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Online and Digital Education: Ensuring Inclusive, Affordable and Sustainable Education for 21st Century Teacher and Learner - in the light of NEP-2020

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Abstract

The Indian educational system has used the Traditional Teaching-Learning method since ancient times. Indian education gradually moved towards an ICT-based, online-digital, and blended learning paradigm. All learners have benefited greatly from the integration of online and digital learning, which has promoted inclusive, inexpensive, and sustainable education for the past, present, and future generations. This article aims to give a broad overview of the significance of online and digital learning for inclusive, reasonably priced, and sustainable education for teachers and learners in the twenty-first century. It also identifies the several obstacles that online and digital learning must overcome. Every step of the review process was followed in the conduct of this study, starting with the formulation of a relevant and significant critical question and objectives. Systematic quality reviews of relevant publications should be conducted in order to gather data on the subject. This research critically examines the methodological procedures used in content analysis, meta-analysis, and qualitative research. The results of this research show that online and digital learning face many obstacles and that there are important ramifications for online and digital learning. Policymakers and other stakeholders are also given suggestions on how to approach these problems in order to raise the bar for 21st-century students' education through online and digital learning. NEP-2020 also takes into account the significance of blended learning, online teaching platforms and tools, online education pilot studies, and closing the digital divide.

Keywords: Online and Digital Education, Inclusive, Affordable, Sustainable Education

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Introduction

An inclusive, reasonably priced, and long-lasting learning environment has been greatly aided by online and digitally based learning. Furthermore, the provision of continuous professional development opportunities via digital platforms enables educators to remain up to date with changing educational approaches and technical developments.

Technology breakthroughs are causing a rapid transformation in society. Instructors and students cannot fall behind. Given this context, the integration of digital and online learning fosters inclusive, cost-effective, and sustainable education for all in the twenty-first century. Furthermore, tackling issues of digital equity and advocating for opportunities for lifelong learning will guarantee inclusivity and sustainability in teacher preparation. NEP-2020 clause 24.4 indicates that technology is becoming an increasingly important tool for teaching and learning at all levels, from K–12 to higher education, given the rise of digital technologies.

The NEP-2020 suggests the following crucial actions for promoting the technology-based teaching-learning approach:

- Blended models of learning
- Online education platform and tools
- Digital infrastructure
- Addressing the digital division
- Content creation, digital repository, and dissemination

NEP 2020 clause 24.4 (b) encourages and supports investment in the establishment of open, interoperable, evolvable public digital infrastructure in the education sector that can be utilised by different platforms, in order to address India's scale, diversity, complexity, and device penetration. As a result, the National Digital Education Architecture (NDEAR) was created by the Ministry of Education. Online ICT-based digital platforms like SWAYAM and DIKSHA will be promoted and expanded.

Two different techniques to design have been created, according to (Mayer, 2001) one for learning multimedia knowledge and the other for building multimedia knowledge.

- A strategy focused on technology with the goal of answering the question, "How can we use the technological resources that are available for our needs?" Its primary objective is information access.
- Employing a student-centred approach, trying to find an answer to the issue of how to improve the learning process by modifying the technology tools at our disposal? Supporting the generation and acquisition of knowledge is its aim.

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In order to provide immersive and data-driven insights into teaching and learning processes, emerging technologies like AI (Artificial Intelligence), virtual reality, and big data analytics will likely be increasingly integrated into education in the future. In order to guarantee inclusive, accessible, and sustainable education for all in the twenty-first century, this article examines the historical evolution, current issues, significance, difficulties, and future implications of online and digital education. In this study also explain how TPACK, SAMR model, Rogers' Diffusion of Innovation Theory, Digital Equity frameworks and Mayer's theory supports Online and Digital Education for Inclusive, Affordable and Sustainable Education?

