Leveraging Technology for Transformative Changes Analysing the Recommendations of the National Education Policy 2020 for the Indian School Education System

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Abstract

Education policies play a vital role in shaping the development of human capital and consequently, the overall progress of a nation. India, the world's most populous democratic country, has introduced three significant education policies in 1968, 1986 and 2020. The National Education Policy (NEP) 2020 has reemphasised on universal access to education to attain basic literacy and numeracy skills, curtailing dropout rates and holistic development of learners. The policy advocates for extensive use of technology to enhance teaching-learning practices, address language barriers, provide personalised learning, perform continuous and holistic assessment, support teacher development, and improve educational administration. This research article explores the policy's focus on integrating technology to address challenges in the Indian school education system. It examines NEP recommendations on digital learning resources, personalised learning paths and the integration of emerging technologies like AI, ML, Robotics, Blockchain, and Data Science into the curriculum. The use of interactive technologies such as AR, VR, and simulations to create engaging educational contents are discussed. By

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categorising the NEP recommendations and analysing their implications, this study sheds light on the potential impact of technology adoption in resolving challenges faced by the Indian school education system.

Introduction

An education policy sets the vision for human capital development and ultimately, the overall progress of the nation. India, the most populous democratic nation in the world, has come out with three education policies so far, since its independence in 1947.

The first National Policy on Education (NPE, 1968) came in 1968, the second National Policy on Education came in 1986, and the latest National Education Policy (NEP, 2020) came in 2020. This indicates the fact that such policies set out the broad path for educational transformation impacting the decades to follow.

The 1968 education policy aimed at preparing a skilled workforce by providing free and compulsory education until age 14, promoting social and national integration, implementing a three-language formula, promoting science and technology education, adult education, vocational education, and establishing national and state-level bodies.

The NPE 1986 emphasised universalisation of elementary education, quality improvement through teacher training and innovative pedagogies, decentralisation of educational planning, utilisation of educational technology, and inclusive education for marginalised and disadvantaged groups, including children with special needs.

The NEP 2020 envisions an education system rooted in India's ethos, culture and past achievements. The aim is to impart high-quality education so that learners become aware of their roles and responsibilities in a rapidly changing world and commit to human rights, sustainable development and living, and global well-being, thereby reflecting a truly global citizen.

Figure 1: NEP thrust areas on technology in education

The NEP 2020 has suggested extensive use of technology to improve teaching-learning and evaluation processes; removing language barriers, supporting teacher preparation and professional development; enhancing inclusion,

equity and access, and for educational administration and planning such as admissions, attendance, assessments, etc. It acknowledges the emergence of Information and Communication Technologies (ICT) and their disruptive potential. It advocates for the use of emerging technologies such as machine learning, artificial intelligence, big data, AR/VR, to solve some of the long-pending challenges of the Indian education system. The emphasis is also on imparting technical and vocational skills and knowledge among learners right from the school stage.

This article is organised as follows. Section 2 discusses some of the challenges in Indian school education Section 3 categorises the NEP 2020 recommendations for the adoption of technology in different aspects of school education, including curriculum, adult education, teacher preparation, digital content, personalised learning, holistic assessment, inclusion, etc. It concludes by covering the implementations done so far, challenges and possible ways forward.

Challenges of the Indian School Education System

The Indian school education system is one of the largest in the world. There are nearly 265 million school-going children in K-12, for whom there are almost 1.5 million schools and 9.5 million teachers (UDISE+, 2023). There are many challenging areas in the education system (Gupta and Dubey, 2019; Singh, 2016) Some of these are:

- Inadequate funding, lack of sufficient infrastructure such as smart classrooms, facilities for sports and other activities (Barrett et al., 2019; Singh et al., 2023);
- Inadequate teacher preparation program, lack of motivation, non-teaching responsibilities for teachers (Kingdon and Sipahimalani-Rao, 2010; Ramachandran et al., 2005);
- Unequal access to quality learning and resources (Hill and Chalaux, 2011; Majumdar and Mooij, 2012);
- Focus on marks, pressure to perform in highly competitive examinations (Anand, 2018; Deb et al., 2015);
- Focus more on rote learning and less on holistic development of learner (Brinkmann, 2015; Patel, 2003);
- Low literacy and numeracy rates leading to high dropouts (Tilak and Tilak, 2018).

