To-Home
FOSSEE	Free/Libre and Open-source Software for Education
GEC	General Education Council
GER	Gross Enrolment Ratio
GERD	Gross Domestic Expenditure on Research and Development
HECI	Higher Education Commission of India
HEGC	Higher Education Grants Council

HEI	Higher Education Institution
IBEF	India Brand Equity Foundation
IGNOU	Indira Gandhi National Open University
IIMs	Indian Institutes of Management
IITs	Indian Institutes of Technology
IOEs	Institutes of Eminence
IQA	Internal Quality Assurance
ISCED	International Standard Classification of Education
ISRO	Indian Space Research Organisation
ISTE	International Society for Technology in Education
IUTs	Instituts Universitaires de Technologie
LMS	Learning Management System
MCQ	Multiple Choice Question
MERU	Multidisciplinary Education and Research University
MHRD	Ministry of Human Resource Development
MIT	Massachusetts Institute of Technology
MOOCs	Massive Open Online Courses
MOODLE	Modular Object-Oriented Dynamic Learning Environment
NAAC	National Assessment and Accreditation Council
NAC	National Accreditation Council
NBA	National Board of Accreditation
NBC	National Broadcasting Corporation
NCERT	National Council of Educational Research and Training
NDEAR	National Digital Educational Architecture
NEP 2020	National Education Policy
NETF	National Educational Technology Forum
NHERC	National Higher Education Regulatory Council
NIOS	National Institute of Open Schooling
NIRF	National Institutional Ranking Framework
NISHTHA	National Initiative for School Heads' and Teachers' Holistic Advancement
NITTTR	National Institute for Technical Teachers' Training and Research
NMEICT	National Mission on Education through Information and Communication Technology
NPTEL	National Programme on Technology Enhanced Learning

NUIs	Non-University Institutions
NYU	New York University
OBC	Other Backward Classes
ODL	Open and Distance Learning
OECD	Organisation for Economic Co-operation and Development
OER	Open Educational Resource
OU	Open University
PMMMNMTT	Pandit Madan Mohan Malaviya National Mission on Teachers and Teaching
PSE	Personal and Social Education
PSSBs	Professional Standard Setting Bodies
RAM	Random Access Memory
RECs	Regional Engineering Colleges
SC	Scheduled Castes
SITE	Satellite Instructional Television Experiment
ST	Scheduled Tribes
SWAYAM	Study Webs of Active-Learning for Young Aspiring Minds
T4T	Technology for Teaching
TALIS	Teaching and Learning International Survey
TPD	Teachers' Professional Development
UGC	University Grants Commission
UIS	UNESCO Institute for Statistics
UNISA	University of South Africa
WEF	World Economic Forum

Foreword

Technology-enabled learning practices in higher education have paved the way for educators, today, to enhance the learning experiences and the quality of learning among their constituencies. The National Mission on Education through Information and Communication Technology (NMEICT) was initiated 15 years ago to bridge the digital divide in the higher education system by integrating technology effectively. It aimed at building the capacity of higher education institutions and the faculty members to provide open, online, distance and digital learning opportunities to students. Combining face to face instruction and online systems such as the learning management systems, discussion forums, podcasts and video instructions, educators have been able to provide blended learning opportunities to their students where a range of techniques and models are proving to be highly effective.

With more advancements witnessed in technology each day, there are seamless opportunities today for creating personalised learning pathways, engaging students in collaborative learning methods, encouraging them to take problem- and action-based approaches to assimilating knowledge and gaining learning experiences. They are also provided with instant feedback and assessment using innovative methods. Virtual labs and simulations prove very helpful for students to perform experiments, explore scenarios, and gain hands-on experiences in digital settings. However, in all these, while today's students are already tech savvy, the teachers require to continually learn and hone their digital teaching and learning skills on a daily basis.

In advanced economies, there is already a shift to blended learning where European and American Universities are increasingly adopting the blended learning model when they blend face-to-face instructions with online learning resources, allowing for flexibility and personalised learning experiences. There is a greater emphasis on Open Educational Resource (OER) practices that encourage educators to retain, reuse, revise, remix and redistribute content in order to enhance the quality of material, offer academic freedom and autonomy in teaching, provide free and open access to resources, while also reducing the cost of access by learners. We have witnessed leveraging technology, newer pedagogical approaches and practice, where blended learning designs have come to the fore. We have also witnessed adaptive learning platforms, virtual labs, and interactive content in the form of extended realities that augment experiential learning among learners. Learner analytics, predictive analysis and learning behaviour analysis help teachers to devise instructional strategies and, at the same time, help students to carve out their own personalised learning methods. Learners' data helps to devise strategies for improving learning outcomes of individuals. Thus, enabling learning to move away from the massification mode to personalisation.

The National Education Policy 2020 provides a range of reforms in educational practices, which can be achieved only if the Indian education system moves towards blended learning, investing in technology-enabled practices and teacher capacity building. In these efforts, it is important to ensure that equity and inclusivity are achieved in education rather than perpetuating divides in the society between those who can afford and those who cannot. With Generative AI disrupting the education practices beyond measures, there is a need for proper governance systems, including ethical and responsible use of AI. There are concerns about the way AI can provide numerous positive effects.

This Discussion Paper, written by Professor N V Varghese, is meant to provide some glimpses into the ever-evolving higher education landscape, specially steered by technological advances. It is believed that the report will provide a lot of insights for the educators and education planners in developing economies, such as India where their policy instruments can be aligned to the ground realities. I wish to thank my colleagues, Ms Sheriya Sareen, Ms Joyce Sunny and Ms Shipra Sharma for the support extended to CEMCA, and Professor Varghese in the finalisation of the document.

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Technology and flexible pathways for higher learning

Introduction

Universities have historically been relied on for generation and diffusion of knowledge. While research forms the basis for knowledge creation, teaching becomes an important vehicle for knowledge transaction. The emergence of developmental universities linked institutions of higher learning with national production and economic growth. Ever since knowledge became dear to national growth and personal income, higher education institutions became dearer to public policymakers, private/corporate investors and households. This fuelled the social demand for an expansion of the higher education sector.

The expansion also put an end to the monopoly of universities to provide higher education since it was accompanied by diversification of institutions to provide, student body to receive instruction, sources of funding to support expansion and proliferation of study programmes to diversify curriculum. The emergence and expansion of the non-university sector in higher education paved the way for non-degree (at times short duration) tertiary education programmes. The multiple pathways to pursue post-secondary education (PSE) included universities, colleges, technical training institutes, community colleges, nursing schools, etc. The growing social demand for higher education outstripped the fiscal capacity of the state to support the needed expansion. The entrepreneurial public universities, fee levying private universities, open universities and online universities relying on non-state funding became innovative arrangements for financing of higher learning.

The distance education programs attracted a large number of students. Open Universities as separate entities and distance education programmes in traditional brick and mortar

universities became common practices in higher education. The organisation of teaching-learning under distance education programmes varied from their counterparts in the brick-and-mortar system. Soon it was realised, perhaps for the first time, that the cost of provision of higher learning opportunities in open learning systems need not be directly linked to the number of students seeking admissions. The reliance on technology promoted distance education programmes and online programmes transformed the way educational services are sought and provided.

The past two decades have seen an increasing trend of reliance on digital technology in all spheres of life including education. Globally, the percentage of internet users rose from 16 per cent in 2005 to 66 per cent (5.3 billion) in 2022; the same is 92 per cent in high-income countries and 99 per cent among youth in high-income countries. Similarly, the Wikipedia had 244 million page views per day in 2022 (UNESCO, 2023). The reliance on technology provided alternatives to the traditional brick and mortar system of providing higher education. The emergence and fast expansion of Massive Open Online Courses (MOOCs) in the past decades have changed the landscape of higher learning globally. COVID-19 has further accelerated the use of technology in education and the transition of the entire educational process from face-to-face to online and virtual modes within no time.

Higher education became a sector with the highest rate of digital technology adoption and, in many instances, online management platforms replaced campuses. The enrolment in online courses reached 220 million students in 2021. The learning application Duolingo had 20 million daily active users in 2022 (UNESCO, 2023). The adoption of digital technology has not only resulted in an increase in enrolments, but also the way learning takes place. Students gained confidence in skills to navigate the digital world and paper and pen have been replaced by screens and keyboards in the classrooms. The idea that education has always been 'stuck in the past' and is 'slow to change' (Weller, 2022) has been challenged by the technological invasion of the sector. The sector started keeping pace with the digital leaps and adopted technology just like in any other sector, including the knowledge sectors of the corporate world.

The advent of technology-mediated higher learning has challenged the traditional universities and their modes of curriculum transactions. The survival of universities depends on their capacity to change and transform to offer flexible pathways for higher learning. The students, in the future, may opt for multiple flexible modes, switching between on-campus, blended and fully online modes of delivery of study programmes and courses.

Further, the credit transfer facilities expanded the opportunities for students to opt for courses from different departments of the same university and of other universities to acquire the total credits required for the award of a degree. The students may register for one long-term study programme with courses offered by different institutions and in varying modes and follow simultaneously several short-duration online programmes. It is probable that a student may graduate with a degree along with many short-cycle credentials from different institutions acquired through multiple modes. Online courses and fully accredited online universities may become a substitute or supplement for institution-based higher learning and skill formation.

Artificial intelligence (AI) is the latest technology to enter to transform education. AI involves the application of computer science through algorithms to process large data sets to help solve problems. Several countries have evolved national AI strategies to integrate AI in teaching and learning. Global surveys have shown that several countries have developed and implemented AI curricula. Further, the national plan in countries such as Singapore integrates the AI Strategy and the EdTech Plan (2020–30) and it prioritises AI for personalising teaching and learning through national learning platforms (UNESCO, 2022a). AI has gained new impetus after the release of ChatGPT and its use in higher education is expected to be increasing. In short, AI is redefining the landscape of higher learning with unlimited possibilities, which were not foreseen in the past.

Technology is changing the face of learning; technology is making access to learning more open and transforming students into more efficient and faster learners. It becomes impossible for anybody to keep away from personal computers, internet and search engines, mobiles and smartphones and social media, which are transforming the way people learn, work and live. The pace of change is unrelenting and the boundaries between the real physical world and the virtual world are becoming blurred. Recognising these changes and internalising these new forms of learning opportunities are far better options than remaining in doubt and hesitating to be a part of the change induced by technology.

This document attempts to capture the changing landscape of education in the context of technological changes. It is organised in seven chapters.

Chapter 1 discusses the changing context of higher education, focussing on the expansion, diversification and massification of the sector and new directions of change as envisaged in NEP 2020.

Chapter 2 tries to capture the evolution of modes of delivery of higher education from face-to-face to distance mode, online delivery modes and online learning platforms, and challenges posed by the inequalities in access to digital technology.

Chapter 3 discusses the crucial role of teachers in transition to digital technology in curriculum transactions. It also highlights the inevitability of moving towards virtual classrooms and evolving institutional strategies for online learning.

Chapter 4 focuses on the effect of technology mediated education on student learning. It analyses inequalities in access to technological devices, lack of training among students to use technology effectively and assessing and monitoring of student learning.

Chapter 5 discusses equity concerns when delivery and teaching learning process rely heavily on technology. The chapter observes that access to education is at times constrained by the availability of technology and the inequalities in learning outcomes are widening.

Chapter 6 is on the governance and management of online courses. The regulatory bodies in most countries have revisited regulations regarding offering online courses. The UGC in India has brought out regulations on distance education, online education and the reliance on AI in higher education.

The final chapter tries to draw some conclusions from the discussions in the previous chapters.

One

The Changing Context of Higher Education

1.1. Evolution of higher learning

The early universities were derived from the monastic learning schools of the medieval period. They relied on teachers and books as the main sources of knowledge and information. Books were rare and precious material possessed by the elite and education was confined to the privileged. Today, abundance of information, both from the print media and electronic media, is available at no cost or at affordable costs. Internet has revolutionised information dissemination and learning. Ever since personal computer was bestowed the 'man of the year' status by the Time magazine in 1982, its popularity and dominance in communications remained unparalleled. Education sector is a beneficiary of this communication revolution brought about by the information technology. The wide use of technology and the transition from face-to-face to online education made learning a global phenomenon at an affordable cost. The active participation of top-ranking universities such as Harvard in the delivery of online courses at no cost made online courses popular and a credible substitute for the brick-and-mortar system. The wide range of flexible learning opportunities provided by the technological advances are unprecedented and they expanded the scope, opened multiple pathways for higher education and profoundly changed the educational aspirations of millions across countries.

The evolution of educational technologies indicates that even a slow changing education sector has undergone dramatic transformations in the past decades. The Chalkboard technology came around 1890 and was followed by the pencil in the 1900s. Radio education in the 1920s and 1930s sparked an entirely new wave of learning and in a new format – classes on-air for anybody. The televisions in the 1950s accompanied by facilities for overhead projectors, video tapes, headphones and photocopiers further transformed the means and access to higher education. The introduction of hand-held calculators in the 1970s revolutionised classroom transactions, especially in the teaching of mathematics. The next on the list to drive changes were computers.

Technological changes and innovations from the personal computer to the internet and search engines, to smartphones, to social media and natural language models – are transforming the way people live, learn and work in society. The boundaries between the physical world and the virtual world are becoming porous. People need new skills to navigate the changing economies and societies, and to make the most of opportunities. The explosion in demand for skills to navigate the changing aspects of digital technology poses a major challenge to education and training systems.

Technology is going to change the pace of learning by transforming the youth into smart and fast learners. Naturally, like any other change, this transformation is also welcomed with hesitation, uncertainty, and doubt. The pandemic reinforced the reliability of technology as the only alternative to sustain learning and many transitions that happened during the pandemic continue in the education sector. Embracing this change and understanding the directions of change brought out by technology are the ways to prepare for the future – people to learn and organisations to gain a competitive advantage over others in the future. Even the risk- averse academic institutions, such as universities, are taking risks and changing very fast.

Higher education institutions play a key role in supporting national technological development. First, they create a pool of professionals proficient in the use of technology to help spread its use in production and education integrating technology in the teaching-learning process. Second, higher education institutions generate knowledge through their research, which forms the basis for developing technology and innovation. Higher education institutions also collaborate with corporate sectors in knowledge creation and technology development. Their engagement in basic research to expand the stock of knowledge is, at times, supported by the corporate world as they are interested in using knowledge to improve their competitive advantage with the firms they are competing with. Given this advantage, it is not surprising that, globally, private enterprises accounted for an estimated 60 per cent of gross domestic expenditure on research and development (GERD) in 2018 (UIS, 2023).

Universities traditionally invested heavily in buildings and infrastructure, then, shifted investment priorities to laboratory equipment in the post-world war period and further to technology in this century. The global investment in educational technology has been increasing to reach a staggering figure of USD 16.2 billion in 2020 (Economist, 2021). Although the US is the largest investor, the fastest growth in investment in Edtech is in Asia, notably, in China and India. These two countries also lead in terms of student numbers in higher education, accounting for nearly 40 per cent of the global enrolment.

1.2. Global expansion and diversification of higher education

While the missing link in development in the early decades of the past century was capital, development today depends on human capabilities and the pace of development relies on the knowledge produced by human beings. The capacity to produce knowledge domestically or to absorb knowledge produced elsewhere defines the potential for national development. Educational institutions are central to the production and distribution of knowledge. While knowledge production can be confined to a limited number of specialised higher education institutions, knowledge dissemination is more widely shared among educational institutions at all levels – from primary to university levels. Empirical analysis indicates that the expansion of schooling and universalisation of learning are necessary conditions for faster economic growth and fairer distribution of the national income.

One of the significant phenomena of the twentieth century, thanks to the expansion of schooling, was the dramatic spread of literacy. The world has moved from mostly an illiterate society to predominantly a literate society during the past century. The global literacy rate increased from 21.4 per cent in 1900 to nearly 56.0 per cent in 1950, to 82 per cent in 2000, and further to 86.7 per cent in 2016 (UIS, 2023). The significant trend in the second half of the twentieth century was the expansion of schooling and education. The student enrolment increased and the number of non-

enrolled children declined dramatically in most countries. The post-colonial initiatives in the newly independent countries and the Education for all (EFA) movement globally from the end decades of the past century have, no doubt, contributed significantly to the expansion of school education in the first instance and it exerted pressure on the higher education sector to expand in the subsequent period. These achievements were mainly the results of the global commitments, national priorities and public investments.

Higher education remained a privilege of the developed countries and of the privileged in the less developed countries in the twentieth century. While it remained a tiny sector accounting for single-digit gross enrolment ratios (GER) in less developed countries till the turn of this century, the sector started growing fast in the past two decades. Global enrolment in higher education increased from 100 million in 2000 to 236.8 million in 2021. An expanded school education, growing demand for skills in the context of globalisation in the modern sectors of the economies and increased engagement of the private sector have contributed to the fast expansion of the higher education sector. The globalisation of the world economies and a growing acceptance that knowledge societies need highly skilled and competent knowledge workers have led to the massification of higher education systems with a dramatic increase in enrolment in the sector (UNESCO, 2022a). As of now, higher education is universalised in developed and upper-middle-income countries, massified in the middle-income countries and remains mostly an elite sector in the least developed economies of the world (Varghese, 2022). It is increasingly recognised that higher education can become a significant divider contributing to widening inequalities when opportunities to pursue higher learning are not equitably distributed. The rights-based approach implies the need for expanding education by extending access to all based on the capacity to pursue higher learning.

Global expansion of higher education

The first two decades of the post-world War period experienced a fast expansion of higher education in developed countries. It was a period of laying the foundations of higher education in many of the less developed countries, especially those

which were freed from the colonial regimes. The expansion of higher education came to an almost halt in the developed countries in the 1980s when enrolment declined in response to fiscal crisis. Many countries responded to the budgetary cuts to higher education by curbing enrolment. This decline in enrolment was short-lived and the decade of the 1990s was a period of revival for the higher education sector in the developed countries as they have been recovering from the cutback management measures (Pratt and Silverman, 1988). This century experienced further expansion of the sector in most countries.

This century experienced a fast expansion of higher education worldwide. In the past two decades, the global enrolment in higher education increased from 100 million in 2000 to 236.8 million in 2021, accounting for an annual increase of more than 6.5 million students. This massive expansion was accompanied by increasing diversification as was experienced in the previous decades. The more important dimension was the increasing role of the private sector in the fast expansion of the sector. The proliferation of providers and modes of delivery, diversified study programmes and increasing student diversity is also accompanied by reliance on non-state funding.

Although higher education is a powerful enabler, it can become a significant divider when opportunities to pursue higher learning are not equitably distributed. The International Education 2030 Agenda and the Sustainable Development Goal 4 encourage countries to develop well-integrated education systems that provide learning opportunities and flexible pathways for all students to ensure 'leave no one behind'. The technology-mediated provisions make institutional affiliation virtual and very often beyond the confines of any national boundaries. The 'net generation' prefers to access study programmes as per their liking and study at their own pace. In other words, technology is reshaping the landscape of higher education and is posing challenges to the traditional brick-and-mortar framework of imparting education and conventional face-to-face classrooms.

New ways of learning, highly diversified providers (including the emergence of private providers), distance and online learning, international joint degrees, cross-border higher education, transnational education, offshore education, borderless education as well as increasing academic mobility have direct implications on delivery, certifications, and quality assurance. The pressures to reform higher education policies and systems and to rethink institutional priorities have thus been immense (UNESCO, 2022).

Diversification of the higher education sector

The expansion of higher education is accompanied by diversification of the sector. Expansion was faster in those countries where higher education was diversified (Varghese, 2012). Initially, higher education was mostly identified with universities since they were the main channels for imparting higher learning and training. The land grant-universities in the US and the emergence of nation-states in Europe prioritised the role of universities for national development. The universities were relied on to meet the increasing demand for professionally trained civil servants to manage economic and social development. The universities met these expectations and developed an academic culture common across countries.

The establishment of a research university in Berlin by Wilhelm Von Humboldt changed the orientation of universities. Research became an essential part of universities and this model of universities as institutions focusing on research and teaching were widely accepted as the framework for the development of universities globally. The German universities were the first to start research and study programmes leading to the award of doctoral degrees in the 19th century. The purpose of research was to support industrial development and hence the physical and natural sciences became important areas for university research and doctoral studies in the initial stages (Subramaniam, 1999). For example, traditionally, the largest investment was in infrastructure on most university campuses was followed by investment on the university library. From the second half of the previous century, the investment priority shifted to laboratories and equipment and it was expected to support the production sectors to promote national economic growth. The heavy

investments in technological equipment were a phenomenon from the last decades of the previous century.

Universities in the less developed world have been mostly a phenomenon of the post-colonial period. The primary objective of the establishment and expansion of the universities in the post-colonial countries was to nationalise development. Nationalising development meant the replacement of foreign nationals and production of skilled national workforce to meet the growing needs of the public sector to manage the economy and develop an educational system rooted in national ethos and domestic priorities. Universities became a symbol of national pride and a sign of self-reliance (Coleman and Court, 1993) in newly independent countries and they were relied upon for curriculum development and trained teachers at all levels of education.

The demand for trained workers increased with the expansion of the public sector in the post-independent period and diversification of economic activities, following the strategies of development adopted by the less developed countries. However, with a decline in employment in the public sector, it became clear that the graduates with academic training provided by the university had less acceptability among employers and universities had limited capacity to produce trained workers in large quantities as per the requirements of the diversifying economy. Households were less willing to invest in long years of education leading to a university degree, which had less premium in the employment market. It had two implications for higher education. First, the demand in the labour market was for skills, which required short-duration programmes that helped the students to acquire more practical skills instead of academic training.

Two, the diversification of the economy, the decline in public sector employment and the demand for vocationally skilled people necessitated a workforce with skills different from those produced by the universities with specialised academic curriculum. The limitations of the university sector to respond to the skill requirements of the economy necessitated looking for skill-inculcating institutions as alternatives to universities. This marked the felt need for creating a non-university sector to offer vocational and professional courses (Grubb, 2003; Varghese, 2012). Thus, the idea of higher learning expanded beyond the universities and higher education became identified with education in the universities or non-university institutions.