- **Context matters for TPACK: Implication of TPACK model for Inclusive, Affordable and Sustainable Digital Education**

One of the most well-known frameworks for characterizing teachers' expertise in incorporating technology into the classroom is Technological Pedagogical and Content Knowledge (TPACK). Punya Mishra and Matthew J. Koehler developed it around 20 years ago (Mishra & Koehler, 2006). TPACK is based on the Pedagogical Content Knowledge (PCK) paradigm developed by Lee Shulman (Shulman, 1986). Technological knowledge (TK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), Technological Pedagogical Content Knowledge (TPCK), and Contextual Knowledge (CK) are the five additional domains specific to the following technology that are included in TPACK which was shown figure.1 below.

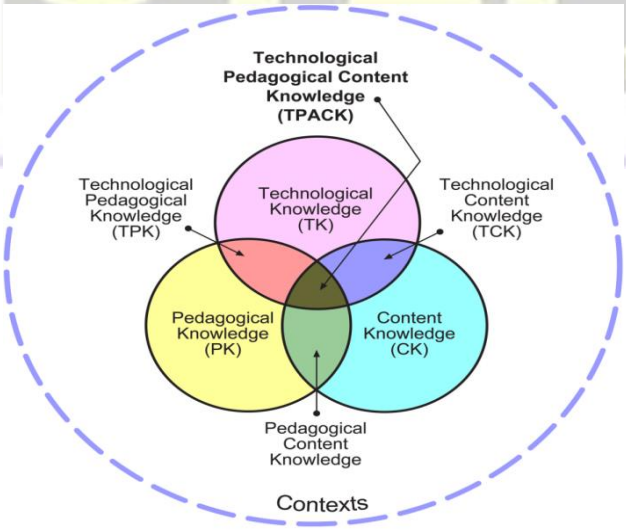

Fig. 1: The original TPACK model 2009

Source: (Koehler & Mishra, 2009)

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The seven fundamental elements of the 2009 TPACK model are encircled by a dotted circle marked "Contexts," as seen in figure-1. According to this framework, effective technology integration depends not only on a high degree of expertise in each of these domains but also on a combination of factors from these domains that inform the pedagogical design of instructional activities.

One of the most crucial frameworks for creating accessible, reasonably priced, and long-lasting online and digital education is the TPACK Model (Technological–Pedagogical–Content Knowledge). It guarantees that technology is intentionally combined with good education and in-depth topic understanding rather than being utilised haphazardly. This approach guarantees the efficacy, equity, and significance of digital education. By combining technology with pedagogy and content, TPACK assists educators in creating inclusive and accessible learning environments. TPACK makes guarantee that language minorities, rural students, learners with disabilities, and students with a range of ability levels can all benefit from online education.

- **Implication of SAMR model in Digital educational practices:**

Dr. Ruben Puentedura, a former Harvard teaching fellow and well-known authority on technology and education, developed the SAMR model to assist educators in analysing and evaluating the use of technology in the classroom. With the use of technology, this SAMR approach assists teachers in discovering methods to enhance their students' learning. The usage of technology in the classroom and its effects on students' education is examined using the SAMR model. Figure 2 illustrates the four hierarchical layers of the SAMR model.

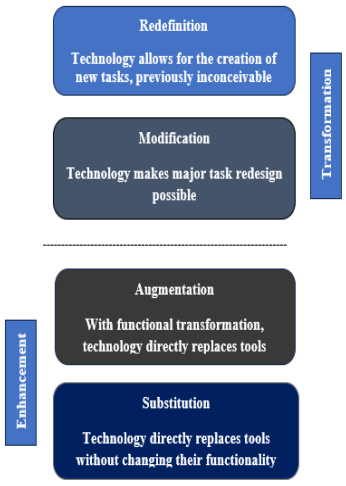

Fig. 2: The SAMR Model

Source: (Puentedura, 2020)

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Digital technologies have the potential to either improve or revolutionise educational practices, according to the Puentedura SAMR model (Puentedura, 2009). The SAMR Model (Substitution, Augmentation, Modification, Redefinition) offers a clear, useful framework for changing how technology is used rather than merely adding it on top of conventional practices, which makes it crucial for attaining inclusive, affordable, and sustainable online and digital education. SAMR makes sure that technology serves as a bridge rather than a barrier for students with special needs, rural pupils, and marginalised learners. SAMR makes it possible to make wise, economical choices that lower the cost of digital education for both students and institutions.