This section elaborates on the two important, challenging aspects of the Indian school education system.

2.1 Removing Language Barriers

India's linguistic diversity is vast, with at least 121 languages having over 10,000 speakers (Census, 2011). The constitution recognises 22 languages in Schedule 8, encompassing 96.71 per cent of the population. The NEP 2020 emphasises schooling

in local languages till at least Grade V, but preferably till Grade VIII and beyond. However, ensuring high-quality learning resources in multiple Indian languages remains a challenge (Benson, 2005). The policy encourages the use of technology to preserve and promote all Indian languages, including classical, tribal and endangered languages. It has emphasised the need for machine translation systems to enhance accessibility to learning materials in various languages. Nevertheless, the development of highly reliable machine translation systems for major Indian languages is an ongoing endeavour.

2.2 Achieving Universal Foundational Literacy and Numeracy

The RTE Act (2009) established the right to free and compulsory education for children aged 6 to 14, laying the legal foundation for universal elementary education (Grades I–VIII). Complemented by initiatives like Sarva Shiksha Abhiyan, mid-day meal scheme, teacher orientation, and community involvement, India has achieved nearly 100 per cent Gross Enrollment Ratio (GER) in schools (UDISE+, 2023). GER measures enrollment in a specific education level as a percentage of the age-appropriate population, demonstrating near-universal access for children aged 6–14.

However, concerns remain regarding learners' attainment of competencies. Quality Early Childhood Care and Education (ECCE), as per NEP 2020, remains inaccessible for millions of children (NEP, 2020), with an estimated 5+ crore learners lacking foundational literacy and numeracy skills. Surveys like the National Achievement Survey (NAS, 2021) and Annual Status of Education Report (ASER, 2022) highlight the impact of COVID-19 disruptions, indicating a decline in learning outcomes, particularly in basic reading and arithmetic skills for children in Class 3 and Class 5. The Foundational Learning Study (FLS, 2022) emphasises global proficiency challenges, and UNESCO (2021) reports that nearly two-thirds of 10-year-olds struggle with basic reading comprehension.

NEP recommendation about technology in the school curriculum

The policy has called for restructuring the existing 10+2 schooling system (covering 6–18 years) to a new 5+3+3+4 design, covering ages 3–18 years, as shown in Figure 2.

The policy has made the following major recommendations regarding the inclusion of technology education in school curriculum:

- Digital literacy, coding, and computational thinking are among the subjects, skills, and capacities to be learned by all students.

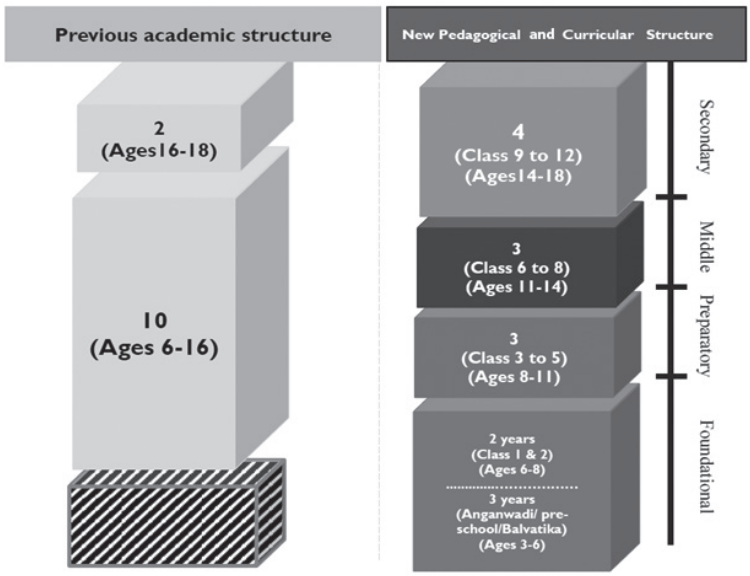

Figure 2: New curricular design of school education as per NEP (2020)

- Computational thinking skills are to be given increased emphasis throughout the school years, starting with the foundational stage.
- Activities involving coding to be introduced in the Middle Stage.
- Artificial Intelligence to be introduced as a contemporary subject at relevant stages.
- Computer Science as a discipline to be introduced in Grade XI.