With the proliferation of the non-university sector, the university lost its monopoly as the only institution offering higher education. The more appropriate term describing higher education became tertiary education (OECD, 1998). Later, it was found that short-duration skills-based programs offered by the higher education institutions included non-tertiary level instruction and, hence, Post Secondary Education (PSE) came to be a more commonly used term. Diversification can be seen in terms of many different institutions offering opportunities to pursue PSE, as well as very varied study programmes, student backgrounds or kinds of clientele, and different forms of ownership and control of provisions (Teichler, 2008). It is also evident in structural and cultural aspects linked to institutional missions or academic programmes (Fairweather, 2000). Institutional differentiation in the provision of higher learning in the context of increasing diversity of the learners became necessary and it complemented the emergence of non-university sector institutions. Those from non-traditional social backgrounds preferred enrolling in short-duration skill oriented PSE programmes to long-term academic degree programmes.

The division of labour is such that universities have been oriented to academic core, offering study programmes and research, leading to the award of degrees including doctoral degrees. The non-university sector include institutions, which focus on professional education and vocational training and are less engaged in research or awarding research degrees. In many countries, the non-university sector emerged by upgrading existing colleges and vocational institutions. The *Fachhochschulen* in Germany, the *Instituts Universitaires de Technologie* (IUTs) in France, the polytechnics in the UK and community colleges in the USA are examples of non-university sector in higher education (OECD, 1973; OECD, 1991).

While public universities remained the mainstay in most countries, the emergence of non-

university sector also encouraged private players in the sector. In the later decades, the sector also witnessed the emergence and expansion of private universities in many countries, especially in the less developed countries. The non-university sector institutions in the private and public sectors offer vocational courses, professional courses and short-duration courses many of which may not lead to a university degree.

It can be seen that diversification of the sector implied institutional diversification for provision, diversification of study programmes, sources of financing and student diversity. The emergence of non-university sector broadened the institutional arrangements for higher learning. Higher learning is no longer identified with a unitary and university structure only. Non-university higher education institutions, such as universities of applied science, colleges, institutes of technology, and polytechnics focus mainly on professional and vocational education. The non-university sector, which was initially called short-cycle higher education (OECD, 1973), later became an alternative to university education (OECD, 1991). Non-university institutions (NUIs) were either short-cycle multi-purpose institutions, such as community colleges, or short-cycle specialised institutions offering vocationally-oriented short duration courses in a few selected subject areas. In some instances, there can be 'binary' structures where both universities and NUIs award degrees as used to be the case with Polytechnics in the United Kingdom and binary systems in Canada, Germany, and the Netherlands (Goedegebuure and Meek, 1997).

Terms such as tertiary education and PSE became more commonly accepted and they included both university and non-university sectors of higher learning. The learners of tertiary institutions were more diverse in terms of their social backgrounds, motivations for pursuing education and subjects chosen for studies (OECD, 1998). PSE includes a network of institutions to deliver the varied levels and types of skills required by a diversified economy. Universities, colleges, technical training institutions, community colleges and nursing schools are all part of the PSE. The diversification of post-secondary education involves the diversification of providers, programmes, clientele, and sources of financing. PSE has two distinct components, namely, tertiary and non-tertiary education. Tertiary education refers to all programmes offered at ISCED levels 5A, 5B, and 6 (OECD, 2008) which will lead to the award of a university degree. Non-tertiary PSE refers to all programmes offered at ISCED level 4, which will not lead to a university degree. These developments also indicated that there are multiple routes and flexible pathways for higher education.

In many countries the private sector was (and is) more active in providing non-university PSE education than public funded institutions. The social demand for PSE continues to grow even without public funding support because households are willing to invest in these courses since these programmes are perceived to be aligned with job market. In other words, the expansion of higher education in the present phase of development is not limited to studies for degree programmes and is not constrained by state funding. The next stage in the diversification was the emergence of distance education programmes. The brick-and-mortar system was reaching its limits of expansion and the end of its monopoly as the sole avenue for higher learning. The emergence of distance education programmes further diversified the channels of provision.

Distance education and online courses

The demand for skills in the production sectors continued to increase but the demand for skill acquisition was more from new groups than from the traditional groups. With fast-changing technology in the production sectors, the skills of those employed became obsolete within a few years and, hence, there was a demand for skill upgradation by those who are already employed (WEF, 2023). Unfortunately, those employed were not able to attend regular classes offered by the brick-and-mortar system either in the university or in the non-university segments. In other words, the existing organisational arrangements were not able to provide further education to those already in employment and those who would like to get into labour market because of economic compulsions, including those who would like to continue

studies and jobs simultaneously. The alternative was distance education, which did not mandate compulsory attendance in any institution.

The demand for distance education, initially, was mainly for vocational skills. Expanding the base of vocational training to workers through distance education met the requirements of skill demand from the employers and the prospective employees. It is interesting to note that the first distance education course was in shorthand, offered by Sir Isaac Pitman in the 1840s. The technology relied on for distance education programmes changed over a period of time and it kept pace with the availability of new forms of technology. The distance education programmes, initially, were in the form of correspondence education relying on postal services followed by a reliance on radio from the 1930s. The courses offered through radio declined in the 1950s when television became popular and common among the households. Although the first Open University was established in South Africa (UNISA) in 1916, the Open University system as an alternative to the brick-and-mortar system of education emerged only with the establishment of the UK Open University in 1969.

This century experienced a fast expansion of the open learning systems and the technology relied on also changed. The new and fast-moving form of alternative provision was online learning. In many instances, face-to-face learning is supplemented or substituted by online or blended learning. The emergence of new modes of provisions such as MOOCs and other technology-based provisions diversified the channels of provision and changed the landscape of higher education. Unlike the university system, there are alternative pathways for higher learning through multiple channels or a combination of alternative delivery systems.

The online education opportunities have widened the scope for seeking flexible pathways for higher learning, especially at the post-secondary levels. Some of the limitations of the brick-and-mortar system gave scope for expansion of the online education. The rising cost of face-to-face college education is an important factor deterring many from pursuing higher learning. At the same time, the rate of returns on higher education over secondary education continued to be positive. This gave an incentive to students and households to invest in higher learning. Many students, especially in the US, relied on student loans, which was also drying up for many aspirants of higher education. These factors positively contributed to the increased demand for distance education and online education.

Some claim that online learning will be able to provide a world-class education to anyone, anywhere, and anytime as long as they have access to internet. Some of the companies offering online education are also expanding their operational areas. For example, Khan Academy, Udacity, edX and Coursera are some of the most prominent and well-respected companies created to expand online learning and MOOCs. The digital revolution – including the emergence of artificial intelligence, the rise of web-based education and training and big data developments – has an impact on higher education (UNESCO, 2022a). The expansion through the online mode is also large and, at times, massive. As indicated earlier, the Coursera platform alone enrolled 20 million students in 2021.

1.3. The expansion and Massification of higher education in India

India accorded high priority to higher education since its independence in 1947. Higher education was seen as a critical input in the country's efforts to assert self-reliance and support economic progress. Accordingly, the first Commission appointed on education in independent India – Radhakrishna Commission – was on higher education. The recommendations of the Commission laid the foundation for higher education development in India. India adopted a planning framework and a public-sector-led strategy of development in its economic and social sectors. Higher education was seen as an important element in framing the strategies for development and the sector was supported by public policies and funded through public investment.

The priorities for investment in higher education reveal that they were closely aligned with national development. India established agricultural universities, medical colleges and specialised institutions such as Indian Institutes of Technology (IITs), Indian Institutes of Management (IIMs), and Regional Engineering Colleges (RECs) to support economic development. With a view to expand higher education with equity, the country established several institutions of higher education (colleges) with the support of public investment. These initiatives helped the development of agriculture, industry and technological advances.

This strategy of public investment and provision of high subsidies in the sector helped in expanding the higher education sector in India. There was a sudden spurt in enrolment in the first two decades of planned development in India. Enrolment in higher education institutions increased by 10 times – from 0.2 million in 1950 to 2.0 million in 1970 (Table 1). However, this momentum in the rate of growth in enrolment could not be maintained in the subsequent decades. By the turn of the century, the higher education sector in India remained a tiny sector with an enrolment of 8.8 million students and a gross enrolment ratio (GER) of 8.1 per cent. In other words, in the first fifty years of planned development (between 1951 and 2001) when public sector investments were the driving force behind the growth of the sector, the expansion of the sector was relatively slow and GER was low.

Table 1: Higher Education Expansion in India

Year	Total	Colleges	Enrolments (in millions)	GER (%)
1950-51	27	578	0.2	
1960-61	49	1819	0.6	1.5
1970-71	102	3277	2.0	4.2
1980-81	132	4577	2.8	4.7
1990-91	185	6627	4.4	5.9
2001-02	260	11146	8.8	8.1
2005-06	343	17625	11.6	11.6
2011-12	621*	34908	28.5	19.4
2015-16	799**	39071	34.6	24.5
2018-19	993**	39931	37.4	26.3
2019-20	1043**	42343	38.5	27.1

*This figure includes others category
**This figure includes others category and Institutes under State Legislature Act
Sources: Varghese (2022); MHRD (several years)

The enrolment scenario changed in this century when India experienced a revival and fast expansion of the higher education sector. The demand for higher education increased; so also the paying capacity of the growing middle class in India. Recognising the role of higher education in the knowledge economy, investing in higher education became an area of corporate interest and household investment. These two factors – corporate interest and the willingness of the household to invest – led to increasing social demand fuelling fast expansion of higher education sector in this century. The social demand for higher education, very often, surpassed the fiscal capacity of the state to finance the sector. The market-friendly reforms in the form of privatisation of public institutions and fast growth of private institutions were the driving forces behind the massive expansion and massification of the sector in this century.

A revival of higher education was reflected in terms of an increase in the number of institutions, student numbers, and resource availability (including non-state sources) in the sector. Between the period of 2001 and 2020, the number of universities increased by over 400 percent or more than four times (mostly private universities),

colleges increased by nearly four times, enrolment over four times and GER by more than three times (Table 1). This massive expansion helped India enter a stage of massification of higher education (Varghese, 2022). In this century, India surpassed the USA in terms of enrolment in higher education and became the second-largest higher education system in the world. With around 40 million students, 1.5 million teachers and more than forty-two thousand higher education institutions (MHRD, 2020), India has one of the largest higher education networks (next to China) in the world.

The massification of the sector is also because of the growth and expansion of private universities and institutions. India has been making efforts to permit the operation of private universities since 1990s. Since a bill permitting private universities to operate in India could not be passed in the national Parliament, many state governments legislated to establish private universities in the decade of 2000s. State legislations were passed and private universities were established in many states and the number of private universities proliferated within no time in some of the states. Between 2002 and 2020, around 328 private universities were established in India (MHRD, 2020). The open learning systems – Open Universities, distance learning in traditional universities and the Indian MOOC platforms also helped in massifying higher education in India.

Higher education in India is mainly undergraduate education, leading to the first university degree (Bachelor's degree). The division of labour in India seems to be that undergraduate education is mostly an area left for colleges and graduate education (Master's and above) is a priority segment for university departments. While the colleges, traditionally, have been teaching institutions, the university departments have been focusing on research and graduate studies. The diversification of the sector has been increasing more at the undergraduate than at the graduate segment of the higher education sector. The increase in the share of certificate and diploma programmes in enrolment from one percent in 2001 to 7.3 per cent in 2020 is a reflection of the expansion of the non-university segment and diversification of the sector. Correspondingly, there was a decline in the share of undergraduate enrolment in the colleges from 89 per cent in 2005 to 79.5 per cent in 2020., even when the expansion of this segment was substantial in terms of student enrolment.

The private sector was active in higher education in India from the 1980s onwards. Their involvement during this period was mostly in establishing self-financing colleges and offering study programmes in engineering, medicine, management, law and other vocational courses, which were employment-oriented study programmes. Although these courses were very expensive, more than ten times more expensive than general courses (British Council, 2014), households were willing to invest in these courses. Therefore, the expansion of these study programmes was through non-state funding and mostly through mono-discipline institutions.

Legislations on private universities were passed in several state legislatures and private universities came into existence from the first decade of this century. The student enrolment increased very fast and the sector experienced high rates of growth – an acceleration in the rates of growth when compared to the trends in the previous decades. The private sector in higher education in India became a dominant segment overtaking the public sector in terms of the number of higher education institutions and the number of students enrolled. It is interesting to note that while the public sector dominated higher education in the first 50 years of planned development, the private institutions dominated the sector in the recent decades and they continue to retain their dominant and influential position in this decade too.

1.4. NEP 2020 and the directions of change in higher education

India announced a new National Education Policy in 2020 (NEP 2020) (MHRD, 2020) to guide education development in the country in the coming decades. The NEP 2020 envisages to universalising higher education, facilitating institutional consolidation, and encouraging

flexible pathways to higher learning by taking advantage of technological developments and introducing new governance structures.

One of the important departures made by the new policy is that, unlike the previous education policies of 1968 and 1986, which focussed on the consolidation of higher education, NEP 2020 makes a welcome recommendation for an expansion of the higher education sector. It envisages that Indian higher education will be at par with the expansion experienced by the sector in the developed countries. The sector is expected to move from a stage of massification to universalisation by 2035. It implies almost a doubling of the GER from the level of 26.3 per cent in 2020 to 50 per cent in 2035. The sector is expected to experience massive expansion in enrolment in the coming years.

At present, the inter-state variations in enrolment are substantial and, therefore, some of the states with low enrolment ratios (GER) may find it difficult to reach the target of universalisation of higher education by 2035. Some other states such as Tamil Nadu have already achieved the target with GER crossing the 50 per cent mark. The GER at the school level is low in some of the educationally backward states and, therefore, these states may find it difficult to enrol larger number of students in higher education institutions unless the school sector expands and the transition rates are maintained at higher levels.

Another recommendation of NEP 2020 considers to classifying the existing institutions into multi-disciplinary institutions – Research Universities, Teaching Universities and Multidisciplinary Autonomous Colleges – to develop world-class Multidisciplinary Education and Research University (MERU). It will also put an end to the system of affiliated colleges and mono-discipline institutions. (Malik and Annalakshmi, 2022). These institutional changes will be accompanied by promoting flexible pathways to higher learning.

The system will promote flexible pathways for higher education. It will allow four-year or three-year under graduate degree programmes, and one or two-year Master's programmes and may permit one to pursue doctoral studies immediately after gaining their first university degree. The follow-up regulations also accorded the same status for degrees awarded through face-to-face and distance modes including online courses. The credit transfer policies and the establishment of the Academic Bank of Credits (ABC) will certainly change the way higher learning is organised in India. Institutional consolidation is another proposal in NEP 2020. It envisages that colleges with less than 3000 student enrolment will be phased out in the next 10 to 15 years period. This is also a difficult target to achieve since a majority of institutions (more than 90 per cent) have an enrolment of less than 2000 students.

In an effort to promote internationalisation, the University Grants Commission (UGC) has prepared guidelines in 2023 for the recognition of foreign educational degrees and the granting of equivalence. This may be applicable to all degrees awarded by universities recognised and accredited in the home countries. These efforts along with credit transfer policies will help promote more collaborations between Indian institutions of higher education and foreign universities and institutions.

1.5. NEP and flexible pathways for higher learning

The NEP 2020 promotes flexible pathways to higher learning. The expectation is that future growth and universalisation of the sector will make it more just and inclusive. India follows a quota system and 49.5 per cent of the admissions to higher education in public institutions. The seats are reserved (Quota system) on the basis of socially disadvantaged groups, such as Scheduled Caste (SC), Scheduled Tribe (ST) and Other Backward Class (OBC). Another 10 percent of seats are reserved on the basis of economic criteria. Thus, the quota system covers 59.5 per cent of the admissions in institutions of higher education in India. This is the national norm. Some of the state governments follow the quota system in admissions, which exceeds the level mandated by the Union government. In addition, the disadvantaged groups are also provided with supportive facilities, such as fee concessions and hostel facilities in the universities.

The affirmation policies have certainly contributed to increased enrolment (Sabharwal et.al 2014; Sabharwal and Malish, 2018). An empirical analysis of higher education development in India shows that regional disparities and economic inequalities in enrolment in higher education have increased, social inequalities persist to be high and gender inequalities have narrowed down, reaching a gender parity index of unity at the national level and in many states (Varghese, 2019; 2022). It seems that the availability of institutions in a state varies from 15 per 100 thousand population in Bihar to more than 50 per hundred thousand population in Telangana, Andhra Pradesh, Karnataka, etc. A closer examination of the regional disparities will reveal that states with a larger share of private institutions experienced a higher concentration of higher education institutions, contributing to the widening of regional disparities in the number of institutions and student enrolment. Since many of the private the institutions opened in the urban areas, operation of market forces in higher education has also contributed to increasing rural-urban disparities in the number of institutions and in student enrolment.

The social inequalities in access to higher education continue to persist even in a stage of massification. While expansion and massification benefited all social groups, the rate of progress varied among the disadvantaged groups. While Scheduled Tribe (ST) students experienced the least gains in their share of enrolment, the Scheduled Caste (SC) students benefited more than the STs. The fastest progress was experienced by the students belonging to other backward classes (OBCs). The data shows that the OBCs increased their share in enrolment in higher education from 32.9 per cent in 2014-15 to 37 per cent in 2019-2020 and the share of students from General category (non-SC/ST/OBC group) in enrolment decreased from 48.8 per cent to 42.7 per cent (Varghese, 2022). It can be argued that the catch-up in enrolment among the social groups is taking place and the single most beneficiary in the catch-up process are the OBCs. The gains by OBCs are mostly at the expense of the declining share of the General category students in enrolment. In fact, the share of the General category students in enrolment declined almost corresponding to the increase in the share of enrolment of students belonging to the OBC categories.

There seems to exist a positive association between levels of household income and enrolment in higher education. A major share of young adults from higher-income groups attend higher education institutions while the same from low-income groups is low. In the year 2017, the GER in the poorest group (bottom 20% quintile) was 12.2 per cent as compared to 44.6 per cent in the highest quintile (80 to 100%). Further, in rural areas, the GER in wage labour households was 63 per cent lower than households where the major source of income was from regular salaried occupations. The data show that economic inequalities in access to higher education are not only high, but have also been increasing (Varghese and Sabharwal, 2022). Higher education enrolment in India is mostly from the highest two quintiles (60-80% and 80-100%) of income distribution.

The gender inequalities have been narrowing down in higher education in India. India reached gender parity in higher education enrolment even though the GER is only around 27 per cent. This is in line with the global trend of achieving gender parity in enrolment at lower levels of GER in higher education than in school education. In most developed countries where higher education is universalised, the GER of females surpasses that of males. Similar is the trend in some of the educationally advanced states in India where the female GER is more than that of the males. It is important to notice that women from the poorest income groups are most likely to be left behind in access to higher education. The gender gap in enrolment in higher education is generally larger in the poorer income groups in rural areas vis-à-vis higher income groups in urban areas. For example, the chances of women from the richest 20 per cent income group getting access to higher education in urban areas is 4.4 times that of the women in the poorest 20 per cent income group residing in rural areas. In other words, these results show that economic status and geographical isolation pose significant barriers to the entry of women to higher education institutions (Varghese and Sabharwal, 2022).

Quality has been one of the important concerns of higher education expansion in India. The fast expansion and massification have posed challenges in maintaining quality in the sector. Indian universities do not appear in the top positions in the World University Rankings, which is a matter of serious concern in the country. India has made several efforts to improve the quality of higher education. The UGC established an external quality assurance agency – the National Assessment and Accreditation Council (NAAC) – in 1994 to accredit universities and institutions of general higher education and the National Board of Accreditation (NBA) was established by the All India Council of Technical Education (AICTE) to accredit programmes in technical education.

Accreditation by NAAC is voluntary and is valid for five years. The progress in accrediting institutions is very slow in India. It seems that only about one-third of the universities and about one-fifth of the colleges have been accredited in the past three decades of the existence of NAAC. Higher education institutions in India have also established internal quality assurance (IQA) cells. It seems these cells mostly collect data on various aspects related to teaching learning and prepare annual reports. The effectiveness of external and internal quality assurance in enhancing the quality of higher education is a matter of debate (Pachauri, 2018) in India.

The other initiatives in India to improve quality include : a) introduction of national ranking (NIRF); b) establishment of institutions of eminence; c) introduction of a new scheme called Pandit Madan Mohan Malaviya National Mission on Teachers and Teaching (PMMMNMTT) launched in 2018; d) NET examinations for entry into teaching profession started in 1989.

The NEP 2020 considers setting up of a meta-accreditation agency called the National Accreditation Council (NAC). The NAC attempts to create a set of accreditors at the regional level. The NAC will accredit the accreditors (the decentralised or regional accreditation agencies) to create a pool or an ecosystem of accreditors. The policy proposes transforming the governance system by setting up a single regulator as Higher Education Commission of India (HECI) with four verticals: for regulation (NHERC), accreditation (NAC), Higher Education Grants Council (HEGC) for funding and General Education Council (GEC) for academic standard. The standard-setting functions will be performed by the Professional Standard Setting Bodies (PSSBs) under the GEC.

1.6. NEP 2020 and technology in education

The NEP 2020 envisages that education and technology will play a mutually reinforcing role in shaping the future of higher education in India. Digital technologies offer a range of applications and tools that enable us to incorporate industry engagement into programme development and course planning. This is instrumental in enhancing the relevance and quality of higher education programmes. Digital transformations in higher education can be vital in shaping shared priorities for mobility programmes between universities within the country and among institutions across countries. The policy makes a serious effort to link the digital India initiatives, and demands emanating from the knowledge economy and the educational sector.