Implication of Rogers' Diffusion of Innovation Theory for Ensuring Inclusive, Affordable and Sustainable Digital Education:

An innovation: what is it? In his book "Diffusion of Innovations," Rogers (1983) defined innovation as a concept, method, or item that a person or other adoption unit perceives as novel (Wani & Ali, 2015). Although the Innovation Diffusion Theory was first proposed in 1962, Rogers refined it in 1995 (Rogers, 1995) Understanding how, why, and how quickly novel concepts and technology proliferate within a social system is the main goal of innovation diffusion theory (Rogers, 1962). According to Les Robinson's diffusion of innovations idea, innovations themselves undergo change rather than people (Les Robinson, 2009). The transmission of ideas from one society to another or from a focus or institution within a society to other areas of that society is typically referred to as the diffusion of innovations (Rogers, 1962). Over the past 20 years, the innovation diffusion hypothesis has been a key theory in the study of technology diffusion. Because Rogers' Diffusion theory explains how new technologies spread, why adoption is uneven, and what tactics are required to ensure that all learners and institutions can benefit, so Rogers' Diffusion of Innovation (DoI) theory is crucial for developing inclusive, affordable, and sustainable online and digital education. According to Rogers' hypothesis, breakthroughs like digital classrooms, online learning platforms, AI-based tools, and educational technology disseminate throughout a community. No student, instructor, or community is left out of the advancement of digital technology thanks to Rogers' Diffusion of Innovation (DoI) hypothesis.

What is Digital Equity Framework and why is it so Important for Inclusive, Affordable and Sustainable Digital Education?

Integrating fairness into the creation and deployment of digital technologies is known as "digital equity." It is to acknowledge that access, affordability, and the skills required for

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these digital platforms and systems vary among individuals, groups, and communities (CASY Digital Equity Framework, 2021-2025). In order to encourage equitable participation in the digital era, digital equality has been universally acknowledged as a crucial educational objective (Mikhailov et al., 2024). By addressing the unique digital demands of various populations, digital equity seeks to integrate equitable access and benefits into digital systems. It is a strategy that seeks to provide all people and communities with the digital resources, abilities, and self-assurance required to engage in our economy, society, and democracy (CASY Digital Equity Framework, 2021-2025).

In order to address digital inequalities, many educational initiatives and interventions concentrate on closing gaps. Examples include investing in telecommunication infrastructure in rural areas (Liao et al., 2016), strengthening parental mediation to support students' technology use (Yuen et al., 2018), and increasing students' preparedness for the internet (Al Mamun et al., 2022). For online and digital education to be accessible, inexpensive, and sustainable, digital equity is crucial. A digital education system that is technologically, socially, and environmentally sound both now and in the future is considered sustainable. Additionally, digital equity has a significant economic component. It guarantees that students won't be financially burdened by digital learning.

Research Gap of the current study

One major limitation of systematic review studies, according to Luo and Chan (2022), is that the review can only include studies that meet the authors' predetermined criteria. In order to ensure accessible, reasonably priced, and sustainable education, the designated field for this study is online and digital education. Based on the literature analysis, it can be stated that while digital inclusion is crucial for a country's overall growth, students from various socioeconomic backgrounds have serious concerns about equitable access (Rawat et al., 2025). The lack of thorough, India-centered meta-analyses and extensive content-analyses that synthesise empirical evidence on what actually works (for whom, at what cost, and under what conditions) undermines the policy design for inclusive, affordable, and sustainable digital education under NEP-2020, despite the abundance of commentary, case studies, and narrative reviews about digital education and NEP-2020. Recent scoping/review literature and the prominence of policy opinions over pooled quantitative summaries provide evidence for this gap. Numerous descriptive studies and policy recommendations are highlighted in a recent scoping/review of NEP-2020 & digital education, but it also emphasises the need for evidence to guide scalable implementation and the insufficient empirical synthesis. Instead of

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using pooled meta-analytic study, several Indian periodicals conduct qualitative content analyses or narrative evaluations of NEP-2020 and digital policy.