Ensuring digital literacy and computer skills for every student requires qualified teachers, proficient in areas like coding, computational thinking, AI or ML, ethics and privacy. While basic coding concepts can be introduced in early grades through unplugged activities, effective teaching of computer skills in higher grades necessitates computers, Internet, and electricity with a manageable student-computer ratio, emphasising the need for widespread availability.

Adult Education and Lifelong Learning

The NEP states that schooling and continuing education shall aim to raise the general populace's awareness about the possible effects of disruptive technologies and related issues like ethical aspects, and privacy (NEP, 2020).

- Smooth and beneficial integration of technology to expedite the aim of achieving 100 per cent literacy.
- Financial literacy, digital literacy, and commercial skills are among

the critical life skills to be imparted to all adults.

- Schools and public library spaces to be ICT-equipped for adult education purposes after school hours and on weekends.
- Technology-based options to be enabled for adult learning. These includes apps, online courses or modules, satellite-based TV channels, online books, and ICT-equipped libraries and Adult Education Centres.
- Quality adult education can be conducted in an online or blended mode.

The official definition considers someone literate if they can read and write with understanding. Despite adult education schemes in the past, around 250–280 million illiterates exist in India. Post NEP 2020, the government introduced the 'New India Literacy Programme' (NILP, 2022) for non-literates aged 15 and above. The scheme aims to impart basic skills in literacy, numeracy, financial and digital literacy, vocational skills, and provide education equivalent to Grade XII. Implementation plan includes involvement of volunteer groups, Self Help Groups, and community-based organisations, utilising schools after regular hours for adult education programs.

Motivating illiterate adults engaged in manual labour for volunteer-driven educational activities can be challenging. Considering many have mobile phones, technology could offer a solution. Technology-based interventions, especially on social media, can be effective. Gamified, multilingual content focused on creating awareness on cyber frauds, digital footprints, and data privacy can be beneficial.

Teacher Preparation

The policy puts teachers at the centre of the educational transformation and advocates for their empowerment to ensure the best possible future for children and the nation. Following are some of the recommendations of NEP to bring back the glory of teaching as a noble profession:

- A technology-based transparent, and efficient system for comprehensive teacher-requirement planning, recruitment, and posting or transfer.
- Automation of routine and non-teaching activities of teachers so that teachers can focus on their core job.
- Online platforms for teachers to share their ideas and best practices.
- At least 50 hours of continuous professional development opportunities for every teacher and school head in online, face-to-face and blended modes. Appropriate MOOC platforms shall be made available for this purpose.
- Training for teachers on how to become high-quality online content creators themselves using online teaching platforms and tools.

- E-learning platforms such as DIKSHA (DIKSHA, 2020) to provide teachers with a structured, user-friendly, rich set of assistive tools for online teaching as well as monitoring the progress of learners.
- Digital devices are to be made available to teachers at schools to suitably integrate e-contents into teaching-learning practices.

DIKSHA is India's national platform for school education, having a wide array of digital resources, designed to offer curriculum-aligned contents for different Central and State boards. Teachers can benefit from DIKSHA by accessing a diverse range of courses and teaching-learning resources that assist in their professional development and classroom instruction. DIKSHA has content available in more than 35 languages, including sign language.

The potential of teachers leveraging technology depends on access to digital devices, internet connectivity, and a supportive environment. Key prerequisites include digital literacy and self-motivation. With around 220 working days in a year, teachers spend a significant portion on non-teaching tasks, necessitating the need for automation. Implementing a Learning Management System (LMS) or school ERP, coupled with proper training, can be beneficial.