The new technologies involving artificial intelligence, machine learning, smart boards and other forms of hardware and software will change what students learn and how students learn. The policy proposes to set up National Educational Technology Forum (NETF) to provide a platform for free exchange of ideas on the use of technology in enhancing planning and learning in education (MHRD, 2020). It envisages to develop a variety of educational software and content developed by educational institutions, which will be uploaded onto the DIKSHA platform.

With the help of digital technologies, new forms of mobility and new opportunities have emerged. The popularisation of virtual campuses, online classrooms and virtual mobility for students and professionals within and between countries are changing the landscape of higher education. These innovative approaches are not only expanding enrolment within the national boundaries, but also creating new opportunities for cross-border education and enhancing the internationalisation of higher education.

Digital technologies also help establishing a lifelong learning society. It facilitates access to lifelong learning through online and blended learning opportunities for individuals, who did not access brick-and-mortar system of higher education when they were young. The easy availability of large amount of online learning resources, particularly through Open Educational Resources (OERs), is a treasure for those who would like to pursue higher learning. Since the demand for digital skills and competencies is increasing rapidly, it is important to incorporate digital technologies into the national framework for lifelong higher learning programmes.

The technological advances will, no doubt, change the way knowledge is produced and shared among the population. The universities will continue to remain the major sources of knowledge production even when channels of production and diffusion of knowledge are diversified. The universities will also be shaping the collective imagination to design an inclusive framework for economic and social development. In this scenario, the traditional brick-and-mortar universities may survive only by breaking away from their tradition. They need to adopt new technologies and adapt their styles and modes of operation to keep abreast with the technological development.

The generations of doctoral students will remain the backbone for future knowledge production globally and in India. Doctoral studies may remain more like a dominant domain of the traditional university system even when technological intervention in higher education continues to be strong. The probable scenario may be that the brick-and-mortar system will become more focused on long duration degree programmes, enrolling students more for graduate programmes and doctoral studies. The experience around the world also indicates that the main focus of distance and online programmes may not necessarily be on doctoral studies and knowledge generation but more on knowledge transaction even when the doctoral students may be relying on technological interventions and innovations.

The future of universities lies in their capacity to offer flexible pathways to learning (Malik and Annalakshmi, 2022). Studying in multiple flexible modes, switching between on-campus, blended and fully online modes as per the convenience of the learners may become common modes of higher learning. The students may opt for courses from different departments of the same university and from other universities to acquire total credits required for a degree. Therefore, credit transfer will become an important instrument facilitating and promoting credit accumulation from different universities and credit transfer to the ABCs.

While certification will be based on credits, the modes of credit accumulation may be flexible. The entrepreneurial students enrolled in long-duration study programmes in the universities may also pursue short-duration skill based certificate courses from other institutions along with long duration degree programmes. It is probable that the most common model may be the one where the students may graduate with one university degree and multiple short cycle credentials.

The brick-and-mortar universities may lose its hold in imparting job-specific skills. The non-university institutions will be fast expanding their influence and attracting students for skill training. It seems that becoming work-ready may cease to be a good reason to go to a university. Instead, many students may seek admissions in non-university sectors to be trained in employable skills. Online courses and fully accredited online universities may become a common feature to supplement institution-based learning and skill formation.

The COVID pandemic has already accelerated the transition to new modes of learning. Even the worst critics and those who resisted transition to online modes are fast embracing virtual learning facilities. While digital inequality is a topic of discussion, mobile phone-based curricular transactions are breaking the barriers to entry into the digital learning world. The future universities will have less control over the catchment area of their outreach. The challenge will be to maintain equity in the quality of knowledge transaction and social interactions through promoting safe spaces in higher learning.

The COVID pandemic has accelerated the process of technology-integrated education leading to profound changes in teaching methodologies, essential competencies, and assessment methods.

The transformation of the sector was from lecture-based learning system toward problem-based learning methodologies with active engagement of students. This transition from face-to-face to virtual education will have significant implications for changing the landscape of higher learning. These changes will define the skills required by the teachers and students in the classrooms and outside in the coming years. Universities need to invest more and more in designing and developing digital learning methodologies and provide digital learning facilities, tools, and support systems (Krishnamurthy, 2020).

The adoption of technologies has expanded the scope and expansion possibilities of higher education. The multiple delivery modes have created flexible pathways to higher learning. The globalisation process has reduced international barriers to the mobility of higher education services and cross border mobility has increased in higher education. Technological advances have shown that the catchment area of a higher education institution is not confined to its immediate locality or national boundaries. Technological changes have also introduced the need for upskilling on a regular basis. Modern technology has completely transformed the educational system. The internet-enabled classrooms have made education available to anyone who wants to learn anywhere in the world, at any time, on any subject.

The potential of technology-mediated education is high. Unlike the brick-and-mortar-system and traditional face-to-face classrooms, online education does not have any space constraints to accommodate unsatiated social demand for higher education. As of now, there is an infinite amount of learning materials available. The OERs make the availability of learning resources not only abundant but also at low cost or no cost.

Education technology is at times viewed as a threat to the traditional modes of learning. However, now it is increasingly realised that incorporating them into the classroom practices provides students with a new way to better interact and engage with course material. Thanks to the use of technology tools, education is no longer restricted to any building or within the four walls of one's classroom. Teaching-learning has become a globally connected activity. The internet and social media have made information transmission and learning borderless activity. After finding out how technology helps students learn, the teachers can integrate these student practices into lesson plans and help improve the teaching-learning processes and result in enhanced learning outcomes.

India is progressing fast towards digital education as reflected by a rise in the adoption of digitisation by universities and colleges, increasing internet penetration and soaring demand from students. The online education market (higher education and lifelong learning market) in India is forecast to reach ~US$ 5 billion by 2025 (IBEF, 2022). Digital education has benefited significantly from the initiatives by the government to improve digital infrastructural facilities in the country. The government initiatives to provide internet connectivity in the rural areas have a significant effect on the expansion possibilities of digital education in India. It is expected that the number of internet users in India will increase from 622 million in 2020 to 900 million in 2025 and this necessitates technological intrusion to the remote rural areas (IBEF, 2023).

The role of the teachers and institutional leadership is important to bring about changes in the teaching-learning processes and classroom practices. There is a strong need for institutional leadership to mobilise support from faculty members, students, and technical staff to translate these ideas into operational practices. The first step is to provide basic technological facilities by improving the technological infrastructure in the institutions. However, experience has shown that resistance to change is a major constraint in introducing new pedagogical practices and technological orientation in the teaching-learning processes. The successful transformation of higher education will depend on the influence of leadership to overcome resistance to change by the faculty, students and staff to adopt mew methods of teaching learning and new methods of administering courses. It necessarily means dialogues with students teachers and administrators, introducing faculty development programmes and evolving institutional support in the classrooms and in facilitating teaching-learning processes through online mode.

Two

Digital Technology and Higher Education

2.1. Global trends in transition to distance and online education

The education world traditionally was socialised to face-to-face interactions where the teacher and the taught progress together. The emergence of distance education programmes changed this view of education since in the distance mode of delivery the teacher and the taught are separated by time and space. The communications are established by the existing technology. Initially, the print media and postal services provided the possibilities of communication between teachers and the taught.

An in-person institutional association is not mandatory to continue higher learning through distance mode. The technology-mediated provisions make institutional affiliation virtual and very often beyond the confines of any national boundaries. The 'net generation' prefers to access study programmes as per their liking and study at their own pace. In other words, technology is reshaping the landscape of higher education and is posing challenges to the traditional brick-and-mortar framework of imparting education and conventional face-to-face classroom-centred curriculum transaction models.

The infusion of the technologies into higher education was further catalysed by the COVID-19 pandemic. After briefly discussing the patterns of technology usage in global higher education, this section illuminates the expansion of distance and open education, and their intricate interrelationships.

COVID-19 had a devastating effect on the economy, health and education. The *Economist* considered the years 2020 and 2021 as lost years for economic growth – millions were pushed out of schools and the pandemic claimed seven million lives. With the spread of COVID-19, more than 180 countries mandated temporary school closures, leaving nearly 1.6 billion children and youth out of school and it affected approximately 85 per cent of children world-wide. The education sector experienced higher student dropouts, widening learning deficits and increasing student failures. The alternative ways of organising teaching and

learning became a necessity during the pandemic in most countries. Technology-mediated education became the only option available to continue learning. Consequently, online transactions and distance learning became the norm of the day. The digital divide exacerbated the learning loss since millions of students were pushed out of classrooms with no reliable technological devices to transition to online learning modes.

COVID, however, has changed the debate on EdTech from a question of 'if' to a question of 'how'. In a situation when there are no alternatives, the best route is to discuss how to make use of the opportunities provided by technology. Although experience showed that teaching and learning through remote mode is different and challenging compared to face-to-face pedagogy, all were compelled to transition to the online mode of curriculum transaction. In this sense, responses to the COVID-19 pandemic led to educational technology being used for learning outside the school at a pace and scale with no historical precedent. For millions of students, the continuation of formal learning became heavily dependent on technology.

The learning environment was not ready for this swift change in the use of technology. Neither the teachers nor the prospective students were at ease with new devices and their use. Given the limited exposure and competencies, many teachers with access to e-content use it like any other textbook to read from in the class. Some adjustments include shorter and more modular content, more engaging content, continuous feedback, and smaller group online discussions on more open-ended questions. All these point to the urgent need for teacher training to make technology-mediated education a reality and widely acceptable. Having discussed the reverberations of the global crisis on higher education, the subsequent discourse in the section talks about the genesis of distance education, and the incremental shift to online teaching-learning.

The delivery of learning via technology has been classified as distance learning when the teacher and student are separated by distance. Keegan (1996) defines distance learning as a planned learning experience or method of instruction characterised by quasi-permanent separation of the teacher and learner(s). Within a distance education system, instruction occurs through various analogue and digital modalities, such as television, radio, and, more recently, mobile learning and online learning. Traditionally, in such cases, the teachers or educators design learning experiences that match the technology delivery system in order to provide instruction to students.

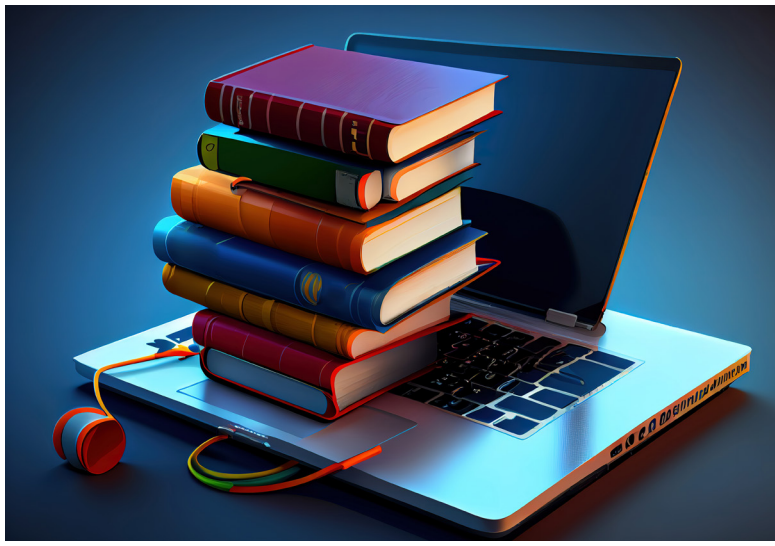
To start with, distance education emerged to compensate for the limitations of the brick-and-mortar system. It tried to help expand the system and to provide relevant skills for its graduates. In a sense, in the initial stages, distance education courses were offered to expand the base of vocational training to workers. As mentioned earlier, the first distance education course was in shorthand offered by Sir Isaac Pitman in the 1840s. The technology relied on mailing texts transcribed into shorthand on postcards and receiving transcriptions from the students in return mail for correction. This early beginning proved extremely successful, leading to the establishment of a phonographic correspondence society and Sir Isaac Pitman institutions for distance education across the United Kingdom. This was followed by establishment of the European institution of distance learning by Charles Toussaint and Gustav Langenscheidt.

The next stage in the change in the technology of distance education was from postal services to radio services. Radios became popular in the 1930s and were relied on for distance education. The advantage of radio was that it was used widely for listening to news and was widespread in its availability, even in rural areas. The notion of 'college by radio' emerged when the University of Louisville in the US, in collaboration with the National Broadcasting Corporation (NBC), developed programmes and disseminated them by relying on radio as a medium for distance education. The 'college-by-radio' became popular in the US, although this popularity was short-lived. The advent of television made it more attractive since one could see the instructor while listening. Since television became commonly available among households and as television education prospered, the role of radio in distance education declined.

The establishment of the first Open University in South Africa (UNISA) in 1916 had limited impact in the initial years. The Open University system was not seen as a credible alternative to the brick-and-mortar system of education and UNISA did not make a wide spread impact in favour of distance education programme. The establishment of UK Open University in 1969 gave a new push, credibility and acceptability to distance education programmes. Following the UK experiment, other countries also started establishing Open Universities. The establishment of the Athabasca Open University in Canada in 1970; National University of Distance Education in Spain in 1972 and FernUniversität in Hagen in Germany in 1974 are examples of spread of Open University system of higher education as an alternative to the traditional brick-and-mortar system. At present, Distance Education Institutes (DEIs) and Open Universities are common in most countries of the world. The enrolment in distance education institutions has been increasing.

The next important development was the online courses and digital universities. The University of Phoenix began to use online technology with CompuServe (the first online service provider) in 1989 even before the World Wide Web came into existence in 1991. The New York University started NYU Online courses in 1998. The first fully accredited online university was St. Jones University in the USA, which was established in 2003. Online education is a story of the past two-to-three decades when early course delivery was through the web-based programme that started in 1994, soon followed by a more structured approach using the new category of course management systems. The emergence of MOOCs and the engagement of Stanford, MIT, Harvard, the University of California–Berkeley, and others have made it a widely acceptable mode of delivery.

The emergence of MOOCs and OER has changed the landscape of technology-mediated higher education globally (Yuan and Powel, 2013). The welcome that MOOCs received surprised everybody. For example, Coursera, within a year of its launch, has attracted 3.1 million users globally, who have registered for various open-access courses offered for free by 62 leading colleges



and universities (Washington Post, 6 April 2013). In fact, the enrolment of nearly 2.4 million learners in online courses offered by Coursera, EdX, and Udacity together in the initial year of 2012 was four times higher than the combined enrolment in Open learning institutions, Open Universities and Phoenix (0.66 million). These enrolments drew students from all over the world and, in that sense, MOOCs really globalised higher education.

The massive expansion of online higher education courses through MOOCs was an eye opener for decision makers and admission seekers. It generated significant interest from governments, universities and commercial organisations to create and extend similar facilities in their own countries and institutions. The public authorities found MOOCs a convenient way of finding an alternative to highly criticised high-cost higher education offered through the traditional brick-and-mortar system. It was estimated in 2013 that the cost of a US bachelor's degree of four-years duration was around $100,000. At the same time, a survey by the Pew Research Centre indicated that nearly 60 percent of Americans believed that the country's colleges and universities were failing to provide students with good value for the money they and their families invest (Caar, 2013). Under these circumstances, MOOCs were welcomed by a large number of students for its low cost, flexibility and perceived relevance and quality.

Investors showed interest in MOOCs and they were influencing policy makers to legitimise the changes to take advantage of the opportunities

provided by the new online platforms, and many public authorities and policy makers responded positively (Levine, 2013). Needless to add, online education opened immense scope for cross border trade in higher education. For example, India accounted for the second largest student enrolment in Coursera programmes after USA. It was, thus, expected that the growth of online courses will increase cross border demand for such courses and it will expand the scope of international trade in higher education (Lester, 2013).

In other words, it can be argued that MOOCs have tremendous potential to change the higher education scene by improving teaching and encouraging institutions to develop distinctive missions that will include considerations about openness and access for different groups of students. MOOCs also provide institutions with a vehicle to think creatively and innovatively and to explore new pedagogical practices, business models and flexible learning paths in their provision (Yuan and Powell, 2013). Some of the studies (Rizk and Hillier, 2022) showed that digital technologies enhance classroom interactions and students with disabilities benefit from the new technologies.

With the popularity of MOOCs, universities and colleges are compelled to rethink how to make their curriculum delivery models and courses truly flexible and accessible. Open courses based on new structures, ways of working and the use of technology can make higher education more cost-effective and accessible and may also contribute to balancing work life, family and social life. More flexible models and open approaches will encourage more mature students to participate in higher education and gain qualifications to further their careers (Carr, 2013).

The leaders of Udacity, Coursera, and edX have not limited their aspirations to enhancing distance learning. They believe that online instruction will become a cornerstone of the college experience for on-campus students as well. The merging of virtual classrooms with real classrooms will be a process of reinventing education and changing the landscape of globalisation of higher education.

The introduction of new technology-assisted learning tools, such as mobile devices, smartboards, MOOCs, tablets, laptops, simulations, dynamic visualisations, and virtual laboratories have altered education in schools and higher education institutions. The future of developments in higher education will also be guided by alternative channels of delivery of educational services provided by educational technologies.

The introduction of MySpace in 2003, Facebook in 2004 and Twitter in 2007 have changed both communication and social outreach. The fast connectivity has branched out from merely a tool of personal communication, to a platform for educational instruction and outreach. Social media is now being recognised as an accepted form of instruction in many instances. Many teachers use social media to communicate directly with their students or to form forum-style groups for students to communicate with each other, and the method seems to be proving valuable in providing one-on-one attention to student's questions and concerns. These changes indicate that the transformation of higher learning with technological mediation has become fast, unpredictable and unimaginable.

Many top-ranking universities started offering online courses and their involvement has enhanced the visibility and credibility of online programs as an alternative or a substitute for traditional face-to-face study programmes. For example, Harvard University is offering more than 600 online courses which are free of cost. The MIT in the US also offers several online courses. Ecole Polytechnique in France is a leading and top-level research institution and it offers 29 online courses. What is surprising is that 19 of the 29 courses offered by Ecole rely on English as the medium of instruction and communication. Michigan State University in the US is one of the largest universities in the country offering a large number of online courses. University College of London, another top ranking institution in the UK, offers many online courses. The Hongkong University of Science and Technology is one of the top ranking universities of Asia offering online courses. Today, especially after the pandemic, online courses have become an integral part of the higher learning system.

It is equally important to see the nature of courses offered by these institutions. Many of them offer non-traditional courses, which were considered impossible to be offered online. The courses and the institutions offering these courses gave credibility to online courses. Needless to add, during the COVID pandemic, a larger number of students joined online classes since colleges and universities were closed. This has helped in expanding the terrain and outreach of online courses. Technology has profoundly changed higher education and increased access to learning opportunities, which is unprecedented in scope.

Correspondence courses

Independent India, initially, followed a policy of cautioned expansion of higher education since it was feared that fast expansion of the system may lead to dilution of quality. However, with the expansion of school education, the social demand for higher education increased and it surpassed the institutional capacity to accommodate all those, who sought opportunities for higher education. Distance education through correspondence courses was considered as an alternative option to expand access to higher education. The Central Advisory Board of Education (CABE) meeting in 1961 recommended setting up a Committee to explore the possibilities of introducing correspondence courses in higher education in India. The Committee recommended the introduction of correspondence courses administered by universities leading to bachelor's degrees. A Secondary School Television Project was launched in 1961 for the secondary school students of Delhi. This is the first instance of using television for distance education programmes in India.

The first correspondence Department/ School was established by Delhi University in 1962. It offered correspondence courses at the undergraduate level – BA and B.Com courses. This experience was followed by other universities and the National Policy on Education in 1968 (NPE 1968) formalised the policy on correspondence courses. NPE 1968 recommended the introduction of part-time education and correspondence courses at the university and secondary levels on a large scale. The policy directive was translated into a plan target in the national Five Year plans. For example, the Fourth Five Year Plan set a target of 15 per cent of higher education enrolment through distance mode (an enrolment of 1.5 lakh students out of the total enrolment of one million students). Many universities started correspondence courses following the example of Delhi University. The correspondence courses, at this stage, relied on postal services to deliver the study materials, answer sheets and other educational services. The distance education programmes (correspondence courses) organised by some of the universities also introduced face-to-face interactions with faculty members occasionally to give lectures, interact with students and support learners. All the distance education programmes were offered by departments established by the respective universities specifically for offering correspondence courses. The universities which offered distance programmes along with regular programmes were referred to as 'dual mode' universities.

Open Universities in India

The next stage in the development was the move towards establishing Open Universities similar to the UK Open University at Milton Keynes. A Working Group under the Chairmanship of Professor G Parthasarathy, the then Vice-Chancellor of Jawaharlal Nehru University, was set up to explore the possibilities of establishing an Open University in India. The Working Group submitted its report in 1975 and it strongly supported the idea of establishing a National Open University. The State of Andhra Pradesh established the first Open University (APOU) in India in 1982 with Professor G. Ram Reddy as the founding Vice Chancellor. In 1992, APOU was renamed Bhim Rao Ambedkar Open University (BRAOU).

India established its first national Open University – the Indira Gandhi National Open University (IGNOU) – in Delhi. The Prime Minister of India announced the creation of a national open university in 1985. IGNOU came into existence with Professor G. Ram Reddy as its founding Vice-Chancellor. Many new Open Universities and Distance Education Institutes came up in India

in the subsequent years. In 2021, there were around 15 state Open Universities, one National Open University (IGNOU) and hundreds of dual-mode institutions offering distance education programmes in India.

Distance education in India was offered in two modes – a paced mode established by the university and a self-paced mode. Most Open Universities in India offer courses in a paced delivery mode, which is similar to the traditional face-to-face mode offered by the campus- based study programmes. Under this pattern, students commence and complete a course at the same time just like a regular course in any traditional university. In self-paced models, the learners choose the time of enrolment and completion at their convenience. For example, NPTEL is offering self-paced courses where learners may progress through the course and complete assignments at their own pace. While paced courses may be offered in synchronous mode, the self-paced courses are offered mostly in asynchronous mode. Institutions that offer both distance and campus programmes usually use paced models since it allows the planning and execution of delivery in a more structured way.