Therefore, it is necessary to broaden the conceptual lens to acknowledge more varied and powerful approaches to comprehending digital equality in education, even though the existing efforts to define digital equality offer helpful advice for future research and practice. The complexity of digital equality is widely acknowledged, as noted by Ferrante et al. (2024). A large portion of the literature did not properly examine the potential implications of the term "digital equality." There are worldwide systematic reviews and meta-analyses on the efficacy of online learning, but they primarily use foreign research (rather than samples particular to India) or combine contexts without conducting subgroup analyses with an emphasis on India. This creates a gap in evidence peculiar to each nation. India desperately requires thorough, India-centred meta-analyses and content analyses that convert a vast but dispersed body of literature into practical, context-sensitive policy and practice in order to fulfil NEP-2020's promise of inclusive, affordable, and sustainable digital education.

Research Questions

1. What are the historical trends and development for Online and Digital education?
2. What cutting-edge technologies have the potential to revolutionise education sector for 21st century and how might they be combined?
3. What is the NEP-2020 Recommendations on integration of Educational Technology for all?
4. What aspects of lifetime learning and ongoing professional development are supported for educators and students by the integration of online and digital learning??
5. What obstacles have prevented in the path of Online and Digital education in the 21st century learning environment?
6. What tactics may be used to go beyond the obstacles that stand in the path of online and digital education?

Objectives of the study

1. To examine the historical progression of Online and Digital based education for ensuring inclusive and sustainable education for all.
2. To identify emerging technologies and potential future trends of Online and Digital education.
3. To analyse the NEP-2020 Recommendations on integration of Educational Technology for all.

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4. To explore the role of Online and Digital education in enhancing lifelong learning and continuous professional improvement for teachers.
5. To investigate the challenges and barriers faced in the past and present regarding the integration of Online and Digital education.
6. To propose suggestions and recommendations for policy makers and stakeholders on how to overcome the challenges and better integrate of Online and Digital education.

Significance of the study:

Addressing the changing requirements of contemporary educators and learners requires an understanding of the effects and efficacy of integrating online and digital resources in the classroom. Through investigating this subject, scholars might unearth novel approaches to augment inclusivity by engaging marginalized communities, ameliorate affordability by diminishing obstacles to obtaining high-quality education, and foster sustainability by adopting digital solutions that facilitate lifelong learning. Furthermore, examining online and digital education through the lens of NEP-2020 enables a thorough examination of the ways in which initiatives and policy guidelines can be used to promote the use of technology in the classroom. In the end, this study can help advance inclusive, affordable, and sustainable education for teachers and students in the twenty-first century by offering insightful advice to stakeholders, educators, and policymakers on how to successfully implement online and digital education practices that support the objectives of the NEP-2020. In the context of NEP-2020, the NCF 2005 underlined ICT's "significant role." As technology advances, its significance in K–12 and higher education will only increase, contributing to the maintenance of standards, affordability, inclusivity, and sustainability of education for future generations.

Methodology:

The methodology helped the investigator to form a deeper understanding of a theoretical rationale. The current study is purely theoretical, thematic and conceptual based. The methods of the present study are qualitative in nature and systematic review based. A thoroughly review of related literature and content analysis was employed in the production of this study and the data collection process. A range of secondary sources, such as books, journals, theses, published records, NEP-2020 policy, scientific data, UGC report, various official websites of both governmental and non-governmental entities, reports and articles, etc., are used to obtain the essential information. The use of secondary sources for data has well defined sample and dimensional research limits in this work. This study systematically examined the definitions of digital equality/online and digital education in 90 educational studies that were published

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between 1962 and 2025. This study complied with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement and the commonly used methodology for performing systematic reviews described by Petticrew and Roberts (2008), (Page et al., 2021). Figure 3 below provides a full description and summary of the review process.