Motivating teachers involves recognising their efforts, performance-based career growth, and timely redressal of other concerns. Technology can expedite this and enhance transparency. Beyond digital literacy, teachers need subject-specific ICT skills for teaching, classroom integration, managing assignments, and curating digital content. Government efforts, like the ICT@school Scheme (2023) may not be sufficient, as evident from the limited schools having adequate digital infrastructure. Additional budgetary allocation, as emphasised in NEP 2020, is crucial to expedite the process and achieve an acceptable pupil-computer ratio.

It is important to ensure that teachers and school heads are proficient in ICT skills through regular training. While online training is an option, global MOOCs completion rates highlight the effectiveness of face-to-face programmes in achieving impactful teacher training.

Digital Contents

Digital learning resources offer flexible, on-the-go accessibility, enabling learners to access materials anytime, anywhere. A flipped approach provides students with a variety of resources, allowing teachers to utilise classroom time for essential discussions and activities. While preparing lessons, teachers can turn to digital content for insights into content-specific pedagogies, suggested activities, and assignment ideas. Notably, the NEP 2020 has laid following emphasis regarding digital content in school education:

- Teaching-learning content in digital format shall be developed in multiple Indian languages, and made available for both teachers and students through DIKSHA and other such platforms.
- Digital repositories of content, including coursework, educational games and Simulations, Augmented Reality and Virtual Reality based content to be developed in multiple languages.
- Virtual labs to be developed for students to have equal access to quality, practical and hands-on experiment-based learning experiences.
- For a fun-filled experience, student-appropriate tools like apps, gamification of Indian art and culture in multiple languages to be created.

Government initiatives for digital content repositories at the central level include DIKSHA (2021) and National Digital Library (NDL) (Das et al., 2016), but students and teachers can access other resources too. The World Wide Web (WWW) is full of learning resources from almost anyone and everyone. Unguided exploration by learners in early grades can misguide them with irrelevant content. It requires skills and experience to assess the contents in the WWW for their quality and accuracy. At present, many of the teachers themselves need to gain such skills, and hence are unable to guide learners to the appropriate contents or repositories.

Teachers also play an essential role in the creation of content. Many online platforms and software today allow easy creation of digital content. Traditional e-contents such as, text, graphics, animation, audio, and video are the basic elements of any content. However, these contents in their basic forms may have limited effectiveness in engaging learners and drawing their attention. An effective e-content challenges the learner, arouses creativity, excites to explore further, tracks the learner's progress, discloses reviews and ratings, provides feedback and tracks the performance. We need to design e-contents that are interactive, immersive and accessible from mobile devices too. They can be in the form of educational games, interactive quizzes with adaptive feedback, simulations, AR/VR-based content, 3D/360 content, etc.

Personalised Learning, Assessment and Holistic Progress Card

Each child has a unique learning style, learning speed and preferences. Besides, students from different socio-economic backgrounds with varying levels of prior knowledge require different degrees of attention and effort from teachers. Therefore, the same approach towards all learners is not appropriate. But, it is humanely difficult for a teacher to pay attention to each learner as and when required. Hence, the NEP 2020 suggests leveraging technology for personalised learning and assessment.

- A learning management system powered by AI or ML that gauges each learner's strengths or weaknesses, likes or dislikes, learning style, and prior knowledge and guides on an individual basis while giving children the flexibility to learn at their own pace, time and convenience.
- Adaptive computer testing to identify children's strengths and weaknesses.
- A digital holistic progress card that records each learning activity and accumulates the credits earned by a learner from multiple sources applies data mining to infer the student's actual progress, interest, aptitude and attitude.
- A National Assessment Centre called PARAKH (Performance Assessment, Review, and Analysis of Knowledge for Holistic Development) is to be set up as a standard-setting body for setting norms, standards, and guidelines for student assessment and evaluation for all school boards of India.
- Addressing the challenges in conducting online examinations at scale, including limitations on the types of questions that can be asked in an online environment, handling network and power disruptions, and preventing unethical practices.

As a positive impact of the Covid-19 pandemic, a plethora of educational technology (EdTech) companies offer various commercial education services these days. But there are few solutions powered by AI/ML in a true sense. It is challenging to develop an Intelligent Tutoring System (ITS) to support personalised learning and teaching at the level of the student. Such systems should be able to model a student's cognitive and affective traits to carry out personalised tutoring (Barbhuiya et al., 2013).