How large is the size of the distance education programmes in India? The enrolment in distance education has been increasing in India. The establishment of Open Universities further increased the size of the segment in the total higher education enrolments. In fact, enrolment in distance education (Open Universities and Distance Education Institutions (DEIs) has been increasing at a rate higher than enrolment in traditional universities and for conventional programmes. According to the Madhava Menon Committee report, the share of distance education increased from 2.6 per cent in 1975-76 to 10.7 per cent in 1990-91 and to 20.56 per cent in 2008-09.

The increase in the number of Open Universities and dual-mode universities is an indication of the popularity of distance mode of education in India. It is estimated that, at present, the distance education programmes account for nearly 24 per cent of the total enrolment in higher education. The Open Universities accounted for 10.3 per cent (2.1 million) of the enrolment in higher education. As per the All India Survey of Higher Education (AISHE) report 2015-16 (MHRD, 2016), more than half of the total students enrolled in Open Universities are in the four Open Universities of Delhi (16.7%) Maharashtra (16.5%), Tamil Nadu (12.3 %) and Andhra Pradesh (8.3%) (Varghese, 2018). Between 2021 and 2022, student enrolment in Open and Distance Learning programmes increased by 41.7 per cent. The new admissions in ODL programmes in 2022 accounted for 2.0 million student enrolments (Times of India, 31 October 2022).

It may be interesting to see the difference between level-wise enrolment in the Open University and traditional university systems. The basic difference is that while traditional universities and colleges predominantly enrol students at the undergraduate level (nearly 90%), the Open Universities enrol a relatively large share (more than 40%) at the post-graduate (Master's level). The enrolment in the courses at the Diploma and Certificate level is high in the Open Universities and they account for nearly one-fifths of the total enrolments. The demand for post-graduate programmes (Master level) offered by the OUs is very high partly because of the limited number of seats available in the conventional system. Similarly, the higher share of enrolment in diploma programmes in the Open Universities in comparison to conventional universities indicates that people are enrolling to improve their employability skills. This is true for the majority of those, who are employed but enrolled in the open learning systems.

It is also important to note that a major share of the distance learners enrolled in post-graduate degree programmes are enrolled in professional degree programmes, such as B.Ed, M.B.A and M.C.A. Those enrolled in Science disciplines in Open Universities are less and same is the case with enrolment for doctoral programmes. At the undergraduate level, B.A. and B.Com. attracted more than 75 per cent of the students. Among the professional degree programmes, the Bachelor of Education (B.Ed.) attracted the maximum number of students followed by the Bachelor of Computer Applications (BCA). Surprisingly, the enrolment in Agricultural courses is very low although Open Universities attract a major share of their students from rural areas.

2.3. Online education in India

The internet has brought about a paradigm shift in the way learning takes place. It has taken learning from classrooms to drawing rooms and mobile phones have taken it to the palms of everyone. The Open University in the UK was the first to offer online distance learning in the early 1990s. The Indira Gandhi National Open University in India was the first to offer online courses in the 1990s.

In 1994, the Indian Space Research Organisation (ISRO) provided a teleconferencing facility at IGNOU in New Delhi for the first time. It provided one-way video and two-way audio communication through phone lines for establishing live interaction for the learners. A number of educational institutions relied on the teleconferencing facility at IGNOU for online courses. In 2000, teleconferencing got recognition as an official education channel under the Gyandarshan platform, which was made available as a Direct-To-Home (DTH) channel.

In 2005, an effort was made by ISRO in collaboration with MHRD and IGNOU to launch an EDUSAT satellite to provide two-way video communication. The success in the initial stages was limited. In the 2020s, online learners have many apps developed for two-way communication. Even mobile phones are sufficient to facilitate two-way communications using several apps.

Today e-learning has become common and popular among prospective students. Online learning has become an integral part of academic life and is perceived as critical to an institution's long-term strategy. Globalisation along with the growing trend of open resources enabled the spread of digital technologies all over the world (Cohen, et. al, 2022). **Educational technology transforms the way we learn. Online learning is becoming a normal learning mode because of the inherent benefits of** technology to accommodate more diverse provisions, more equal access to higher education, more efficient delivery, and more personalised learning processes (Cohen, et.al, 2022). Educational and instructional television played a pivotal role for some time. The origins of the Central Institute of Educational Technology (CIET) and NCERT's role in teacher training during SITE (Satellite Instructional Television Experiment) reflect faith in technology-mediated educational programmes (Sanjay, 2016).

Digital technology for online learning includes electronic tools, systems, devices, and resources that generate, store, or process data. Computers, tablets, smartphones, Facebook, Moodle, online library services, Google, YouTube, Content creation apps, and other apps enabling people to access the internet are part of the technology to access education. The widespread use of computers and the internet have made distance learning easier and faster. At present many distance education institutions in India deliver full curricula online. E-learning applications and processes include web-based learning, computer-based learning, virtual education opportunities and digital collaboration. Content is delivered via the internet, intranet/extranet, audio or video tape, satellite, TV, and CD-ROM. It can be self-paced or instructor-led and includes media in the form of text, image, animation, streaming video and audio.

Internet communication has drastically increased the ability of educators to reach a global scale. The rise of mobile devices has also given online educators leverage to engage students on a personal level while allowing them the ability to interact with their classroom from any location. These advantages provide the student with fully dynamic learning through any digital outlet. The conventional educational institutions are changing. Some of the most prominent universities on a global level are offering online study programmes in a big way. An explosion in online learning, very often free of cost, implies that knowledge is no longer a privilege to be enjoyed by a few, but an item of mass consumption to be enjoyed by millions.

The 21st-century learners are 'net generation learners'. They have their own choices regarding the programmes of study that suit their tastes and employment prospects. These learners are more comfortable with the digital world and look for more flexible forms of learning modes and opportunities. They depend more on online learning resources than on traditional library resources and printed books and materials. The availability of opens educational resources open

innumerable opportunities and reinforces their choices of study programmes.

The role of the teacher is also changing from the provider of information and knowledge to facilitator of online learning. The teacher manages teaching-learning process rather than engages in lecture mode of teaching. The challenge for the teachers as facilitators is to recognise the potential of students and provide them with opportunities to improve their strength and learning skills. This is a transition from improving teaching skills to enhancing facilitative skills to improve learning.

The technology enabled learning such as e-learning, virtual campuses and virtual learning spaces offer students alternative avenues for learning. At present, teaching-learning has become more of a social process of interaction, knowledge construction and collaboration among teachers, students and experts. In fact, teaching-learning has become student-centred or 'learner-centric' and has shifted from a 'transmission paradigm' to 'constructivist paradigm'. The students interact through debates and direct engagement with peers and experts both online and face-to-face. The challenge both in campus-based and online provisions is to provide the new generation with an active and interactive, social as well as constructive learning environment.

There are also instances, where mixed-mode courses, such as e-learning elements replace classroom time. In this case, the online discussions, assessments, and project/collaborative work replace some parts of traditional face-to-face teaching and learning. There are also fully online courses, which allow students to follow courses offered by a university located in one country, far away from their own.

The E-learning programmes, like the correspondence courses, can be synchronous or asynchronous. A synchronous learning process involves the interaction of participants with an instructor via web in real time and supported by media, such as virtual classrooms, audio and video conferencing, chats and shared whiteboards. The most popular synchronous method is virtual classroom that has features of real classroom, but is organised online. In virtual education situations, although the teacher and students are separated by space, they interact with each other online as well as through instant messaging, chat, audio and video conferencing.

An asynchronous e-learning process allows learners to progress at their own pace without live interaction with the instructor. Asynchronous technologies are audio cassettes, e-mail, and message board forums, print materials, fax, voice mail and CD-ROMs. The learner logs on at an e-learning site(s) any time and downloads the study documents or sends messages to teachers and peers any time convenient for him/her. It allows learner to learn according to his/her own pace. The converging trend in e-learning is the promotion of blended learning which, perhaps, improves learning outcomes and reduces dropouts when compared with fully online courses and study programmes.

Since distance education and online study programmes are not part of the traditional system, the regulations governing higher education may not cover online education. The UGC being the Regulatory body in higher education in India has been bringing out regulations and revising them as and when changes were necessary. In 2020, the University Grants Commission brought out new regulations for ODL. These regulations laid down the minimum standards of instruction for the grant of degrees at the undergraduate and post graduate levels and grant of post graduate diploma, through ODL and Online modes. It states that only those degree programmes, which the university has already been offering in conventional mode of classroom teaching or in ODL mode and from which at least one batch has passed out, can be offered online and that programmes requiring laboratory experiment and practical will not be permitted to be offered online.

According to the UGC regulations on 'Credit Framework for Online Learning Courses through SWAYAM 2021, the institutions offering online programmes should have access to SWAYAM or other learning platform for the proposed programmes of study. For managing teaching-learning activities through online support for interactive learning, the institution will rely on OER and MOOCs. An Institution is permitted to offer up to forty per cent of the total courses being offered in a study programme through the online mode. It is expected that at least 60 per cent of learning materials used in e-learning and online courses will be developed by the in-house faculty members of the higher educational institutions and the remaining part of the learning material may be sourced from available e-resources such as OER, SWAYAM or other sources, duly approved by the statutory authorities of the higher educational institution offering online courses. The online programmes will be delivered through the SWAYAM portal or any other learning platform duly approved by the UGC.

The rapid advancements in technology, such as artificial intelligence, robotics, blockchain, internet of things, and nano and quantum technologies have brought out a paradigm shift in education, especially in technology-mediated online education. Institutions are integrating these emerging technologies into their curriculum to ensure that the graduates are well versed in cutting-edge tools and techniques (Rao, 2023). The 'Digital India' and 'Skill India' are among the several initiatives launched by the government to spread digital literacy and skill formation through digital modes in India. These initiatives also add to the momentum to develop technology-friendly skill development, employment market and society.

The 2020s decade represents a transition from the Fourth Industrial Revolution to the emerging Fifth Industrial Revolution. One of the requirements for a successful transition is creating a skill pool relevant to the fifth industrial revolution. This can be achieved only when educational institutions are willing to infuse technology-enabled learning into every aspect of the educational process in a seamless way (Blessinger, et. al 2023).

Between 2021 and 2022, student enrolment in online education programmes increased by 170 per cent and student enrolment in online courses increased from 25,905 to 70,023 (Times of India, 31 October 2022). As per the study by KPMG India and Google (2017), the online education system in India stood at nearly US $247 million with an average of 1.6 million users and was projected to grow to the US $1.96 billion with around 9.6 million users by 2021. The major drivers for online/blended education in India may include: a) phenomenal growth in Internet and smartphone penetration; (b) low cost of online education; (c) digital-friendly government policies; and (d) escalating demand by working professionals and

job-seekers for continuing education through digital mode (Bansal, 2017).

2.4. Indian initiatives to integrate technology and education

Information and Communication Technology (ICT) has made inroads in the education sector in India. The Government of India (GoI) has been active in promoting technology in education. In 2009, the GOI launched a National Mission on Education through ICT (NMEICT) for e-content generation. The Government of India introduced a pilot virtual lab in 2009 and the main one in 2010 to enable undergraduate and post-graduate students (pursuing science and engineering courses) to remotely access the labs and enhance their study experience. The virtual labs offer students a Learning Management System and various study aids such as video lectures, web resources, self-evaluation and animated demonstrations.

According to the UGC regulation of 2018 for online programmes, a higher education institution may offer Certificate, Diploma and Degree Courses or Programmes in full-fledged online mode provided these programmes are duly approved by the academic and statutory authorities and the delivery mechanism conforms to the quality standards of online education as specified under the UGC regulations. With an increase in access to devices like computers, tablets, smart phones and the internet at low cost even in rural areas, the technology can be used to its optimum through online education to increase access and equity in higher education.

The Indian government launched the 'Digital India' initiative in 2015 with an objective to strengthen online infrastructure and expand internet accessibility among citizens living even in remote rural areas. The 'Digital India' initiative also includes the Government of India's e-education initiative to provide online education in remote and urban areas using smartphones, apps and internet services. Similarly, the Government of India has taken several initiatives to provide technology-integrated education at par with the best global online education programmes and has relaxed regulations for the existing universities and colleges to offer extended online and distance learning opportunities to students.

Some of the educational digital initiatives of the union government include Shiksha Vani for widespread use of radio, the Central Board of Secondary Education's (CBSE) podcast, sign language content on the National Institute of Open Schooling (NIOS) website/YouTube and Digitally Accessible Information System (DAISY) for accessing special e-content for hearing and visually impaired learners, and Free Open-source Software for Education (FOSSEE). The government has relaxed the regulations and allowed universities and colleges to extend 20 per cent of the course contents of a degree programme in online mode from 2020 onwards.

India has also developed a MOOC platform named SWAYAM (Study Webs of Active Learning for Young Aspiring Minds) which is indigenously developed. The NMEICT project which started with the objective of e-content development and distribution to be used as OER has been further extended to SWAYAM, which hosts several programmes that can be accessed by potential students. SWAYAM, in a sense, is an attempt to provide students with the best quality study programmes and faculty from all over the country. This would also help the students as well as teachers to update their knowledge and skills which would successfully bridge the gap in access to quality education and would help the nation move towards an information-rich society. Thousands of MOOCs are already running on the SWAYAM platform with a large number of students registered for these courses.

The Government of India established the National Digital Educational Architecture (NDEAR) (as revealed by the budget of 2021-22) to strengthen digital infrastructure and expand online education opportunities in India. Further, the National Educational Technology Forum (NETF) has been conceived as an autonomous body to enable free exchange of ideas pertaining to the use of technology to enhance learning, assessment, planning and administration for School and Higher Education and Skilling Initiatives. Another initiative by the government is the introduction of the PM e-VIDYA programme

in May 2020 to make e-learning more accessible for Indian students and teachers. The programme aims to converge all activities related to online/ digital education and is expected to benefit around 250 million school students. Under this programme, there are initiatives to design e-content for hearing and visually impaired students and offering radio/podcasts and QR-coded digital textbooks to school students (Classes 1 to 12) on the DIKSHA portal. Further, top 100 universities are permitted to offer online courses to provide better learning prospects to 37 million higher education students.

The SWAYAM provided an integrated platform for online courses at affordable costs to all citizens. The portal hosts MOOCs to offer quality education on various subjects for students from Class 9-12 in schools and under graduate and post graduate students in higher education institutions. Another initiative is the launching of Swayam Prabha in 2017. It is a group of 40 DTH channels dedicated to broadcasting educational programmes round the clock.

In 2015, the government launched the e-Pathshala portal to build a resource store for educational videos, audios and flipbooks. Resources on the portal are available in languages such as Hindi, English and Urdu and can be accessed via smartphones, laptops, desktops and tablets. It broadcasts new content for a minimum of four hours every day, and this is repeated five times during the same day for students to select a convenient time slot.

In 2021, the National Initiative for School Heads and Teachers' Holistic Advancement (NISHTHA) Phase II was launched at the secondary level to tailor modules for online education. As per the Union Budget 2021-22, a total of 5.6 million teachers were expected to be trained under the NISHTHA training programme in the year 2022.

Today, technology has made it possible to address the disruptions by providing any learner the opportunity to learn anytime and anywhere, that too, free of cost. The lessons from the best teachers can be accessed online on SWAYAM for free, thereby giving everyone access to quality education at practically no cost. The only requirement is a computer or laptop or tablet

or a smart phone with internet connectivity. For those areas where internet penetration is not very good, the access to open education resources is through Direct to Home channels on the television through DTH Swayam Prabha. As mentioned in the previous section, Swayam Prabha is an initiative of MHRD for disseminating the audio-visual content developed as part of e-content and MOOCs through 40 DTH educational TV channels. These channels are broadcasting educational content in diverse disciplines throughout the day, allowing the students to choose the time of his/her convenience for watching these videos. Content telecast covers all levels of education from school education to postgraduate education. This is particularly useful for areas where the internet is not available or bandwidth poses a major challenge.

2.5. Digital support for online courses

Online education in a country characterised by the digital divide needs to bridge the gaps in: i) digital infrastructure (connectivity, devices and software); ii) human infrastructure (teacher capacity, student skills and parental support); and iii) logistical and administrative systems to deploy and maintain tech architecture.

The digital infrastructure includes hardware and software. Hardware implies a computer – desktop or laptop, tablet and smartphone – with a good amount of memory and hard drive. However, it is not possible to stipulate any quota for the random access memory (RAM) or

central processing unit (CPU) speed. It should have sufficient capacity to accommodate most learning management systems (LMS). At times, mobile devices are relied on and are more widely used than computers for online education. In fact, during the covid pandemic period, large number of students were relying more on mobile devices than laptops or desktops. In many cases, the mobile phone became the only device, which the students could afford since computers were expensive. Further, when there are more than one child attending school or college from the same family, they need more than one computer and it becomes impossible for households to buy them. On the other hand, it may be financially easier for households to procure more than one mobile phone than computers. However, even this proposition becomes too difficult for poor households.

Another equally important part is the Microphone/Spes/Headset to hear audio clips and files. Most computers of recent versions do have built-in speakers and camera facilities. A microphone allows one to participate in audio chats and also to record audio files and post them. A headset will help one to listen privately and without disturbing others, or being disturbed by the surrounding noise. Similarly, having a printer and scanner is useful but not absolutely necessary for most of the courses. A stable internet connection is an absolute minimum requirement. Most of the transactions take place through software programs connected through emails. The E-mail accounts through Gmail, Yahoo, Hotmail, etc. are common among students and teachers.

LMS is a major requirement to facilitate online learning. It refers to the software that can be used to track and store user performance and generate reports on it. It also tracks the amount of time spent by the learner on the course and the contents the learner studied. It also generates progress reports for learners by assessing them. Once a learner registers for the course, the LMS provides all the administrative facilities to the learner. Hundreds of LMS are available in the market. Some of them are commercial while some others are open-source applications. MOODLE is one of the commonly relied-on Open-Source LMS. A related requirement is a reliable content management system (CMS).

CMS is like a database that is used by instructors to store their course content, multimedia, graphics, student records, and other important files. With the help of a CMS, instructors can easily manage their content and keep track of all the data related to their course. The CMS allows easy search through all the content saved in it based on keyword search methods. Content creators or course instructors can navigate, add, update, and delete data with the help of the CMS interface. There are a number of open-source e-learning CMS available to choose from.

Videoconferencing software can be helpful. There are many easily available video conferencing software. Zoom, Google Meet, Webex by Cisco, etc. are some of the commonly available software which can be used for video conferencing. Relying on some of these software involves no cost. Zoom is one of the easily available and widely used video-conferencing software. It also has facilities for conversation and making straightforward text notes which can be used by all participants to write on and it also has the provision of a 'break-out room'. This helps very much in the classroom teaching situations where the teacher can put students into small groups, monitor them, and create possibilities for students' collaboration and team work.

The UGC regulation of 2020 has specified technical support for online programmes as: (a) Technical Team for Development of e-content as Self-Learning e- Modules: (A) Technical Manager (Production) –minimum one (B) Technical Associate (Audio-Video recording and editing) – minimum one (C) Technical Assistant (Audio-Video recording) – minimum one (D) Technical Assistant (Audio-Video editing) – minimum one (E) The technical support required for the development of e-content may be outsourced to the centres across the nation having requisite facilities. (F) These numbers are for the initial stage of e-content, for self-learning e-modules development and delivery.

The regulation also specifies requirements for the delivery of online programmes:

a) Technical Manager (LMS and Data Management) – minimum one (per Centre);

b) Technical Assistant (LMS and Data Management) – minimum two. The

requirements for Admission and Examination for Online mode are: a) Technical Manager (Admission, Examination and Result) – minimum one (per Centre); b) Technical Assistant (Admission, Examination and Result) – minimum two; c) these activities may be carried out by the Admission/Registration and Examination Units of the Open Universities having requisite resources for their ODL programmes under the overall supervision of Centre for Online Education.

2.6. Online delivery modes

The most common learning delivery modes are face-to-face learning, virtual classrooms, online learning, blended learning, and mobile learning. Among these, face-to-face learning is instructor/ teacher-led and implies, the physical presence of the teachers and students in one place. The traditional system of education revolved almost entirely on face-to-face learning delivery system. However, it is limited by space and availability of instructors and it is a very expensive form of organising learning. In general, face-to-face learning or training is preferred where the demand for precision and accuracy is very high and when it involves engagement with sophisticated equipment and machinery. However, this belief is changing since students who graduated during the COVID-19 pandemic period showed that they are equally competent like those who graduated through face-to-face degree programmes. For example, online learning readiness showed a significant positive relationship with online academic performance during COVID-19 (Wang, et. al 2022).

A virtual classroom implies meeting the teachers and the taught online. This meeting will be organised in a designated way. It can involve video call sessions and sharing of teaching and learning experiences with all. This experience can be participatory and all learners do have the opportunity to raise questions, clear doubts and interact freely. More often than not, teaching and learning through virtual classrooms includes the display of presentations, such as PowerPoint presentations and delivery of lectures. The teacher can also divide the students into small groups to work on specified themes and request them to come together to discuss the results. Any student from anywhere in the world can participate in the virtual classrooms, even when they are travelling.

Online learning delivery method or e-learning relies on digital devices and e-content for teaching-learning processes. It may be slide-based classroom interactions, interactive quizzes, video conferences and tutorials, screencasts, simulations, podcasts, and e-books. Learners can access these materials on their PCs, laptops, tablets, and mobile devices. These learning materials can be accessed from anywhere at any point of time. The pace of learning will be decided by the learners (self paced learning by the learner). Unlike face-to-face classes, there is no restriction on the number of students that can be enrolled in any course. The number of students in a group need not be a function of the class size.

Mobile learning is becoming more and more common. Mobile learning has many features similar to e-learning. The difference is that it relies on mobile and other portable devices to deliver the courses. However, the contents provided for mobile learning is digital but, at a given time, the material provided should be small in size and quantity. Mobile learning became quite popular during the COVID pandemic when several educational institutions, both at the school and higher education levels, were closed down and students left the campuses. Many of the households did not have financial capacity to procure computers and it was easier and financially feasible to rely on mobile phones.