Inclusion and Exclusion Criteria

Research publications that meet the following criteria were included in the review:

1. An empirically grounded research report.
2. The chosen research paper's target population (primary to higher education level, for example).
3. Featured of digital education which is included (e.g., including online and digital education, digital equality, digital education for inclusive, affordable and sustainable education).
4. Research paper published between 1962 to 2025.
5. Research paper published in peer-reviewed journals, national and international journals in English Language.

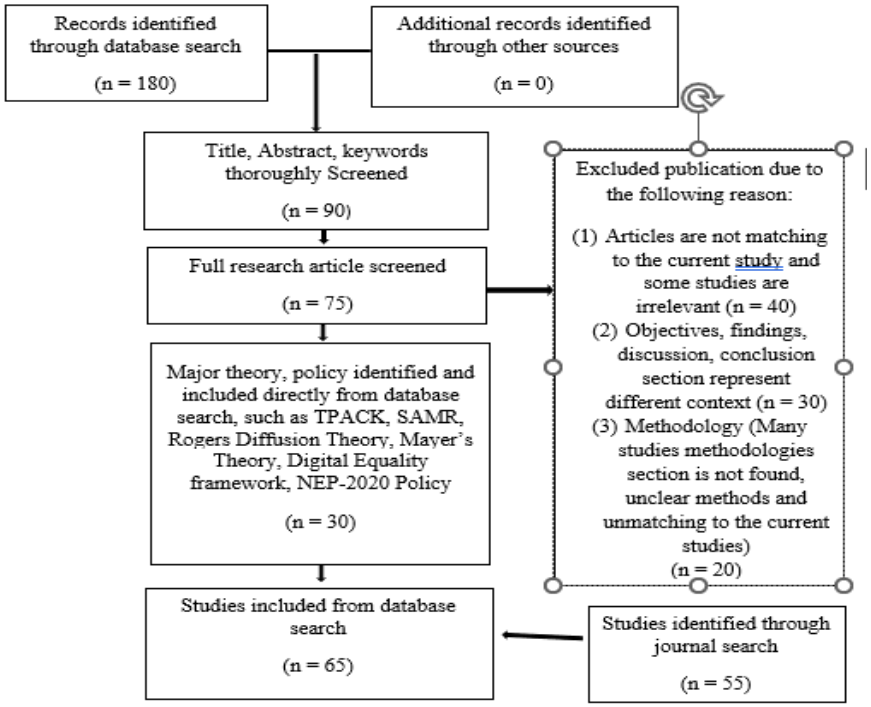

Fig. 3. Flow diagram of the screening process for the systematic review and publication selection

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Historical progression of Online and Digital based education for ensuring inclusive and sustainable education for all:

In ancient India, the Traditional Teaching-Learning approach constituted the core of education. Digital technology and online integration have steadily contributed to the transformation of higher education. Following that, the educational system implemented learning-based online teaching strategies. Studies conducted by a numerous of scholars have demonstrated the importance of e-learning environment design to the learning process (Baker & Lund, 1997). Clause 24.2 of NEP 2020 emphasises the need for technology to be used in digital and online learning focuses on issues of equity.

Examining the present, we find that digital and online learning have been crucial in advancing inclusive, excellent, cost-effective, sustainable education both now and in the future around the globe. Here are a few key points that highlight its evolution and function.:

Past:

i) **Improved Communication:** Teachers, students, and educational institutions may now contact with each other more easily thanks to digital tools, which promotes collaboration and knowledge sharing.

ii) **Make use of Resources:** ICT provided access to a wide range of educational resources, reducing dependency on conventional, frequently limited learning materials.

iii) **First Adoption:** In the past few decades, ICT has mostly been added to teacher education programmes as a way to enhance communication and administrative tasks.

iv) **Insufficient connectivity:** There were significant issues with the digital divide and limited access to technology, especially in underdeveloped countries. Therefore, limitations in the infrastructure often restricted the effect

v) **Supplementary Resources:** Digital tools including instructional software, CD-ROMs, and rudimentary internet resources were added to traditional teaching methods in the early stages of integration.