Online and hybrid delivery of courses requires a mechanism for proctored examination as well. This poses the dual challenge of ICT infrastructure and teacher orientation for online remote examinations. Besides, online platforms currently can handle only objective-type assessment questions, which is not sufficient for assessment in all domains. Today's learners can learn from available resources besides the classroom also. All such evidence of learning needs to be recorded progressively for a holistic assessment. A universal credit framework can be defined to recognise all the credits a learner earns from different avenues.

Inclusion, Equity and Access

The Sustainable Development Goal (SDG) 4 of the United Nations (UN) is to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. Equitable and quality primary and secondary education shall be provided to all learners regardless

of their gender, socio-economic backgrounds, or geographic locations, including persons with disabilities. As mentioned earlier, the linguistic diversity of India demands technological solutions to provide learning opportunities in the language of one's choice, including the availability of textbooks, e-contents, and communication with teachers and peers.

- Every classroom shall have access to the latest educational technology that enables better learning experiences.
- To address the issue of the digital divide, mass media such as, television, radio, and community radio are to be extensively used for telecast and broadcast of content on a 24/7 basis in different languages to cater to the varying needs of the student population.
- For educational inclusion of differently abled, technology-based solutions to be used for the orientation of parents or caregivers along with wide-scale dissemination of learning materials.
- Educational software, apps and all the learning materials for students and teachers will be available in major Indian languages.

India still has a significant proportion of learners who need continuous access to Internet and computer facilities. There are ongoing attempts to address the digital divide by adopting mass media for education. However, they are less effective compared to online modes of teaching-learning in a synchronous environment.

Divyang or Divyangjan is a Hindi term for persons with special needs or disabilities. As per the UDISE+ report for 2021–22 (UDISE+, 2022), around 20 lakh Divyang learners are enrolled in schools across India. They often face difficulty in accessing the e-contents because the web portals and mobile apps are often not designed as per the universal standards of web accessibility. Learners with visual impairments can easily navigate the web with the help of screen reading software if the web pages are developed following the standards. Further, the e-content themselves shall also be developed, considering the accessibility requirements. Sign language-based video content can be helpful for those who can not hear. Here again, teachers require special orientation on how to deal with Children with Special Needs (CWSN) while using technology in education.

Generic Areas

- To raise awareness on issues of privacy, laws, and standards associated with data handling and data protection.
- An autonomous body, the National Educational Technology Forum (NETF), is to be created to provide a platform for the free exchange of ideas on the use of technology to enhance learning, assessment, planning, administration, and so

on, both for school and higher education.

- There is a need to create an open, interoperable, evolvable, public digital infrastructure in the education sector that can be used by multiple platforms and point solutions, to solve at India's scale, diversity, complexity and device penetration.
- The digital divide is to be eliminated through concerted efforts such as, the Digital India campaign, the availability of affordable computing devices, public and private expenditure on providing digital devices in schools, and last-mile Internet availability.

Status of Implementation of NEP recommendations

The recommendations of NEP are being implemented in a time bound manner. An indicative and suggestive Implementation Plan for School Education called Students' and Teachers' Holistic Advancement through Quality Education (SARTHAQ) was launched by the Government of India in 2021. It defines a total of 297 tasks and activities with clear goals, outcomes and timeframe alongwith responsible agencies for the implementation. Some of the technology related tasks and their status of implementation so far are given below:

(i) MOOCs: To facilitate learners in their digital and hybrid mode of learning, NCERT is running 28 online courses for students of Classes 9–12. These courses are run on an annual basis.

(ii) *Virtual labs:* A dedicated vertical on DIKSHA has been created to design and disseminate virtual lab contents for school education. NCERT, in collaboration with CDAC and Amrita University are developing virtual labs for Science, Mathematics, English and Computer Science. A total of 218 virtual lab activities have been developed so far.