Blended learning combines the learning delivery modes of classroom and online learning. It integrates information technologies to provide wider online access and more flexible learning spaces to traditional classroom-based teaching and learning. Blended learning is based on the premise that while classrooms are important sources of learning, a majority of students' learning activities can take place outside the classroom.

It gives learners online access to learning materials to study at their own pace, but it also includes meetings for discussions, group tasks and mentoring sessions. When implementing blended learning, the teachers maintain control over schedules and pace, and students can learn

synchronously. But you also reserve some activities and content for online asynchronous learning and independent study.

Blended learning is becoming effective, affordable and responds to students' and teachers' growing interest in technology-based learning. It has become a popular method of course delivery in higher education for various reasons. First, it provides scheduling flexibility which becomes convenient for those, who cannot attend classes regularly. For students who work full-time and/ or have family responsibilities, the flexible design accommodates their busy schedules. Second, it has the ability to meet the needs of a larger number of students since their enrolment and participation need not be constrained by the availability of space and the number of seats prescribed by the public authorities. Third, it meets the varying needs of the students depending upon their social background, academic levels and learning styles. Fourth, experience shows that dropout rates are lower in blended learning courses than those courses in which are fully online because the time commitment needed for blended learning situations can be flexible.

The blended learning methods give students more freedom of access and interaction utilising online learning technologies along with the traditional classrooms. It combines face-to-face classrooms with live e-learning and self-paced learning. It can be a mix of traditional instructor-led training, synchronous online teaching, asynchronous self-paced study and structured on-the-job training.

Blended learning can be implemented in a variety of ways. It can be a mix of offline and online forms of learning. It may have a learning programme that provides study materials and research resources over the web and instructor-led, classroom sessions as the main medium of instruction. At one extreme, the blended learning can imply that curriculum is fully online with options for face-to-face instruction and interactions. On the other end, blended learning can imply class room instruction that includes online resources with limited opportunities for students to be online. In reality, the instructional practices under blended learning lie between these two extremes.

Blended learning can be self-paced learning – at a pace managed or controlled by the learner. It can be in the form of collaborative learning, implying more dynamic communication among many learners that brings about knowledge sharing. Computers, digital cameras, SmartBoards, mobile phones and iPads have made their way into classrooms. The students in blended courses generally get time gaps between online work time and face-to-face meetings. In general, the online materials are given in advance so that the students get enough time to read, reflect and interact with classmates before they meet in a class room.

There is another notion of blended learning as flipped a classroom model where the traditional lecture is delivered outside of classrooms through video and other web-based materials. The classroom time is used for collaborative project work, small group problem-solving, and other such activities that allow students to engage at a deep level with the content they viewed and reviewed outside of (and before) the class. This model provides faculty with more time in the class to work with individual students and allows students to master the lecture content at their own pace.

The advantage of blended courses comes also from the fact that they provide opportunities for increased interaction between the students and faculty. Some students are more comfortable in communicating with their professors in a digital format via e-mail or online discussion posts. Some of the reviews of online learning opportunities indicate that blended learning is the most commonly used online delivery mode. This is more so in the case of training organised by companies and courses offered by universities.

One of the positive effects of the transition to online learning is that the main stakeholders of the higher education sector, i. e., students, faculty, institutional leaders, and policymakers have gained more confidence, developed a positive approach, and a hope regarding the visible and potential benefits of technology for the teaching-learning process and activities and for the future of higher learning. Ever since online education became common, learning management systems have become a multi-billion-dollar global business,

valued at USD 14.4 billion in 2021 and projected to grow to USD 41 billion by 2029. Although Northern America continues to hold the largest market share, the strongest growth is expected in countries in Asia and the Pacific, including Australia, China, India, Japan, Malaysia and Singapore (UNESCO, 2023). These are the regions with good potential for fast expansion of online education.

2.7. Online learning platforms

Online learning platforms are information systems that provide a learning environment where students can take online courses. The prospective students can search and opt for courses of their liking. Some of these platforms are for sale in the market place. In such instances, one needs to pay for pursuing a course. Some of the popular online learning platforms are Coursera, Skillshare, Udemy, Codecademy, Edx, Pluralsight, Future Learn, and Moodle. Similarly, some of the learning course platforms are LearnWorlds, Teachable, Thinkific, Kajabi, and Podia. Some of these platforms have become big industries running into billions of US dollars.

An online course platform is a type of LMS that a provider can use to create, host and deliver online courses. These courses can be priced or open to all without any payment. At times, the LMS of the universities may include course platforms. There are also higher category LMS, usually used by enterprises for employee training, customer education, and onboarding. However, they include course platforms or even WordPress plugins being used by SMEs to create and sell online courses. Some of these online course platforms can be cloud-hosted software that allows instructors to create online classes or individual lessons by uploading educational material that they have created.

The basic difference between an online course platform and an online learning platform is that the learning platform approaches teaching-learning process from the learner's perspective, while a course-platform approaches teaching learning from the perspective of an online instructor/teacher. From an online course platform perspective, it is a convenient place to sell the course to the prospective customers – the students. The online learning platform, on the other hand, is a place where students can search for course contents, identify the most appropriate course and buy the course by making a payment. Online course platforms are relied on for shopping for courses while learning platform software create a learning environment.

Some of the online course platforms are Udemy, Coursera, Linkedin, etc. Udemy is one of the most popular online course platforms on the web and it offers more than 213,000 online video courses with more than 40 million students and 50 thousand instructors, and subject matter experts creating online courses. Coursera is an online education platform partnering closely with top universities and businesses and has more than 82 million students and participants. One advantage with Coursera is that the students will get certificates from renowned institutions upon joining their paid courses.

The Linkedin learning platform is another educational platform that offers professional courses in business, digital marketing, and web development in the video lesson format. It offers over 16,000 courses in 11 languages and focuses on helping individuals invest in their professional development. Skillshare is another popular course platform with more than 35,000 courses attracting more than five million students. Classes on Skillshare are taught by industry leaders, everyday creatives and professionals and are divided into four categories: a) **Creative arts such as** graphic design, fine arts, cooking, and music production; b) **Technology:** including data science, web design, and e-commerce; c**) Business**: finance, accounting, and project management; and d) L**ifestyle**: teaching, languages, gaming, and wellness.

2.8. Challenges to expand online higher education in India

Online education is welcomed in India. The COVID pandemic opened possibilities for expanding online education all over the world and in India as there were no alternative ways of continuing education of millions of children in the schools and higher education institutions. The transition from

face-to-face to online education was very swift and without adequate preparations in many instances. While it opened possibilities, the swift transition also posed challenges.

One of the major challenges is the availability of digital infrastructure at the school and college levels. In May 2020, the Indian government introduced an initiative named PM e-VIDYA programme as an attempt to make e-learning more accessible to teachers and students (IBEF, 2021). The program aimed to assist 250 million students in strengthening digital education by converging all the activities related to digital learning. The programme included learning designed for hearing and visually impaired students as well. In India in 2016, the value of online primary and secondary supplemental education was estimated at USD 73 million. These initiatives of the Indian Government in strengthening the online mode of education can also be coupled with decreasing drop-out rates, thereby increasing the Gross Enrolment Ratio (GER). In the future, online education can be seen as a hub for quality learning integrated with each stage of formal education.

It is also true that resistance to change is a major challenge. The students are more socialised to traditional classroom teaching-learning processes. And teachers find it difficult to move from the classroom practices they are familiar with. The teaching process relying on technology-demands new skills and orientation. In most cases, the resistance to change is partly due to the lack of competency to manage technology oriented teaching methods. There is a need for more training and orientations of teachers to make them confident to use technology in their regular teaching-learning processes.

Analyse, design, develop implement and evaluate (ADDIE) model has been almost a standard for professionally developed, high-quality distance education programs, whether print-based or online. It is also heavily used in corporate e-learning and training programmes. The model is mainly applied on an iterative basis, with evaluation leading to re-analysis and further design and development modifications. One reason for the widespread use of the ADDIE model is that it is extremely valuable for large and complex teaching designs.

It is equally important that the teachers are given opportunities for training in integrating online learning with face-to-face teaching and learning processes. In the absence of such teacher development programmes, the use of technology in classroom learning situations may remain limited in scope.

Three

Digital Technology and Teachers

3.1. Technology and changing role of teachers

The aim of teaching is to make student learning possible (Ramsden, 1992). Effective teaching involves transmitting knowledge, engaging students and promoting independent learning among students. Effective teachers are those whose subject knowledge is deep, pedagogical skills are good and the ability to manage interpersonal relationships is effective. In the present context, a good teacher is also the one who can manage the integration of technology in the teaching-learning process. The shifts in teaching patterns and styles are from reproductive to productive learning, teacher-centred to learner-centred, content based to outcome based and teaching to learning facilitation (Brown, 2005).

Learning was traditionally seen as a process of receiving and accumulating knowledge in a systematic and organised manner. The constructivist argued that individual learners construct their knowledge through inquiry, interactions and experimentation. In fact, learning is enhanced through collaboration and support. In the digital era, learning through forming connections around information (Selwyn, 2022) gained importance. Technology is slowly but surely changing the teaching profession. In those education systems where technology is widely available, teachers need to adapt their pedagogy, use multiple resources related to the curriculum and assessment, and interact more frequently with students and parents.

Technology has also begun to change the roles of teachers and learners. In the traditional classroom, the teacher is the primary source of information, and the learners passively receive the instruction. This model of the teacher as the 'sage on the stage' has been in education for a long time, and in many classrooms, today, we see the teacher's role shifting to be a 'guide on the side' as students take more responsibility for their own learning using technology to gather relevant information. Schools and universities across countries are beginning to redesign learning spaces to enable this new model of education, foster more interactions and small group work, and use technology as an enabler.

Effective use of education technology by teachers can strengthen the extent to which they can facilitate student-centred learning through project-based activities. Technology provides teachers with a variety of tools and platforms to boost interaction with students and parents. These include online communication tools such as email, messaging applications and discussion forums as well as online platforms such as forums, chat rooms and video conferencing tools. Some teachers also use social media platforms, often on a voluntary basis, to share updates and information with students and parents. Teacher-student interactions using messaging applications were encouraged during COVID-19.

Teachers are increasingly expected to integrate technology into various aspects of their professional practice, including their pedagogy, student assessment, interactions with students and parents, and professional development. Effective integration means enabling teachers to make their teaching practices more learner-centred; creating engaging and relevant learning environments; and preparing students with technological knowledge and skills. However, despite these expectations, teachers receive varying levels of support to improve their skills in ICTs, and use them to teach. Many teachers remain hesitant or lack confidence in using technology.

Teachers in low and middle-income countries have lower levels of access to devices and software. In Punjab in India, nearly eight out of ten teachers reported outdated computers in ICT laboratories and poor internet connections in schools. The most common teacher practice at the undergraduate level in India is the lecture method and the orientation is to equip students to pass examinations (Mandal, 2022). A major share (nearly 80%) of the enrolments in higher education in India is at the undergraduate level. Undergraduate education mostly takes place in colleges while a major share of the enrolments at the graduate level (Master's level and above) takes place in the university departments. Therefore, if any major change in teaching-learning is to take place, it should be at the undergraduate level and in the colleges.

Introducing technology into the curriculum should be accompanied by adequate teacher training and professional practice. Recruiting and retaining qualified teachers in technology-related subjects remains challenging. The colleges in India are rarely engaged in activities related to curriculum development. Curriculum and Syllabus are given to the colleges by the respective universities to which a college is affiliated. It is to be noted that all affiliated colleges under one university follow the same curriculum and syllabus. The college teachers are essentially engaged in curriculum transactions through the engagement of students in the classrooms.

The teachers at the undergraduate level in India face difficulties in organising and facilitating teaching and learning. The class size, very often, is large, especially in the colleges in the urban areas. This is more so in non-laboratory based subject areas, notably, in Arts, Humanities and Social Sciences. This is partly because of the fact that in response to the increasing social demand for higher education, admissions to non-laboratory based subject areas are financially advantageous to expand enrolment. Therefore, public policy may be supporting additional intake in arts, humanities and social science subject areas rather than in science subjects which require investment in laboratory equipment.

A related factor for large class size is the fact that teaching positions in public institutions remain vacant for years; hence, the availability of teachers at the institutional level is declining. The public authorities see these two factors, namely, non-recruitment of teachers and increasing class size, as strategies to respond to financial constraints caused due to reduced public allocation to higher education institutions, especially of the colleges affiliated with state universities. The teachers teaching at the undergraduate level point out that the large class size acts as a major constraint to introducing innovations and new technologies in the teaching learning processes (Snehi, 2020).

After the introduction of the semester system in India, the workload of the teachers in teaching and evaluation of students has increased. The larger the class size, the more the number of assignment sheets to be assessed, which adds to the workload of the teachers. The issues related to class size, namely class management, discipline,

and addressing the needs of diverse student composition of classroom become more alarming. Large class sizes also become a challenge for teacher to engage all students in tutorials, project works and additional co-curricular/extra- curricular activities. Teachers indicate that their priority is to complete course contents and they get limited time to introduce new methods or technology in the classroom practices.

The technological infrastructure available in many undergraduate classes in the colleges is also in a poor state. As a result, the faculty members are not in a position to integrate ICT in teaching learning process. The teachers, during the interviews, also indicated that the use of ICTs in teaching was limited due to the unavailability of relevant e-resources integrated with the curriculum, lack of capacity to develop e-learning material and even lack of interest among teachers to pick up these skills (Snehi, 2020).

Technology intervention in education has challenged traditional classroom practices and teaching methods. There are those who argue that the new technologies and online learning will replace the teachers. This seems to be a farfetched idea. It can be argued that teachers are the single most important school-based determinant of student learning (Hanushek 2011). Teachers still remain central to student learning even in an environment rich with technology. However, this does not mean that teachers will continue to engage the students the way they have been engaging them for years. The teachers need to change their classroom practices to survive effectively in a technology-rich learning situation. The use of technology changes the role of the teacher from a traditional knowledge provider to a facilitator guiding the students' learning processes. It is argued that traditional pedagogy and regulated learning focus on lower-order knowledge acquisition whereas online interactions focus much more on higher-order skills such as application, analysis, synthesis and evaluation (Passey and Lee, 2020).

It is neither possible nor desirable to substitute teachers with technology and it may not lead to enhanced learning outcomes. Students, very often, learn more effectively with direction and learning is more effective through guidance from a teacher. Unfortunately, the working conditions of teachers are poor and many of them work in poorly resourced classrooms in the colleges with limited or no pedagogical support from experts and college administration. The effective use of digital learning tools in classrooms, no doubt, can increase student engagement, help teachers improve their lesson plans, and facilitate personalised learning. What is important is to provide opportunities for the professional development of teachers so that they can change their classroom practices and integrate technology with the teaching learning processes. The future learning environments will be shaped by the teachers' success in utilising new technologies in support of learning.

Technology cannot improve education on its own, but education cannot be improved without technology (Burns, 2021). Teachers do play a role in integrating technology in teaching which is different from the traditional role they have been playing. Schools were conceived in the 19th century as teaching institutions, which underlined the importance and primacy of teachers. In the traditional classroom, the teacher is the primary source of information, and the learners passively receive it. When schooling was an accepted social responsibility of the public authorities, the important area of investment was in teacher salaries. This trend continues even today with a very high share of educational expenditure on salaries.

Technology has begun to change the roles of teachers and teaching-learning processes. The teachers' role in many classrooms is shifting to more democratic norms and a teacher is seen more as a facilitator. With advances in technology, and easy access to technology, students are better informed than students in the previous generations. The students increasingly rely more on technology to gather relevant information and communicate among themselves. These changes infused by technology have tremendous influence on classrooms practices, teaching learning processes and the way teaching learning is redesigned to foster more interaction and small group work and discussions.

Studies have shown that when teachers rely on technologies to support pedagogies, they should be trained in three areas of knowledge, namely, technological, pedagogical and content knowledge (Mishra and Koehler, 2006). An integration of technology into teaching and pedagogy requires a deep understanding of the ways that each one relates to the other. For example, pedagogical orientation in a 'flipped classroom' model (where video or audio is used prior to classroom sessions and in-class discussion and reflection) will be more towards integrating concepts of social and individual students gaining greater autonomy for learning rather than being taught (Passey and Lee, 2020).

These observations do not imply that teacher-centred instruction has been ineffective. The research does not support such a view. A 2018 meta-evaluation of 413 study designs and almost 4,000 effect sizes assessing direct instruction (the most common form of traditional teaching) reported medium effect sizes for reading (0.51), mathematics (0.55) and language (0.54). These results suggest that teaching basic skills and competencies through direct instruction is at least as effective as the best forms of individualised and adaptive instructional systems and approaches (Stockard, et. al, 2018). The promise of educational technology lies in what educators do with it and how it is used to best support their students' needs. Technology for Teaching (T4T) is the World Bank's programme to assist countries in implementing effective, and scalable teacher professional development (TPD) programmes that use low-technology and high-technology solutions to train and support teachers/Pedagogical Leaders (PLs). T4T provides practical tools to policymakers and practitioners for designing and implementing operationally feasible tech-based TPD in their contexts (Quota et. al, 2022).

One of the limiting factors to taking advantage of technology to expand higher education and deepen student learning in colleges and universities is the competency of the faculty members to use technology easily and incorporate it in classroom practices. It is found that the limited technological skills of teachers of colleges and universities are the most formidable barrier to the digital transformation of higher education (Borte et al., 2020). A study in Norway found that technology was most often used to support traditional teaching and that scholarly approaches that promote active pedagogies are lacking (Lillejord et al., 2018). An updated review by the same group concluded that the teachers' professional development is a prerequisite for the successful implementation of technologies in active pedagogies (Borte et al., 2020).

Integrating technology with teaching learning-processes requires the training teachers to upgrade their professional competencies for managing technology-rich classrooms (Misra, 2021). Investment in technology is a necessary step; however, unless investment in teachers in the form of professional development takes place, technology integration will remain a distant dream. Investment in technology hardware is, by itself, not sufficient to reap the full benefits of new technology unless it is accompanied by strong teacher training programmes. It is pointed out by researchers that 'the real [information technology] challenge is people, not products' (Green, 2000, p. 1).

To sum up, digital education requires appropriate infrastructure and technological platforms, solid servers that can sustain the virtual workload, and methodological training of professors and students for online delivery. Technology will neither reap its full potential nor revolutionise higher education if these positive conditions for technology adoption are not put in place at the individual, institutional and educational system levels as a whole. It is generally assumed that older teachers possess fewer technological skills and are less prepared to use technology in teaching. According to the 2018 Teaching and Learning International Survey (TALIS), older teachers in the 48 participating education systems were more likely to have weaker skills and lower self-efficacy in using ICT. Along with age, gender is also sometimes believed to have an impact on ICT skills, as there is the stereotype that female teachers may be less comfortable using technology.

3.2. Virtual classrooms

Technology places the world in the hands of every student inside the confines of your

classroom. Virtual learning platforms are key for streamlining teaching and learning, hosting digital and interactive lesson plans, allowing for communication and launching video chats. A virtual classroom is an online learning environment that allows for live interaction between the tutor and the learners as they are participating in learning activities (Racheva, 2018). A virtual classroom is associated with synchronous online learning and the students experience a similar situation as in the traditional face-to-face classrooms. The learners and teachers in a virtual classroom work together and simultaneously interact together mostly through video conferencing. The virtual classrooms may find tools such as videoconferencing facilities, online white boards for real-time collaboration, instant messaging tools, participation controls and breakout rooms. The teacher has the important role of moderator who guides and facilitates the learning process and supports group activities and discussions among students. The virtual classroom is synchronous and it allows for instant feedback, direct teacher-student interaction, and student engagement activities that ensure increased participation.

A virtual classroom is characterised by some of the following features:

a) ***High interaction:*** The success of a virtual classroom is its interactive nature where the teachers and students are participate in the teaching-learning process. The interactions may be between teachers and students, among students and between teachers, students and curriculum. The brainstorming sessions, small group discussions, group work, individual tasks, Q&A sessions and hands-on experience are modes to increase, enhance and improve learning in a virtual classroom.

b) ***Collaborative learning*:** Collaborative learning means that the learners work together, exchange views and clarify the meaning of concepts and solve problems together. These interactions and learning together help in developing the collective construction of knowledge using the virtual classroom group as a source of information and a means of mutual support.

c) ***Student-centred Instruction*:** The lecture is the most common and traditional format for teaching where the focus is on the

contents and the students are mostly passive participants. In asynchronous virtual teaching the tutor creates video lectures and self-directed activities, which the learners learn on their own and at their own pace. In synchronous virtual classes, the teacher creates opportunities for both independent learning and learning from one another, and guides the learners in developing and practicing the skills they need.

d) ***Blending different types of learning activities*:** The presentations and learning activities in the virtual classrooms take into account the diversity of the student body and their varying levels of learning. It also takes into account the special needs of individual learners. In this sense, virtual classes can help in the creation of more personalised learning even when learning is a collaborative activity. The use of text, images, diagrams, audio and videos provide flexible learning modes tailored to the needs and preferences of individual students. Similarly, switching between individual work, small group collaboration, and class discussions also addresses the varying learning preferences of all the students.

e) ***Psychologically safe environment*:** Interactions in a virtual classroom create the sense of a more informal and safer emotional environment as the learners usually participate from the comfort of their homes. Psychological safety leads to better learning outcomes. It also fosters creativity, confidence, and a willingness to experiment on the part of the learners. The virtual teacher also has a crucial role here – they need to encourage safe discussions, mutual respect, equal opportunities to participate, and free sharing of different viewpoints. The teacher can enhance the psychological safety of the learners and make things more personalised by adding options for self-directed learning, as well as by communicating more frequently with every student through a Learning Management System.