Present:

i) **Integration with mainstreaming:** online and digital learning have become crucial components of learner's preparation curricula worldwide.

ii) **Worldwide cooperation:** ICT makes it possible for educators to collaborate internationally by exchanging ideas, resources, and best practices.

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iii) **Blended Learning:** The incorporation of ICT enables blended learning approaches, which combine traditional classroom instruction with online resources to fit a variety of learning styles and demands.

iv) **Cooperative education:** ICT enables teachers and students to work together across geographical boundaries on lessons and to exchange resources, knowledge, and best practices. Relational communities are currently the places where collaboration has taken the role of local communities (Bess et al, 2002).

v) **Personalized or customized education:** Thanks to digital platforms that provide personalised learning experiences, teachers may tailor their lessons to each student's needs and interests.

Future:

i) **Emerging Technologies:** Emerging technologies like AI, VR, and AR have the ability to dramatically change teacher education through immersive and interactive learning experiences.

ii) **Inclusivity and Accessibility:** Closing the digital gap is a goal in order to ensure that educators around the world have equitable access to professional development opportunities and instruction.

iii) **Lifelong Education:** ICT enables lifelong learning for educators, fostering continuous professional development and adaptability to evolving pedagogies and technology breakthroughs

iv) **Sustainable Development:** ICT integration fosters sustainable growth by providing educators with the information and tools they need to properly tackle both current and upcoming educational issues.

Emerging technologies and potential future trends of Online and Digital education.

In the future, a number of cutting-edge technologies have the potential to significantly alter sustainable teacher education:

i) **Artificial Intelligence (AI):**

- AI-powered personalised learning platforms can provide flexible learning opportunities tailored to individual teachers' needs and preferences.
- Teachers can get assistance from AI-powered virtual assistants with lesson preparation, grading, and providing students with personalised feedback.
- AI-driven analytics may examine large data sets to identify trends, patterns, and areas where teaching strategies and student learning outcomes need to be improved.

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ii) Virtual Reality (VR) and Augmented Reality (AR):

- The immersive and engaging training experiences provided by VR and AR simulations can be advantageous for both pre-service and in-service educators. They can rehearse classroom management, teaching strategies, and student engagement techniques in a risk-free setting thanks to this.
- By utilising VR and AR to create virtual field trips, educators and students can investigate real-world places and scenarios that might not be available otherwise.

iii) Internet of Things (IoT):

- Examples of Internet of Things (IoT) devices that can collect data in real-time on student interactions, classroom activities, and ambient factors are wearable technology and smart sensors. Teachers can utilise this information to guide their reflection and decision-making.
- IoT-enabled smart classrooms can maximise resource efficiency, automate tedious processes, and create more productive and sustainable learning environments.

iv) 3D Printing and Robotics:

- With the use of 3D printing technology, educators may develop personalised models, prototypes, and instructional aids that are precisely suited to their own learning objectives.
- Robotics may help with experiential learning in STEM subjects by allowing teachers and students to explore concepts like robotics programming, engineering, and coding.

NEP-2020 Recommendations on integration of Educational Technology for all.

We must have backup plans for high-quality, equitable education in case traditional, face-to-face classroom settings are unfeasible. This is due to the need to balance present circumstances with future requirements. In this regard, NEP-2020 acknowledges the significance of taking advantage of technology's advantages while recognising the possible risks. To address the existing and future challenges in delivering high-quality, equitable education for everyone, the current digital platforms and ongoing ICT-based educational endeavour will need to be improved and expanded.

Technology must be included into a number of areas, including management, administration, and planning of education in addition to teaching, learning, and evaluation.

- The National Educational Technology Forum (NETF) is defined in clause 23.3 of NEP-2020 as a venue for the open discussion of methods to use technology to improve teaching, evaluation, planning, and administration consultation, as well as for the sharing of best practices (Kumar, R., & Ganesh, R.S. 2022).