(iii) *VidyaSamiksha Kendra (VSK):* Data driven analytics play a key role in getting the insights about programs and schemes. Analysis of various kinds of data across various initiatives at Central and State Government levels helps in timely visibility to progress and relevant metrics. Realising the significance of data, an integrated system called Vidya Samiksha Kendra (VSK) has been established to effectively collect, monitor, co-relate, and analyse data for timely actions to implement schemes.

(iv) *TV Channels:* Under the centrally sponsored scheme called Prime Minister's eVidya, a total of 12 DTH TV channels are run by NCERT, one each for Classes 1–12. This has been further extended to 200 channels in which States or UTs have also started running curriculum based video contents for their state specific curriculum. These channels are curriculum

based video contents on a 24 by 7 basis.

(v) *FLN:* A separate vertical for Foundational Literacy and Numeracy (FLN) has been created in the DIKSHA platform. Under the National Initiative for Proficiency in Reading with Understanding and Numeracy (NIPUN Bharat), a national mission on FLN, developmental goal wise e-contents for ages 3–8 years have been created and made available on DIKSHA. A total of 12 online courses for continuous professional development of teachers at primary schools have been developed under NISHTHA and these are delivered through DIKSHA platform.

(vi) *Inclusion:* CIET, in collaboration with Indian Sign Language Research and Training Centre (ISLRTC), is developing curriculum mapped video resources in sign language. In all, 954 textbook-based ISL videos have been uploaded on DIKSHA. To facilitate learners with visual impairments, about 4,460 audiobook chapters based on textbooks for Classes 1–12 have been developed. For screening of early signs of disabilities among learners at school level by teachers, a mobile app called PRASHAST (Pre-Assessment Holistic Screening Tool) has been developed to digitally screen the students with disabilities. It is available in 18 languages for easy access of teachers, special educators and school heads. So far, 6,15,325+ users have registered on the app. In addition, a total of 10,500+ ISL dictionary words were recorded and uploaded on DIKSHA.

(vii) *Teacher training:* NEP has recommended at least 50 hours of program for continuous professional development of teachers for every year. In this regard, NISHTHA courses for different school stages are being delivered in online mode where teachers are certified based on assessment and other course criteria.

Conclusion and the way forward

Governments, both at the central and state or UT levels, have consistently introduced initiatives to integrate educational technology across all levels of school education. The evolution began with the provision of tools like radios, cassette players, televisions, microcomputers, desktop computers, and satellite-receiving terminals. Gradually, the focus shifted towards modern day Information and Communication Technologies (ICT), powered by the Internet. The Satellite Instructional Television Experiment (SITE) in 1975–76 marked India's initial large-scale attempt at running educational television channels. The launch of the Indian National Satellite (INSAT) in 1980 further facilitated educational use, paving the way for producing educational content transmitted via Doordarshan.

The Computer Literacy and Studies in Secondary Schools (CLASS) project came in 1984, utilising microcomputers sourced through BBC to enhance computer literacy among teachers. Subsequent efforts, such as the ICT@School scheme, aimed at developing high-quality digital content and recognising outstanding teachers integrating ICT in their schools. The revised ICT and digital initiatives under the samagra shiksha (ICT@School Scheme, 2023) fund government and aided schools for establishing ICT labs, and equipping classrooms with interactive boards. Government initiatives have consistently emphasised technology adoption, with the current policy renewing the focus on information and communication technology in various aspects of school education. The implementation of NEP 2020 recommendations on ICT promises to contribute significantly to achieving the SDG 4 goals of universal and inclusive quality general education (Boeren, 2019).

Executing these recommendations will require substantial financial investment in providing and maintaining ICT devices in schools nationwide. Teachers play a pivotal role in seamlessly integrating technology with classroom teaching and assessment. The training of nearly 95 lakh school teachers demands a mix of online, offline, and hybrid approaches in professional development programs, incentivising proven ICT based instructional strategies. NEP 2020 also advocates pilot studies on technology use before large-scale adoption, emphasising the need to transparently outline the limitations of technology adoption. Mindful consideration of concerns related to ethics, data privacy, cyber security, online fraud, and ergonomic and health-related issues is crucial in harnessing the potential of ICT in school education.

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