Online courses can be asynchronous. Asynchronous courses are those which allow students to view lectures, access materials, and collaborate with teachers and peers according to their own schedule. Lectures might be pre-recorded or presented on a programme and the delivery methods allow students to review and re-review lessons as necessary. These options could be quite helpful to students who cannot attend scheduled sessions, hope to minimise live group projects or discussions, or want to work through lessons at their own pace. Programmes that use asynchronous content delivery methods require a different approach to teaching—one that depends heavily upon the technologies used. As with synchronous instruction, characteristics like class size and instructor preferences can influence which tools are used in an asynchronous class.

3.3. Instructional strategies for online learning

Many institutions of higher education have technology-rich learning spaces and classrooms which are engaged in diverse activities. Technology supports the learning process by engaging students in an interactive process in the classrooms, both traditional and through promoting a shared learning experience. Through continuous usage and experience, teachers rely on technology and students use educational technology to support their learning. Over a period of time, technology has become an inseparable part of the learning process among the students.

Instructional strategies include lectures, discussions, demonstrations and simulations.

Lecture: Lecture is perhaps the most commonly found instructional strategy irrespective of the mode of communication. It is equally relied on for face-to-face instruction and online courses. The LMS permits instructors to record lectures or deliver them live. As is well known, the lectures keep students in a passive role and student engagement in this mode of pedagogical practices is limited even when discussions are finding a place in the classroom sessions. However, a common practice found increasingly acceptable is that online lectures are not the only mode and they are relied on in combination with other instructional strategies.

***Discussions*:** Discussion is a very effective form of learning process. It helps interactions with teachers and students and among students. It engages students and also helps them to socialise by speaking, developing an argument and helps in understanding the concepts clearly and aids in maximising collective learning. Whether used in conjunction with lectures or as a separate learning exercise, classroom discussion supports learning and actively engages online students in the learning process. There is scope for wider use of discussion as a mode of learning strategy so that the curriculum is reinforced among students.

Language competency is an essential requisite to promote discussions. It needs to be noted that all students may not have the same level of language proficiency and articulation capacity to participate actively in the discussions. In many instances, language competency is an important constraint to participate in classroom discussions. Students from rural areas and those following a different language of communication at home may find it difficult to participate in the discussions along with those who are more proficient in the language of instruction. In such a situation, a limited number of students take advantage of the opportunity and try to dominate classroom discussions. This is not a healthy trend for active learning. The teachers have an important role in ensuring that every student is encouraged to participate in classroom discussions. It is found that over a period of time, even those reluctant students begin to gain confidence and engage actively in classroom discussion. It is also observed that student participation in discussions is higher in smaller groups. In synchronous modes, teachers pose questions and discuss course material using real-time chats and web-conferencing tools. Students enrolled in asynchronous classes tend to communicate with peers and instructors using discussion boards, web forums, and social media tools.

***Demonstrations*:** Demonstration is a part of teaching and learning in all modes of learning – face-to-face and e-learning situations. For example, role-playing is an accepted and appreciated mode of classroom interaction. Demonstrations are very helpful to conveying certain concepts which are relatively abstract. Teachers, in the online situation, very often upload recorded video demonstrations to the LMS for instructional practices. The advantage of recorded demonstrations is that the students can see these clips again and again till they master their understanding of the concept or lesson.

***Simulations*:** Simulations help online students practice practical skills and learn to use them confidently. Simulations are used quite often in online learning situations to train students for field-work situations, to train them to conduct interviews and group discussions while in the field. Among the disciplines, it is mostly the engineering, medical and management studies that use demonstrations and simulations more often as an aid in the teaching learning process. Simulations are very useful to pick up competencies in decision making. With advances in technology use in teaching learning, it is easy to use simulation exercises.

Simulation exercises in online courses are relatively easy nowadays since technology can help to avoid the tedious process of preparing simulation exercises. The LMS platforms can help teachers to choose from a variety of scenario that complement course content. Nowadays, the higher education teachers also rely on OERs to identify simulations that fit well with the courses they have developed and offered.

It can be seen from the discussions that technology offers opportunities not only to students but also to teachers provided they are ready to change their mind set. Technology allows teachers to customise teaching learning and in ways different from what was possible a few years ago. It can support them in their teaching efforts and simultaneously the students to adapt to the most suitable strategies for better learning.

3.4. Student assessment in online learning situations

Assessment attempts to measure, with a certain level of reliability, the extent of student learning. The focus in assessments shifts from how well a teacher teaches or how well the student learns what he/she is supposed to learn. The results from assessments are relied on for

improving learning, if assessment is an ongoing activity along with learning, or for certifying, if it is an end semester or end of the year exercise. Assessment reassures the teacher and the system that the learning outcomes indicate that the learning objectives are achieved.

In one of the recent surveys of past, present, and prospective online college students, (Magda and Aslanian, 2018), it was found that 74 per cent of online college students are pursuing their programmes for employment or career-focused reasons. This has two orientations – entry into a job and upgrading the skills required for their current job as per the changing circumstances of skill requirements. These students need to be assessed on the basis of skills acquired during the study programme. This can be facilitated by resorting to three types of assessments – diagnostic assessments, formative assessments and summative assessments.

The purpose of these three forms of assignments is different and the time when these assessments are organised is also different. In general, diagnostic assessment takes place before the course starts, formative assessment takes place during the course and summative assessment takes place after the course is completed. The purpose of diagnostic assessment is to assess the entry-level understanding of the student and it helps the teacher to understand the extent of extra help required or not required by a student. The diagnostic assessment when compared with the summative assessment also helps in measuring the value added or the extent of additional learning, taking place while pursuing a study programme.

The primary objective of formative assessment is to understand how well a student is progressing in his/her studies. This assessment helps the teacher to help the students improve in those areas where the students are progressing slowly or are found to be weak. Projects and project work are good examples of formative assessments since they give the opportunity to evaluate students' progress in subject knowledge, linguistic competency, oral and writing skills, communication, and collaboration skills. Formative assessment is a task which adds to the workload of the teachers since the feedback needs to be provided while the course is going on. However, technology has made formative assessment easy for teachers. Digital education offers unique opportunities for instant feedback either by integrating it into the software or through a collaborative and team-based activity to offer formative feedback.

Summative assessments take place at the end of the semester or study programme. It is an indicator or a measure of what the student has learned after completing a course/ study programme. Annual or end-semester examinations are good examples of summative assessment. They help the students to reflect and apply their knowledge to answer questions, solve problems, and communicate information. Unlike the formative assessments, the results of the summative assessment are relied on for certification issued by higher education institutions.

The face-to-face teaching learning process in the brick-and-mortar system heavily relied on annual examination systems and on the old-fashioned paper and pencil methods. Although most institutions have moved to semester systems, the end-semester assessment patterns remain the same. However, formative assessments have become part of the teaching learning processes in the semester system. The more important is the fact that the teachers who teach the student are directly involved in the assessment since internal assessment is an integral part of student assessment.

In the traditional system, learning assessments used to be exclusively paper-based and manually corrected, but are now increasingly administered using technology, with substantial gains in measurement precision, ease of administration and sharing of results with learners and parents. Computer-based assessments and computer adaptive testing have been replacing many paper-based assessments in most schools and higher education institutions. With new technologies and online learning processes, the modes of assessment have changed. Online quizzes, discussions, essays, game activities, peer evaluation and reviews are ways in which online students are assessed in online study programmes. In a learner-centred approach, student assessment is part of the learning-teaching process embedded in class room activities and it involves interactions between learners and between learners and teachers. Some of the online student assessment procedures are also closely linked to the instructional strategies and learning objectives.

Broadly, the online assessment strategies can belong to the following categories (Kearns, 2012):

a) *Written assignment*: This is a very commonly relied-on method both in the face-to-face and online learning situations. It involves assignments such as term papers, case studies, book reviews and notes or short essays on selected topics. At times, open-ended essays help in assessing critical thinking and reflect the learners' thoughts, feelings, and opinions, while testing their overall comprehension of a topic. Essay questions require a longer time for students to think, organise, and compose their answers and are best suited for evaluating higher-order learning.

b) *Online discussion*: As discussed in earlier paragraphs, a teacher will be able to assess participation in discussions both in terms of active involvement and understanding of the theme by the student. The discussions can be classroom discussions while teaching takes place or it can be organised separately for the purpose of the assignment. A discussion board and blog can be relied on as ways to promote discussions and assess student learning.

c) *Fieldwork*: Some of the courses may involve field visits. It needs preparation before going to the field and also preparation and submission of a report after completion of the field work. Based on the data/information collected during the field work, the student draws insights into the problem. Such filed-work activities not only increase student engagement, but also relate the studies with practical orientation and empirical realities. While this is also an assessment based on the written document, it is qualitatively different from a write-up on a topic in the form of written assignments.

d) *Test/examination* is a very common form of assessment in the traditional teaching-learning processes. In traditional face-to-face teaching-learning situations, test used to be the main form, if not the only form, of assessment. In fact, annual examinations formed the only form of student assessment. With the introduction of semester systems, written assignments and tests became common. In online programmes, a test or examination is a common practice and considered to be an objective way of assessing the levels of student learning.

e) *Presentation:* In assessment based on presentations the students are requested to make presentations on a topic. Presentations help students to focus on major issues and articulate with precision on issues they are studying. In online courses, PowerPoint presentations are very common. Presentations improve students' articulation capacities and argumentation competencies.

3.5. Professional development for integrating technology in teaching

Nobody doubts the potential of technology to transform the classroom practices, even when its effect on learning outcomes is less convincing. One of the constraints in integrating technology in pedagogical practices is the fear of change by

the teachers and their hesitation to fully embrace it. This fear stems from a thinking that they may be replaced by computers on the one hand and that they do not have the training or resources needed to make these pedagogical changes. In the absence of adequate training support, the teachers do not feel confident in their ability to use technology effectively in the classroom. Another reason for the hesitation is that many teachers doubt the effectiveness of technology integration to improve student learning. In such instances, teachers may even view technology as a distraction from learning since students very often get more interested in mastering technology than mastering learning.

The teachers are one of the most important resources for ensuring cognitive development and affective traits among students. The face-to-face interactions and learning processes, no doubt, enhance the skills of interactions, working in teams and collaborative learning. It also inculcates values of positive behaviour, empathising with students, looking out for their emotional and physical well-being. Good teachers facilitate the learning processes, guide students in becoming self-directed learners and use technology to work independently.

The educational process and the teachers develop critical thinking, communication skills, collaboration and nurture creativity. These skills are useful not only for learning, but also after leaving the colleges and universities. For example, those who can work in teams and communicate effectively prove to be successful professionals during their work life. Integrated technology enhances learning by facilitating discussion and group work. Group work helps learners to pick up skills to communicate and interact in teams, which are good qualities in professional life.

Integration of technology in education, if managed effectively, will enhance student learning outcomes. Utilising different types of technology in the classroom leads to following varying pedagogical strategies in the classroom. Technological advances have led to changes in the way we teach, in the way students learn, and the way teachers develop competencies to teach differently. These efforts have led to the development of new teaching methodologies and changes in teaching practices. However, very often, all teachers do not make use of the technologies, even when they are available.

One of the reasons for less reliance on technology integration in teaching is the context of teaching-learning. Researchers point out that there is agreement among leaders in the field of educational technology that, due to a variety of barriers, teachers often fail to capitalise on the educational potential offered by technology resources (Brinkerhoff, 2006). Barriers are defined as factors preventing or restricting teachers' use of technology in the classroom. Research studies indicate that the single most important factor constraining the effective use of technology is the quality of the teacher knowledge of effective technology uses in instruction (Valdez, 2005).

The teachers' constraints to rely on technology in teaching may be external to teachers, sometimes, referred to as first-order barriers, or they may be internal to teachers, referred to as second-order barriers (Ertmer, 1999). The first-order barriers refer to the institutional support provided and may include institutional culture, access to technology, professional development opportunities available to teachers and leadership support (Hew and Brush, 2007). At times, technology may not be available in the teaching-learning situations in the classrooms. For example, computers may be available, but they may be in separate rooms or computer labs and not in the classrooms. At times, the IT support available may be limited or may not be available. This has been a common feature during the COVID period when there was a mass transition to remote learning, especially when mass training of teachers was not easily possible.

The second-order barriers include attitude of teachers to technology use and ability of teachers to use technology. Many teachers are socialised to the teaching routine and they may be refusing to change their teaching styles and strategy from what they have been practising. This resistance becomes stronger when they do not believe in the usefulness of technology replacing the teachers (Hew & Brush, 2007). This also may be due to a lack of perceived knowledge or skills for integrating technology into classroom situations. In other words, even when technology is available,

its use may depend on teachers' beliefs and skills to use it in conjunction with the teaching-learning processes and classroom management practices. The teachers' attitudes and competencies are necessary conditions for translating available technology into classroom teaching practices (Vongkulluksn et al., 2018).

Whether it is first-order constraints or second-order constraints, it can be stated that effective technology integration in classroom is possible only when teachers change their attitude and enhance their ability to use technology. Therefore, professional development of teachers is a necessary initial step and an integral part of the programmes for the introduction of technology in education. Empirical evidence has shown that training programmes are effective measures both in changing teacher attitudes and enhancing their ability to integrate technology in the classroom (Xie, et.al, 2017).

The professional development programmes, very often, focus on improving teachers capacities to use certain devices in the teaching processes. However, it is equally important to assess whether or not integrating technology in the teaching-learning process improves student learning. In other words, the focus of attention needs to change from improving teachers' proficiency in using technology to its effects on improving teaching learning process and student-learning outcomes (ISTE, 2020). It is imperative that teachers develop quality technology-enhanced learning experiences that allow students to develop their cognitive skills in both lower and higher cognitive domains.

NEP 2020 envisages to provide in-service training to teachers in the school and higher education to integrate technology with teaching learning processes. It is expected to enhance educational qualifications of prospective school and higher education teachers and also to provide continuous professional development (CPD) programmes. The minimum degree qualification for school teaching will be a 4-year integrated B.Ed. degree that teaches a range of knowledge content and pedagogy and includes strong practicum training. In addition, it is also proposed to provide 50 hours of continuous professional development programmes for teachers mostly through online mode. It is envisaged that at the higher education level, in-service continuous professional development for college and university teachers will be provided and that technology platforms such as SWAYAM/DIKSHA will be relied on for online training of higher education teachers.

How do we ensure the extent of technology integration in the teaching learning process? The most frequently measured pedagogical aspects of technology integration in instructional practices include the use of technology to: a) enhance students' cognitive engagement; b) promote collaboration among students; and c) allow students to conduct research online. The extent of technology integration refers to quantitative indicators, such as the frequency of technology use in the classrooms, the student-computer ratio, or the amount of time spent in using digital devices (Backfisch et al., 2021). However, in the ultimate analysis what matters is the ease with which teachers use technology in the classroom situations.

3.6. Technology integrated teaching is a slow process

Technology promises major changes in the future of higher education. While the promise of technology to effect changes in the sector is high, its integration in the teaching-learning process seems to be slow and painful. Teachers and students were more willing to embrace technology during the pandemic period since there was no alternative way of pursuing education. Part of the reason for slow progress in the adoption of technologies in teaching and learning is the lack of infrastructural facilities and resistance to change.

The infrastructural facilities in the colleges and classrooms are rather poor and not very encouraging for technology integration in teaching. Minimum facilities, such as computers and internet facilities are not readily available in the classrooms in many colleges. Unfortunately, investment in infrastructure in public institutions is not forthcoming. The budgetary cuts, especially on capital expenditure, adversely affect the pace of

changes and technology adoption in the teaching-learning process.

The other reason for the slow progress of technology adoption by teachers is their resistance to change. The teachers are socialised to lecture methods of transacting curriculum and they are reluctant to change from this mode and adopt alternative instructional strategies using the computers and other telecommunication devices. The reluctance to change comes from two factors. First, they are at ease and more confident to continue with the tradition of relying on printed material and lecture mode. Second, the teachers feel less confident in transiting to technology-mediated classroom situation because they lack the experience and expertise in handling the technological devices and organising the teaching learning processes accordingly. The main difficulties professors highlighted in some of the surveys were the need for training in computer specific skills and proficiency in technology use, communication abilities for an online setting, and proper handling of various teaching-learning tools. Another and a more recent survey found that teachers' conceptions of teaching, lack of digital competence, and heavy workload are the barriers to the successful implementation of technology-supported education in most situations (Borte et al., 2020).

Another important constraint faced by higher education institutions in integrating technology in teaching and learning is the growing student diversity. Ever since India reached a stage of massification of higher education, an increasing number of students from disadvantaged groups and remote rural areas are enrolling in institutions of higher education. A majority of the new entrants to the higher education institutions are first generation higher education learners with less school readiness to attend higher education institutions. They need more support to catch up with others in terms of skills to use technology effectively for learning. At times, first-generation learners face an additional difficulty of language barrier when the medium of instruction in the college is different from the language spoken at home or the medium of instruction at the school level.

The discussions in this chapter show that a higher level of public investment in technological infrastructure and teacher training programmes to enhance teacher competencies to use educational technologies are necessary conditions to effect changes and adopt a more technology-friendly teaching-learning process. As a result of COVID-19 pandemic and remote teaching, many teachers have reported that they have improved their technology skills—although the degree to which this is true across the globe is not yet fully known. In general, students from poorer households or households with less educational attainment consume less information, read less news, use social media sites less frequently, and use simpler applications for communication and entertainment.

Four

Technology and Student Learning

4.1. Students welcome technology use in the classroom

Face-to-face brick-and-mortar classes remained the mainstay of teaching-learning process and it proved to be effective in imparting knowledge across institutions of higher education. Technology-mediated education questioned the monopoly of brick-and-mortar delivery models and face-to-face classroom interactions. Technology showed its potential to revolutionise access conditions by eliminating the barriers to access to education imposed by space and time. Under conditions of online learning, the students no longer have to meet in person in the same place or at the same time to learn together from the same teacher. COVID-19 has reinforced a belief in these alternative modes of delivery and teaching-learning processes since online education became the only available and accepted mode of education during the pandemic.

There is a growing trend towards online access to educational content and learning resources. The use of digital technology to enable learning anytime and anywhere, to deliver content, and to connect learners is increasing in higher education. Now, more than ever, there is a wealth of available online learning opportunities. Part of the appeal of online classes stems from the fact that they are convenient – students can take lessons at home 24 hours a day, seven days a week. They are convenient also because of the abundance and rapidly growing catalogue of available content.

The higher education sector has seen technology changing in the classrooms. The traditional blackboards were replaced by whiteboards, chalk was replaced by pens, overhead slides became common and were later replaced by PowerPoint slides and PCs or notebooks and mobile phones became learning tools widely used by students. Consequently, technology-dependent resources such as e-mail, the Internet, course web pages, and computer simulations are part and parcel of classroom preparations for learning. It is increasingly internalised that technology has the potential not only to revolutionise the traditional teaching and learning process, but also because digital

technologies offer alternatives, which promote more personalised and collaborative learning opportunities (European Commission, 2021).

Digital learning tools in the classroom can boost student engagement, assist teachers in improving lesson plans, and enable personalised learning. Virtual classrooms, if managed well, can foster cooperation, promote collaborative learning and facilitate more inclusive classroom practices. Under technology-mediated situations, teaching-learning becomes a globally connected activity. Student-centredness is the guiding principle in online learning and it implies the involvement of students in every aspect of course development and course delivery, in the development of learning skills, and even in shaping the teacher's role (Lemos et al., 2014). The learning has become not only student-centred but also flexible, experiential, and self-directed and it provides space to students with the opportunity to act upon their learning needs and intentions. In digital learning situations, students engage with peers and teachers and work on meaningful tasks and projects, engage in group discussions, and other collaborative learning activities.

From the perspective of the students, the benefits of technology-mediated learning are many (Henderson, et.al, 2017). The perceived benefits include flexibility of time and place, ease of organising and managing study tasks, the ability to replay and revisit teaching materials and the opportunity to learn in more visual form. Studies have found a similar pattern among teachers and students that perceptions of the usefulness of technology and its ease of use significantly and positively influenced students' actual use of technology in learning. However, unlike teachers, a larger number of students are changing their mindsets and welcoming technology mediated learning because of its perceived benefits (Hoffman and Remirez, 2018). It seems that there is an endless tension between willing students to use technology in learning and unwilling teachers to integrate technology in teaching.

Digital technologies such as games, interactive whiteboards, simulators and collaboration tools, when effectively integrated in the teaching-learning process, can engage students actively in varied forms of interactions and can contribute to enhanced learning outcomes. It is observed that the incorporation of gamification elements in digital learning can improve academic and non-academic skills through increasing learners' interaction. Playing computer games has been found to support learning in science, mathematics and second languages compared to other forms of instruction. A review of studies on digital game-based applications in education found a positive impact on knowledge acquisition, cognitive skills and motivation (Hussein et al., 2021).

Interactive whiteboards or smartboards can potentially support the visual and auditory experiences of teaching and learning. Some studies have shown smartboards to be more effective than traditional instruction based on lectures since students seem to be more engaged when using smartboards due to their potential to engage learners. However, the effects may be linked less to their interactivity and more to the pedagogical approaches of the teachers using them, collaborative and active learning. In the flipped classroom situations, students study the material before class by watching online lectures or pre-recorded videos, at their own pace, and apply the learning material during class, allowing the classroom experience to shift from being teacher-centred to learner-centred.

Studies have shown that the flipped classroom model had a positive effect on learning achievement and motivation compared to the traditional classroom model. It seems video recordings had the highest effect on student learning in flipped learning situations (Bredow et al., 2021). The extent to which and the effectiveness of using flipped classroom pedagogical approach depends on the availability of technological equipment at home for both students and teachers. The use of mobile phones beyond limited hours is seen to have a negative effect, especially at the university level, on learning outcomes.

4.2. Access to online Learning – requisites

Virtual learning (or online learning) can take place either in a self-paced (asynchronous)

environment, in a real-time (synchronous) environment or in hybrid mode. In synchronous virtual learning, students attend online live-streamed lectures. The teacher streams their lecture and students listen to the lectures and ask questions in real-time via webcam, microphone, or live chat. Asynchronous virtual learning, on the other hand, features pre-recorded lectures that students can watch on their own and at their convenient time. The instructor will post either a video or audio file along with lecture notes. A hybrid course, on the other hand, will make use of both virtual and in-person learning. Online education assumes that all students have access to technology. However, this assumption is not always true. In many countries and regions internet-based educational programmes are plagued by the problems of internet connectivity, security risks and lack of technological infrastructure facilities.

LMS bring together all of the components required to support instructional practices and they include tracking student progress, facilitating interactions among students, and between students and teachers. They ensure that these facilities are delivered uniformly across different groups of students, courses, or programmes. It can document, track, report, and deliver educational course materials. It is relied on to create professionally structured course content where a teacher can add text, images, videos, tables, links and text formatting, interactive tests and slideshows. Student data management and tracking are also part of the LMS.

A large number of LMSs are available in the open market. Some of the LMSs are priced while others are not. MOODLE (Modular Object-Oriented Dynamic Learning Environment) is one of the commonly used open-source software. The learners rely on LMS to get details about their course and links to resources after logging in as a student. It also has a provision for students to get in touch with the teacher. The work completed by the students can be submitted online through the student log-in and the teacher will be able to access it. Similarly, there are many video conferencing software easily available. Zoom, Google Meet, Webex by Cisco, etc. are some of the commonly available video conferencing devices. They also may have facilities for conversation and making text notes.

At the institutional level, the main piece of hardware needed is a server. The institution needs to estimate how many users will be accessing and how many may access the server at a time and configure the server accordingly. What is equally important is to ensure a good bandwidth to help users access e-learning courses seamlessly and a hard-disc with enough space to upload e-learning courses and store information in the database.

At the student or individual level, hardware implies a computer with a good amount of memory and a hard drive. Many students rely on mobile devices and, perhaps, mobile devices are more widely used than computers. As discussed before, during the COVID-19 pandemic period, most students relied on mobile devices, mostly mobile phones, to join learning sessions. Students also need Microphone/Speakers/Headsets in order to hear lectures, audio clips and files. The minimum requirement also includes a stable internet connection since most communications take place through software programmes connected through emails.

At the institutional level one needs a support system**.** The support system can be internal to an institution or contracted to agencies (outsourced) engaged in this area of activity. The students need to contact these support team members in case there is any disruption in the flow of services. Students use a variety of digital technology resources in their academic lives in colleges and universities. However, the most commonly used devices for university work have been personally owned computers (desktop/laptop computers) and smartphones. Tablets/iPads and E-readers are used by students to a lesser extent.

It is also important to note that most students commonly use 'official' digital resources provided by the higher education institution or university. The use of OER by the students has been on the increase over a period of time. It seems there is a need for guidelines and formulating national and institutional educational policies that support the integration of non-official resources alongside the official resources of the institution in academic teaching (Murphy, 2013). These guidelines will help the students to make appropriate choices.

Studies indicate that the major challenge faced by students in adapting to online learning in India is technical problems (Mishra et al., 2020). The technical problem involves the availability of technological infrastructure at the institutional level and availability of devices among students. Students from poor families and disadvantaged groups may find it difficult to invest in these learning devices. The other related aspect is gaining experience and competencies to use the devices for teaching and learning purposes. This is an easier task among students than among teachers. Students find it easier to use these technological devices and in case they find difficulties, they will seek help from their friends.

What is important is to mobilise institutional resources to ensure that all students have access to a proper IT infrastructure and bandwidth connection, as well as specific support to solve technical problems. Given the disparities in terms of availability of technological resources at the individual level, it is important for the institutions to extend help to these students by providing them opportunities to use the resources outside the regular college hours. This is more so because it is observed that the students from disadvantaged groups are more adversely affected by the non-availability of technological infrastructure and training to use the technology available in the institutions.

In many instances blended learning is practised in the context of online learning. Blended learning is the integration of traditional face-to-face and e-learning teaching paradigms. Blended learning can be implemented in a variety of ways. It can be a mix of offline and online forms of learning. It may have a learning programme that provides study materials and research resources over the web and instructor-led, classroom sessions as the main medium of instruction. At one extreme, blended learning can imply that the curriculum is fully online with options for face-to-face instruction and interactions. On the other end, blended learning can imply class room instruction that includes online resources with limited opportunities for students to be online. In reality, the instructional practices under blended learning lie between these two extremes.

Blended learning can be self-paced learning – at a pace managed or controlled by the learner. It can be in the form of collaborative learning implying a more dynamic communication among many learners that brings about knowledge sharing. Computers, digital cameras, SmartBoards, mobile phones and iPods have made their way into classrooms. The students in blended courses generally get gap time between online work and face-to-face meetings. In general, the online materials are given in advance so that the students get enough time to read, reflect and interact with classmates before they meet in a class room.

There is another notion of blended learning as a flipped classroom model where traditional lecture is delivered outside of class through video and other web-based materials. The class room time is used for collaborative project work, small group problem-solving, and other such activities that allow students to engage at a deep level with the content they viewed outside of (and before) the class. This model provides faculty with more time in the classroom to work with individual students and allows students to master the lecture content at their own pace. The advantage of blended courses comes also from the fact that they provide opportunities for increased interaction between the students and faculty. Some students are more comfortable in communicating with their professors in a digital format via e-mail or online discussion posts.

The factors that determine the quality and success of blended learning are course design, communication, and motivation. Course design implies the way courses are structured and laid out. The time commitment involved in preparing a blended course is enormous. Communication involves student-teacher and student-student interaction in and out of the classroom such as in-class discussions, discussion boards or blog posts, and email correspondence. Motivation includes extrinsic factors such as teacher encouragement and course organisation.

All these pedagogical practices are based on the assumption that digital skills exist among students and teachers. The digital skills have been evolving along with changes in the digital technologies. At the minimum, the students and teachers should be able to manage basic hardware and software operations, email, and search functions. The Digital Competence Framework for Citizens (DigComp), which was also adopted as part of the Digital Literacy Global Framework by the UIS is used as a basis for defining digital skills.

AI and machine learning are recent developments impacting the education sector. The advantage is that AI can tailor learning to student's individual needs and abilities through personalised programmes. AI also help students to engage in data analysis, gain new insights and internalise the empirical reality of social conditions of educational processes. The expectation is that with the advances in the use of technologies such as AI, students should be able to learn better and faster (UNESCO, 2021a; 2022a). The LMS, in the coming years, will be increasingly AI-enabled and it will help support the automation of administrative tasks to relieve the teachers from administrative responsibilities.

A review of 24 national AI strategies published between 2016 and 2020 found that one-third of them addressed the integration of AI in teaching and learning (Schiff et. al, 2021). In Singapore, the National AI Strategy and the EdTech Plan (2020-30) highlight AI for personalising teaching and learning through national learning platforms. The national learning platforms are accessible to all school leaders, teachers and students. Another global survey found that 11 out of 51 governments had developed and implemented AI curricula (UNESCO, 2022b). All these surveys indicate that AI is coming to the centre stage in the discussions on issues related to technology-mediated education.

4.3. Monitoring online learning

Online learning has changed the methods of monitoring student learning and assessments. The old-fashioned paper and pencil methods are replaced by technology-assisted ways of assessment. As discussed below, the assessment can involve various tasks rather than relying on a single mode of annual or semester-end examinations (Ulum, 2022).

Online quizzes are common ways to measure learning levels. Quiz questions can be in the form

of multiple-choice or fill-in-the-blanks. In any case, they are short and easy to assess. E-learning toolkit such as iSpring Suite includes a quiz maker tool, which helps a teacher to develop quiz questions

Open-ended or essay-type questions are commonly used in online assessments. Essay-type questions help test critical thinking capacities developed by the students and are more suited for assessing higher order learning. However, it requires more time for the students to think and organise their assignments. Unlike the quiz questions, the answers to essay-type questions are not auto scored. The teacher needs to invest time to read and review each answer sheet. It is a indeed more time-consuming exercise for the teacher.

The drag-and-drop assessment method is relied on essentially to measure learners' capacity to use the information and apply the knowledge that s/he has gained during the period of the course. In fact, the iSpring Suite provides a drag-and-drop template that allows one to move text boxes, images, and shapes to a specific place on the page.

Online interviews are another way of assessing student learning. Online interviews give an opportunity to students to demonstrate their proficiency in domains, such as language. Language proficiency is an important attribute that employers value in the hiring process. Therefore, the interview method of assessment is useful to the learners to develop competencies in articulating one's thoughts.

A dialogue simulation exercise is another way of assessing students. It helps students to train in the art of interactions with different categories of customers. It trains a student to engage in real-life conversations with customers, colleagues, and others to format their reactions and responses. This may be very helpful for those who would like to enter into customer service-type jobs.

Game-based assessments are considered good indicators of true non-cognitive skills and knowledge acquired during the study programme. They also reflect the student's capacity to take risks, collaborate and solve problems. Organisations have found that game-type activities work well in employee training and educational institutions found that high-achieving students enjoy competing with their peers in learning games.

Peer evaluation is also used as a mode of assessment. It allows students to review and assess other's work. Such activities give each participant a chance to reflect on their knowledge and then communicate their feedback in a consistent and structured way. The students should be told in advance about the steps of a peer review and the evaluation process prior to its start. It is always desirable to give a set of guidelines to follow to ensure consistency in assessments made by different students or groups.

At times online classes organise discussion forums on a selected topic. In this method, the students contribute to a forum post, which is a good way of assessing their understanding, critical thinking and capacity to formulate questions based on the study material. This method is very useful to improve interaction, communication and collaboration as part of the learning process among the students.

4.4. Online learning and learning outcomes

Online learning is expanding fast and is partly replacing traditional channels of higher learning. It is important to assess: how effective is online learning when compared with traditional face-to-face interaction-based learning? This will depend on the learning outcomes following these two separate modes of learning. Studies have shown that online learning is at least as good as and as effective as the traditional face-to-face format and, at times, better than traditional format regardless of the social background of the students (Navarro and Shoemaker, 2000).

There are a number of studies that find positive and statistically significant effects on student learning outcomes in the online or hybrid format compared to the traditional face-to-face format. Some of the positive learning outcomes are improved learning as measured

by test scores, student engagement with the class material, improved perception of learning and the online format, stronger sense of community and collaboration among students (Nguyen, 2015). However, these findings are not sufficient enough to provide a conclusive statement on the supremacy of one mode of learning over the other. The difference in student learning outcomes was larger in the studies where online elements were blended with face-to-face instruction, although many argue that learning outcomes in the online format are better or higher than those in the face-to-face format. This claim needs further investigation.

As online learning depends on the ability of the students to self-regulate learning, there is no common format to be strictly adhered to. However, the students are more used to and, at times, draw comfort from getting instructions from teachers. Further those from lower socio-economic backgrounds may not be adequately socialised with the digital devices and, hence, may be lagging behind in acquiring skills to manage technology in learning. The explosion in demand for skills to navigate the changing aspects of digital technology poses a major challenge to public education and training systems. The high-performing students, in general, find it easier to engage with technology in more productive ways than the low-performing students. In the absence of adequate family support, student performance declined in several countries during the pandemic period.

Given the fact that a large number of technology products and platforms are available, public policy needs to be framed on the procurement of technology based on the long-

term effects of interventions and positive effects on a larger number of people and students. More importantly, when the area of operation of technology-mediated education is expanding, it is equally important that the design and delivery of education technology interventions need to be tailored to local contexts. At times, language becomes a constraining factor to expand the reach of technology to relatively poorer students from rural areas.

Five

Equity and Quality in Technology-based Learning

5.1. Equity in access

Technology has been relied on for extending education to groups who have traditionally been excluded from mainstream education and also to support learning continuity during emergencies. For example, technological solutions were the only option to continue learning during the COVID pandemic situation. Even otherwise, extending education to unreached groups was through distance education. For example, radio-based instruction was beneficial for the education of the nomads and televised instruction for education in rural areas has helped to increase enrolment and participation of marginalised populations.

Right to Education Acts in countries across the world attempt to ensure equality of educational opportunities by extending access to education for all. Access to digital technology is now considered a part of the right to education. The United Nations Human Rights Council, 2022 considers that the implementation of the right to education must respond to the needs of all persons to access, master and use technology as an empowering tool for being active members of society. These are important equity-oriented policy interventions at the global level to integrate technology in education

The conditions for equalising educational technology are not very conducive in many countries. Unfortunately, access to electricity, devices and the internet is highly unequal between and within countries. Globally, 46 per cent of households had a computer at home in 2020, with the percentage ranging from 7 per cent in low-income to 80 per cent in high-income countries. The variations among schools even within the same country in terms of access to electricity and internet are wide. Globally, the share of schools with computers for pedagogical purposes was 47 per cent among primary, 62 per cent among lower secondary and 76 per cent among upper secondary schools in 2020.

The technological infrastructure conditions vary widely in India too. For example, with the best efforts and impressive progress in rural electrification, millions of households remain without electric power in India. The *Saubhagya* scheme of India did electrify

almost all households that applied for electricity, but millions of households chose not to apply for electricity connection. Only 62.81 per cent of schools in the country have electricity connections.

As discussed in Chapter One, higher education in India experienced a massive expansion in this century and it reached a stage of massification (Varghese, 2022). According to the recommendations of NEP 2020, the higher education sector will expand further and reach a stage of universalisation by 2035. The expansion of the sector is also accompanied by inequalities in access to higher education. While inequalities in access to higher education by sex have improved indicators of gender parity, that among social groups continues to be high. The regional inequalities and inequalities in enrolment by economic categories have widened.

The market processes have contributed to the increased regional and economic inequalities in enrolment to higher education in India. The states with larger share of private institutions experienced higher concentration of higher education institutions contributing to the widening of regional disparities in enrolment among states. Similarly, higher share of enrolment is accounted by students belonging to fourth and fifth quantile of economic categories (Varghese and Sabharwal, 2022). These evidences indicate that higher education still remains a privilege of the better off sections in the society.

Do distance education programmes promote equity? It depends on who take admission in distance education and how many of them complete the courses successfully. One can argue that distance education contributes to the expansion of higher education opportunities among those who lost opportunities to pursue higher learning through regular channels. They may be in employment or could not get admission in the regular system because of poor scores at the secondary education level or they could not financially afford regular study programmes. While in admissions to regular colleges, the share of disadvantaged groups is assured through the quota system, in the distance education programmes the share surpasses such quota system as per the social demand for such programmes

India has one National Open University (IGNOU), several Open Universities at the state level and a large number of dual-mode universities. The non-traditional groups are getting more benefit from the Open Universities. The share of women in total enrolment has been increasing in the Open Universities. A major share of enrolment in these universities in India is accounted for by students from rural areas and those belonging to disadvantaged groups accounting for more than two-thirds of the enrolment. For example, nearly 66.1 per cent of the students enrolled in BRAOU were from rural areas (Varghese, 2018). The enrolment trends in distance education also indicate that the share of students belonging to disadvantaged groups such as Scheduled Caste, Scheduled Tribe and OBC exceeded the quota prescribed by the national authorities (Varghese, 2018). It can be therefore argued that the Open Universities and distance education programmes play an important role in promoting equity in access to higher education.

The share of women in total enrolment has also been increasing in the Open Universities. The IGNOU enrols over 3.3 million students, serves traditionally marginalised communities, who would, otherwise, remain deprived of higher education. In 2020, 45 percent of enrolled students were women, 12 percent were Scheduled Tribes, 18 percent Scheduled Castes and 18 per cent were other Backward Classes. In addition, 45 per cent of enrolled students were from rural areas, up from 38 per cent in 2016. It seems, when compared with the regular system, the non-traditional groups are getting more representation in admissions to Open Universities.

Enrolments in online courses are growing very fast. This was more so during the COVID pandemic. The global enrolment in online courses reached its peak of 189 million in 2020. This pandemic induced increase was unexpected and followed closure of higher education institutions offering regular degree programmes. But the increase is not particularly significant due to COVID because enrolments in online courses have been increasing in the past decades; more so after the introduction of MOOCs. The expansion, in a sense, indicated growing global acceptance of online learning and its spread to new locations and groups of people.

Who are the online learners? Coursera accounts for the highest share of enrolment in online courses. An analysis of enrolment in Coursera reveals that enrolment increased from 76 million in 2019 to 143 million in 2020 and further to 189 million in 2021. A part of this massive expansion of a 2.5 times increase in enrolment between 2019 and 2021 was due to the pandemic. India has seen the enrolment of the second-largest number of students in Coursera and it continues even today. For example, it is estimated that of the 189 million students enrolled in Coursera in 2021, the USA accounted for the highest enrolments with 17.3 million students, followed by India with 13.6 million students.

Studies have highlighted that nearly 80 per cent of learners in the major MOOC platforms already have a tertiary degree. The typical MOOC learner is a professional searching for extra training who already has at least one post-secondary qualification. Further, a large number of those enrolled in MOOCs come from middle or upper-middle class family with good proficiency in the English language since it is the language of one-quarter of internet users worldwide as well as the overwhelming language of instruction in MOOCs, discussion forums, and student engagements. These factors indicate that MOOCs are not bridging the gap in disparities in access, but, indirectly, increase inequalities in terms of helping those already with a university degree. This is an important factor in deciding about the facilities for enrolment in MOOC.

Equitable education and learning take place when each learner has the minimum facilities. Equity in access to the physical, human and social resources needed for digital learning is a necessary condition to ensure equity but it remains an area of serious concern in many countries. The International Society for Technology in Education describes digital equity as the condition wherein all individuals – regardless of their ethnicity, race, socio-economic class, gender, or disability status – have equal access and opportunity to use digital tools, services, and resources to increase their digital awareness, knowledge, and skills. To ensure equity in online courses, it is necessary to have: a) equal access to computers and broadband internet access; b) the skills needed to succeed in less structured online classes; and c) teachers trained to effectively conduct classes online (Tete and Warschauer, 2022).

The online learning facilities are better available in the developed countries. The minimum facilities such as a reliable internet-enabled computer and a physical learning space are not available to many students, especially in less developed countries. Even in the locations where internet connections are available, securing internet access throughout the day is a difficult proposition. In some instances, especially in less developed regions of the developing countries, uninterrupted electricity connection itself is a concern.

Although NEP 2020 promises to provide all classrooms with the latest educational technology, India needs to travel a long distance to reach this destination. There are two generations of learners pursuing higher education simultaneously. The 'net generation' coming from middle and upper-class families are very much at ease with the language of instruction and technology. Many of them possess the technological devices necessary for classroom learning. The other group of students are from socially and economically disadvantaged families with limited or no access to the technological devices necessary to effectively engage in technology-mediated teaching-learning processes.

The mobile phone is more widely available even among the poor and, hence, it has the highest potential to reach the largest number of households and students even among the children in hard-to-reach areas. However, the biggest limitation of online learning still remains that two-thirds of the world's children do not have an internet connection in their homes.

People with disabilities face more difficulties than others in accessing education. Technology provides multiple means of representing information, expressing knowledge and engaging in learning, which can support people with disabilities. It can facilitate personalised learning communication and interaction with their peers and teachers. A variety of technologies are available for people with disabilities. Assistive and accessible technologies should be individualised

to students' specific learning needs. As access to technology will not be equitable until at least electricity supply and internet connectivity are universal. Exclusion remains an issue in mobile broadband coverage, especially, usage. There are gender gaps associated with access to technology. It has been estimated that nine per cent fewer women than men own a mobile phone and 16 per cent fewer use mobile internet in low- and middle-income countries.

5.2. Equity in learning outcomes

Many early equity initiatives focused exclusively on access to physical devices and creating low-cost devices. However, it is important to consider what happens to the students who are enrolled in online education. Do they complete the courses? Are they learning as good as or better than those who are enrolled in the face-to-face learning situations?

Because of the disparities in the availability of technology facilities, it is doubtful whether or not online education contributes to equity from the point of view of disadvantaged groups. There is little evidence to show that online learning opportunities increase access, especially for underrepresented student groups. More importantly, a good share of those who are enrolled in the online courses in the normal times are those who already possess a degree. From this point of view, the contribution of online courses to expand access needs to be reassessed. On the other hand, if the analysis is correct, online courses, especially the MOOCs, increase the distances between online learners and non-online learners. Those enrolled in MOOCs are getting certifications in addition to the qualifications they already possess.

Another important finding is that the gap between those enrolled and those completing a course is very large in MOOCs. Although, evidence is limited in terms of the social background of those dropping out, the phenomenon itself indicates variations in learning outcomes in online courses. There are evidences which indicate that students from under-represented groups perform poorly when compared to those from well-to-do families and even those from disadvantaged families following face-to-face classes (Tete and Warschauer, 2022).

One of the reasons for the poor performance of students in distance education and online classes is that they are poorly prepared for self-study. Many students at the school level are continuing their studies under the close supervision of teachers. Online education relies on self-learning by the students. In many instances, it is found that students' level of self-regulation and preparedness for the self-directed learning varies and in some cases, it becomes a constraint for learning and progressing in education.

Students in online courses tended to fail to complete the course in greater numbers than those in face-to-face situations. The performance decrement of online (versus face-to-face) classes has been significantly larger for students from disadvantaged backgrounds. The performance gap even among disadvantaged groups is larger among those attending online classes.

It can be argued that distance education and Open Universities are the second-best options for the students and they are not the first choice for the brightest and more competitive students from better economic background. The enrolment trends in distance programmes indicate that they attract a large share of students from disadvantaged social and economic background and from rural areas. The same logic may not be realistic in case of enrolments in online courses. The constraints regarding access to technological infrastructure adversely affect admission of

Six

Governance and Management of Online Courses

6.1. UGC Regulations on online learning

Online facilities and enrolment in online courses have been increasing globally. Cross-border engagement and studies are more common in online courses than in face-to-face situations. Enrolment in MOOC courses is less expensive (and, at times, free of cost), and does not involve cross-border mobility of the learner, which reduces constraints imposed by Visa rules and living expenses abroad. The enrolments in online courses indicate that the highest enrolment gains were experienced in the Asia Pacific region followed by North America, Europe and Latin America. Africa lags behind in terms of number of students enrolled in online courses although the growth rate and the percentage increase in student numbers is substantial – around 50 per cent increase during the pandemic period. As indicated earlier, at the country level, the US topped the list in enrolment in online courses followed by India.

In India, online courses are organised as per the regulations of the University Grants Commission of India (UGC). The UGC has brought out several sets of regulations to guide digital education in the context of higher education development in India. The UGC approved online degree courses under the University Grants Commission (Online Courses or Programmes) Regulations, 2018. The UGC Regulation of 2017 permitted that only up to 20 per cent of the total courses in a programme for a given semester can be offered through the online learning mode and they should be provided through the SWAYAM platform.

The 2018 Regulations permitted higher educational institutions in India to offer degrees and other programmes in full-fledged online mode along with other online courses and certifications. The UGC brought out another set of regulations in 2020 for ODL and Online Programmes. These regulations laid down the eligibility criteria, application process and minimum standards of instruction for the grant of degrees at the undergraduate and post-graduate levels for both ODL and Online modes.

The UGC Regulations 2020 allow the top 100 universities in the country to offer online learning courses without any prior approval of the UGC. Similarly, higher education institutions with a National Assessment and Accreditation Council (NAAC) score of 3.26 or above (out of 4) can also provide online learning without prior permission of the UGC. University Grants Commission (UGC) has announced that distance, online learning degrees from recognised institutions will be treated on par with degrees obtained through conventional mode. This is also a welcome regulation to encourage people to pursue higher learning through online mode.

A number of universities started offering online degree courses from 2021 onwards. The regulations were amended in 2021 to allow Institutes of Eminence (IOEs) to offer UGC-approved online courses as part of their study programmes. As of 2023, around 83 public universities and 45 private universities/ deemed to be universities are eligible to offer online degree programmes. In order to ensure the best quality content are produced and delivered, nine National Coordinators have been appointed by UGC. The national coordinators are: The University Grants Commission (UGC) for Post-Graduation Education, the Consortium for Education Communication (CEC) for Under-Graduate Education, NPTEL Consortium of seven Indian Institutes of Technologies and Indian Institute of Science for Engineering, National Council for Education Research and Training (NCERT) and National Institute for Open Schooling (NIOS) for School Education, Indira Gandhi National Open University (IGNOU) for Out-of-the-School Students, Indian Institute of Management (IIM) Bangalore for Management Studies, National Institute for Technical Teachers' Training and Research (NITTTR) for teachers' training programme and All India Council for Technical Education (AICTE) for ARPIT Courses (Annual Refresher Programme in Teaching).

The advantages of UGC online courses include: a) the course fee is relatively affordable and less than the fee to be paid for conventional 'in campus' programmes; b) students from rural areas with scant access to good colleges can enrol for UGC approved online certificate courses from top ranked colleges of India; and c) UGC online degree courses are on par with the conventional degree programmes, although all institutions will have to indicate the mode of the programme in the degree certificate provided to the student.

The higher educational institutions can offer Certificate, Diploma and Degree programs in full-fledged online mode. However, the institutions can offer online courses only in those domains and disciplines in which they have been offering face-to-face or distance education programmes. However, online study programmes requiring Practical/Laboratory Courses as a curricular requirement are not permitted. The examinations to award certification will be conducted in proctored mode and in conformity with any norms for such examinations stipulated by the UGC.

The online courses offered will be following the four quadrants approach, which includes:

a. Quadrant-I e-tutorial containing video and audio content, animation, simulations and virtual labs.
b. Quadrant-II e-content containing PDF document or e-books or illustrations, video demonstrations, documents and interactive simulations, wherever required.
c. Quadrant-III web resources containing related links, open content on the internet, case studies, historical development of the subject, articles.
d. Quadrant-IV self-assessment containing MCQ, problems, quizzes, assignments and solutions, discussion forum topics and setting up the questions and answers.

The learners' engagement will be monitored via participation in asynchronous/synchronous discussions, assignment activity and programme involvement. The analytics of the Learning Management System shall be used for ensuring the learner's participation for at least two hours every fortnight.

The UGC has recognised the validity of degree, diplomas and certificates offered through online mode of education under its University Grants Commission (Online Courses or Programmes) Regulations, 2018. An HEI will be eligible to obtain recognition for offering online education, if it:

a. has been in existence for at least five years;
b. has a minimum score of 3.26 on a 4 point scale by the National Assessment and Accreditation Council (NAAC);
c. is in the Top-100 in overall category in the National Institutional Ranking Framework (NIRF) for at least two years during the previous three years.

   It needs to be noted that (b) and (c) are, however, not applicable to Open University till accreditation and ranking are extended to them.
d. offers the Online Course or Programme only in those disciplines which it has been offering in regular mode (i. e., classroom teaching) or in ODL mode and after at least one batch has passed out.
e. offers the Online Course or Programme subject to it obtaining approval by the appropriate statutory authorities or bodies of the HEI such as the UGC.
f. has demonstrated capability for developing and producing Online Courses and Programmes having access to SWAYAM or another platform for learner authentication (i.e. integration with Aadhaar or other government-recognised identity for Indian students and passport for foreign students), learner registration, a payment gateway and a learning management system.
g. has the ability to conduct examinations either using technology-enabled online tests or through proctored examination (i.e. examination under physical supervision).

The HEIs which are given recognition may operate Online Courses or Programme under the following conditions:

a. The Online Course or Programme should be delivered through the SWAYAM portal or any other learning platform after the same is verified and approved by the Expert Committee of the UGC.
b. Online learning should have a four quadrant 'approach', namely, tutorials, e-content, web resources and self-assessment.
c. Apart from the actual course or programme delivery, other components such as the counselling process, online application processing and fee payment should also be provided through online mode.
d. The duration of the Online Course or Programme should be: i) For a Certification: The Online Course or Programme should be of minimum six months' duration and would have a minimum of twenty credits. ii) For a Diploma: Online Course or Programme should be of a minimum one-year duration and would have a minimum of forty credits. iii) For a Degree: The Online Course or Programme should be for the same duration and for the same credits as specified by the UGC under Choice Based Credit System (CBCS). However, the maximum duration for completing the Online Course or Programme should be double the minimum duration of the course or programme or as laid down by the UGC from time to time.
e. The HEI can provide one or more academic sessions each year, which begin either in July/ August or January/February each year.

6.2. Organising oneself for an online course

Apart from the regulations and the institutional initiatives, the student also needs to be self-organised to be successful in online studies. The first step will be to find a convenient place – calm and quiet and free from distractions, with provisions for electric connections for recharging the devices and, provisions for taking notes either on the computer or by hand. Since one need not be in a classroom situation, these requirements are to be ensured in advance. Classes may be live or recorded. In a live class, one may participate in

the discussions and therefore the microphone and webcam should be active.

The next step is to organise one's files. The course materials may contain several files and they should be organised in such a way that they are easily accessible whenever one needs them. Some students may prefer to work with hard copies for easy cross-referencing. This may require a physical filing system in addition to the digital/electronic filing system.

Preparations for online learning necessarily include familiarisation with the syllabus, class requirements and deadline for submission of assignments. Some students prepare a study timetable for themselves. Nowadays, students use online calenders with set alerts. Proper scheduling of one's study time helps to increase one's learning time without compromising the time for other activities.

Establishing a routine may be helpful in online studies. This is more so since one is not directly supervised by any teacher. This should include all activities related to study. Since the syllabus and study materials are given in advance, it is easy to prepare schedules and adhere to them. At times, students prepare study plans in apps such as my study app and store in the cloud so that it can be accessed from anywhere.

It is important to create a support system for students to ask questions and clear doubts. Very often, one's friends are very helpful. Students create WhatsApp groups and this network serves well to organise one's study. Some of the WhatsApp group members may occasionally meet in person if they live nearby, to clarify or discuss aspects related to studies. In some instances, you may develop or create an online study group as a support system for one's studies. Study groups can act as self-monitoring mechanisms. Taking part in the discussions will help in clarifying concepts and ideas.

What is the most important to progress fast and learn effectively is through developing a self-accountability mechanism by streamlining one's study activities. At times, the public authorities stipulate regulations to provide framework for investing time. For example, the Ministry of Education in China placed a limit of 30 per cent of overall teaching time spent with digital devices as teaching tools and at most 20 minutes per day spent on electronic homework. Guidelines also suggest that students should rest their eyes for 10 minutes after 30 to 40 minutes of educational screen time. The government has set strict limitations on gaming too, at three hours maximum per week, placing some responsibility on gaming companies. Games require all users to register using their real names and government-issued identification documents.

6.3. Artificial intelligence and higher education

Although Alan Turing articulated for the first time the promising vision of 'thinking machines' in 1950, Artificial Intelligence (AI) as a commonly accepted tool in the context of educational technologies is a recent phenomenon. AI is a new entrant in the field of technology and education. AI refers to the ability of a computer to simulate human intelligence and cognitive abilities and enable computers to perform tasks that normally require human intelligence (UNESCO, 2021a; UNESCO, 2022a). AI is increasingly integrated into all spheres of activities including education and is considered to be a convenient tool for improving teaching, learning and managerial and administrative processes. AI-powered virtual classrooms and educational platforms make online learning materials more accessible and inclusive for diverse learners.

AI individualises learning, personalises study programmes and adjusts teaching and learning to the requirements of each learner. The usage of artificial intelligence is leading to the automation of administrative tasks, and this will enable teachers to utilise time effectively. The latest to enter the scene, Generative artificial intelligence relies on applying sophisticated data processing and develops higher-order thinking skills. The future world will surely be one where AI tools are increasingly influential and technology is ever present in their daily working lives.

AI considerably impacts traditional teaching and learning methods, and this advancement has created a shift towards more student-centred and experiential learning methods. Project-based learning provides students with a context for their

skills and helps them understand how to use them in the real world. Collaborative learning is achieved through group work and it allows students to learn from one another and apply their knowledge in a supportive and dynamic environment. Experiential learning methods also empower students to use their knowledge in real-world settings through hands-on and practical experiences such as job placements, simulations and field trips. Integrating technology – like gamification, artificial intelligence, virtual reality and augmented reality – into the educational process is an added element in achieving this change.

AI can enable new pedagogical approaches and curriculum development, help adaptive learning, and intelligent tutoring systems. It can support the development of future-oriented skills, such as critical thinking, problem-solving, and creativity. It can support lifelong learning and upskilling by providing personalised learning pathways, identifying skills gaps, and offering targeted learning opportunities. This can empower learners to continuously update their skills and knowledge throughout their professional careers.

AI can be helpful in extending support to administrative functions, teaching, learning and research activities. It can be helpful to the administration to organise and analyse data on recruitment, admission and retention, to aid in decision-making processes and to assess productivity and performance. It can extend teaching support by providing automated assessments, personalised tutoring and feedback. It can help the learners by providing self-service chat bots and predict student performance. It will be helpful in research to analyse large data sets. AI also have language support facilities for speech recognition, speech synthesis, and language translation. These tools can support learners in developing proficiency in different languages, facilitating internationalisation and global collaboration. AI can analyse large amounts of data generated by students, instructors, and learning platforms, providing insights into student performance, engagement, and outcomes.

The latest to arrive in the field is ChatGPT developed by the OpenAI research lab. It is envisaged to have very high potential in education and research. It can write articles, dialogues, reviews and reports, develop web applications and write programming code. It is not very clear how this will affect education and learnings. Since most of the teaching and learning responsibilities can be assigned to ChatGPT, it will become difficult to identify what teachers have done, what students have done and what ChatGPT has done.

The ChatGPT is one of several writing applications which creates text. It, in a sense, has been designed to mimic humane texts. It will likely be helpful in cases such as examinations which seek straight forward answers. To overcome the reliance on ChatGPT in exams, the educational assessment is introducing new tests emphasising on more skills-based and problem-solving questions. It is agreed upon that some standardised tasks can be accepted to be automated using tools like ChatGPT. It seems it writes good emails and small, simple texts. There are scholars such as Noam Chomsky who argue that ChatGPT in education is 'basically high-tech plagiarism' and 'a way of avoiding learning' (Popenici, 2023).

It is reported that the AI market in India is expected to reach US$7.8 billion by 2025 (UNESCO, 2022a). While these new tools such as AI and ChatGPT are very useful tools in education, one also needs to be clear about its limitations and harmful effects. It is equally important to consider the ethics of AI in education and provide an overall regulatory framework for AI in education. The G7 leaders in a recent meeting organised by UNESCO recommended for regulations in the use of AI technology. UNESCO is planning to bring out a policy paper which can act as a guide for stakeholders in addressing various concerns, proposing concrete actions and a procedural framework for designing, developing, deploying and procuring AI ethically.

To conclude, technology has made a wide range of informal learning and multiple pathways to learning. In a disruptive digital era, fundamental rethinking of higher education is required. One of the important areas of rethinking is to redefine the changing role of universities in the face of digitalisation and AI. We must recognise the transformative potential of these technologies in shaping the future of education and preparing students for an AI driven world.

Seven

Concluding Observations

Education has a vast regenerative potential and can help set the world on a path towards a more just and sustainable future and it necessitates to considering education as a global common good (UNESCO, 2021b). Higher education needs to be democratised. Democratisation implies improved access to quality higher education at affordable costs. The expansion of the sector and provision of quality higher education becomes a non-negotiable component of the new compact to expand higher education.

This century experienced a fast expansion of higher education worldwide. In the past two decades, the global enrolment in higher education increased from 100 million in 2000 to 236.8 million in 2020. The International Education 2030 Agenda, particularly, Sustainable Development Goal 4 encouraged countries to develop well-integrated education systems that provide learning opportunities and flexible pathways to all students to ensure that we 'leave no one behind'.

Traditionally, the brick-and-mortar system enjoyed a monopoly in providing education and higher learning, which was identified with university education. However, the diversification of the sector and changing institutional provisions in the sector paved the way for the proliferation of agencies to provide education and evolve varying categories of higher education. The post-secondary education implied a study programme not necessarily leading to a degree. Short-duration courses offered by the non-university sector became an attractive proposition to youth to pursue higher learning, linked more closely to employment opportunities. The distance education programmes and Open Universities gave new ways of providing education.

Technology has profoundly changed higher education in many ways. It influenced the way to access education, changed the way teaching-learning is organised and the students are evaluated and graduation degrees are awarded. Online education has become the new normal. The COVID pandemic popularised online education and enrolment increased several times.

Technology has also begun to change the roles of teachers, learners and teaching-learning

processes. In the traditional framework, teachers used to be the primary source of information. The role of the teacher transformed from a 'sage on the stage' to a 'guide on the side'. Teaching and learning, which used to be confined to the classrooms, became globally connected. Today, the students take more responsibility for their own learning using technology and gathering relevant information on their own.

Higher education institutions are redesigning learning spaces to create networks to foster more interaction and work in small student groups through integrating technology with learning. Thus, technology enables forms of communication and collaborative learning unthinkable in the brick-and-mortar system of the higher education. AI is encouraging new innovations in the provision of educational opportunities and in the teaching-learning processes and facilities such as ChatGPT is changing the way people write, prepare documents and publish articles.

The National Education Policy 2020 (NEP 2020) envisages to create technology-enabled learning programmes and new flexible pathways for higher learning. The NEP vision rests on the strong belief that technology will be transforming higher education in India – changing how, when and where children learn and taking advantage of unlimited possibilities of supporting the institutions, teachers and students to promote learning. This report attempted to map out the directions of change to be brought out in Indian higher education as a consequence of the technological changes.

The equity and quality implications of a shift to online education are yet to be internalised. Although enrolment trends in online courses are encouraging, the completion rates are not. For example, a study by Columbia University's Teachers College in 2018 indicated that the completion rates in edX and Coursera courses were only 15 per cent. Similarly, questions are also raised about the quality implications of spreading online education. Since the world's top-ranking universities are engaged in online education in a big way, it is expected that online education will be able to maintain good quality.

They noted disadvantages in such a modality include potentially reduced quality of education, increased faculty training costs, faculty resistance, financial aid constraints, employer bias against online degrees, lack of appropriateness for all subjects/course content, increased cost of technological updates, programme startup costs and challenges, potentially reduced student/professor interaction, irrelevance of previous

location advantage, and potential infringement on existing programmes.

The digital revolution – including the emergence of artificial intelligence, the rise of web-based education and training and big data developments – is disrupting all aspects of life and work. Higher education both has an impact on and is impacted by this revolution. The role of the teachers and institutional leadership is important to bring about changes in the teaching-learning processes and classroom practices. There is a strong need for institutional leadership to mobilise support from faculty members, students, and technical staff to translate these ideas into operational practice. The first step is to provide basic technological facilities by improving the technological infrastructure in the institutions. However, experience has shown that resistance to change is a major constraint in introducing new pedagogical practices and technological orientation in the learning processes. The successful transformation of higher education will depend on the influence of leadership to overcome resistance to change by the faculty, students and staff to adopt new methods of teaching-learning. It necessarily means dialogues with students and teachers, faculty development programmes and institutional support in the classrooms and in facilitating teaching-learning processes through online mode.

It is important to recognise the enormous potential of technology in education. It is equally important to realise that technology will not solve all problems in education. One needs to look at education from a social context and with a human touch. The future of education will depend upon how we approach issues related to equity and conclusion, which call for increased social responsibility and improved sensitivity towards those left behind.

Personalisation in education should vary learner paths to reach not the same learning levels but different ones that fulfil individual potential. More evidence is needed to understand whether AI tools can change how students learn, beyond the superficial level of correcting mistakes. AI may not fundamentally change the set of essential digital competencies that were defined before its emergence. Teacher professional development programmes may need to be adapted somewhat to reflect new ways of assigning homework and assessing students. Supporting teachers in developing better prompts for chatbots is one of several potential areas of development. General teacher proficiency remains crucial in making appropriate pedagogical choices while using AI technology.

There is a need to reflect on what it means to be a well-educated person in a world shaped by AI. It need not be a person further specialised in technology related domain, but rather a person who follows a balanced curriculum that maintains if not strengthens and improves the delivery of arts and humanities to reinforce learners' responsibility and empathy. The implication of intelligent tutoring systems cannot be that AI replaces teachers altogether, but that teachers are entrusted with more responsibility than ever to help societies navigate this critical moment. A consensus is forming about the need to enjoy AI's benefits while eliminating risks from its unchecked use, through regulation relating to ethics, responsibility and safety. How digital technology can support the most marginalised so that all can benefit from its potential, irrespective of background, identity or ability is a major question.

UNESCO's strategy in technology and education will consist of: a) observatory of technological transformations in education and knowledge-sharing; b) technical assistance and capacity development at the country level to expand digital learning solutions; and c) formulation and implementation of standard-setting instruments. These functions will be implemented across three transversal areas of action: (i) building competencies for technology-enhanced pedagogy; (ii) encouraging open, inclusive and sustainable technology solutions for education; and (iii) integrating technological innovations in the service of education systems (UNESCO, 2021a; 2021b). A key pillar of the UNESCO strategy is fostering equitable access to technologies and innovation to enhance quality learning in a lifelong perspective, while protecting human dignity, human rights and promoting gender equality.

Education systems propagate change in other sectors and institutions but hesitate to adopt the same changes for themselves. That is why education is often decried for being slow to change and for being stuck in the past (Weller, 2022). This perspective leads to a situation of education lagging behind the digital leaps made by the production sectors and the skills imparted by the education sector remain less relevant to the changing technological orientation of the production sectors leading to deepening unemployment of higher education graduates.

For more than half a century, reliance on technology has increased in every aspect of life. Technology has restructured our lives and interactions in society. Digital technology has defined the way we communicate with people, the way we shop, the way we generate and disseminate new knowledge and reframed how we experience the world – physically, psychologically and socially (Burns, 2021). Now it is time to recognise that whether we like it or not, technology is going to change the face of learning. This change may be for the better, transforming the current generation into more efficient and faster learners. However, unless accompanied by opportunities for equal access to technology, this transformation may lead to the widening of learning inequalities among the children and youth of the present generation. Planning for overcoming these difficulties is the only way to embrace this change. Keeping away from participating in this change process may be unwise since these technology-induced changes are here to stay for long and last for decades. Adapting to these changes by evolving national policies and institutional strategies for preparing for the future may be the best way for institutions to remain relevant and students to remain fast and smart learners.

It seems that the golden age of brick-and-mortar universities is nearing an end. Households and governments are hesitant to invest in long-duration degree programmes and are unwilling to pay the rising costs of higher education. The past centuries have seen a homogeneous vision of education where educational institutions were the main sources of knowledge. Families delegated a large part of their responsibilities to educate children to schools and institutions of higher education. In recent decades, technological advancements have questioned the monopoly enjoyed by teachers and educational institutions as major sources of knowledge and education. Technology facilitates information and knowledge flow beyond the boundaries of institutions and the idea of education has expanded to life-long learning.

Technology is replacing institution-based learning by a multiplicity of devices supported by digital technology and artificial intelligence. It also leads to hyper-personalisation of learning. The future of higher education will combine a mixture of in-person, location-based programmes and the flexibility of both synchronous and asynchronous virtual learning. Universities such as Cambridge have already announced that they would make all lectures available online. Governments, higher education institutions and the private sector will create learning ecosystems that extend beyond the traditional university campus.

The future of universities lies in their capacity to offer flexible pathways to learning which involves studying in multiple flexible modes, switching between on-campus, blended and fully online modes as per the convenience of the learners. The most common scenario may be that the students may graduate with one long-duration degree and multiple short-cycle credentials. In many instances online courses and fully-accredited online universities may become a common feature to supplement institution-based learning and, at times, to replace them. Even when digital inequality is a topic of discussion, online learning through multiple devices will break the barriers to entry into the digital learning world.

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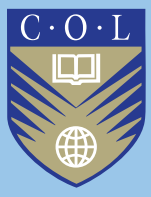

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