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- NEP 2020 clause 15.10 proposes and encourages the use of technological platforms such as SWAYAM/DIKSHA for online teacher training in order to promptly provide standardized training programmes to a large number of instructors.
- NEP 2020 states that a variety of learning modalities and adequate technology assist the teaching-learning and educational processes of the future.
- NEP-2020 states that ICT has a "significant role," which was recognized by NCF in 2005. creation of "smart schools," which serve as technological showcases.
- The necessity of employing technology for online and digital education is highlighted in NEP- 2020 clause 24.2, which also tackles issues about equity.

Role of Technology in Education for creating inclusive, sustainable, affordable educational environment:

There are 169 targets and 17 goals in the Sustainable Development Goals (SDGs) that are intended to foster fair and integrated management of ecosystems and natural resources, increased opportunities for all, decreased inequality, increased living standards, and sustainable, inclusive, and equitable economic growth. The Sustainable Development Goals (SDGs)-4, in particular, focus on providing equitable and inclusive quality education and encouraging opportunities for lifelong learning for everyone. It has been noted that a large number of individuals in the twenty-first century are underinformed and unaware of the importance of a sustainable environment and sustainable educational practices.

However, UNESCO (2005) asserts, that legislation and technological solutions alone will not be sufficient to achieve sustainability. Instead, people must drastically change the way they think and behave.

Information and educational technology will play a major role in sustainable development and education. A rise in technical sustainability initiatives and awareness is necessary in our society if we are to meet the aims of sustainable development in the twenty-first-century, technology-driven economic society. To set the foundation for the achievement of educational sustainability goals, every school, college, and institution should position itself as a hub for technical sustainability, environmental sustainability, inclusion, and democracy.

The preservation of a sustainable learning environment should be greatly aided by the integration of educational technology into the education sector. For instance, since paper is made from trees, it is imperative that the education sector lessen its reliance on paper-based labour. According to this viewpoint, there are many more tools that we should utilise in place of paper-based resources, such as Blended learning, digital learning, e-learning, and online

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education. With these learning technologies, paper-based resources are superfluous. As a result, it was noted that numerous actions are being taken at the academic, administrative, and institutional levels of the organisation to minimise the amount of paper-based work. Using digital resources such as e-books, audio-video resources, PPT presentations, digital libraries, online articles, journal and research papers, social media platforms, and online assessment strategies is an example of the initiative taken in the academic setting.

Role of Online and Digital education in enhancing lifelong learning and continuous professional improvement for teachers:

Integration of online and digital-based education greatly supports learners as well as educators' lifelong learning and continuous professional development (CPD) in a number of ways.

- **Acquiring Resources:** Teachers and students can access a multitude of educational resources, including research articles, e-books, webinars, online courses, and multimedia content, through online and digital platforms.
- **Personalized Learning Experiences:** Professional development activities can be tailored to the interests and needs of certain teachers and learners through the use of digitally based learning.
- **Flexible Educational Opportunities:** Teachers can learn at their own pace and convenience with the flexibility of online courses and webinars, which is especially useful for those with demanding schedules or professional obligations.
- **Stay Updated with Emerging Trends:** It is easier for teachers to stay up to date on new breakthroughs in technology, trends, and educational research when they use online and digital learning environments. Professional learning networks, social media, and internet resources provide forums for debating current affairs, obtaining timely information, and remaining abreast of industry developments.
- **Promoting an Attitude of Lifelong Learning:** By integrating online and digital based learnings platforms into teacher education, teachers are encouraged to embrace a lifelong learning mindset that is marked by curiosity, adaptability, and a dedication to professional growth. According to J. Dewey's educational philosophy, the goal of a teacher is to inspire and encourage students to learn, not to impart knowledge (Dewey, 1916).
- **Communities of Collaborative Learning:** Information and communication technologies (ICT) have historically been employed in education to support knowledge transfer or

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cooperation in virtual learning settings. Computer-supported collaborative learning (CSCL), both synchronous and asynchronous, has promoted over time. (Stahl et al, 2006).

Challenges and barriers faced in the past and present regarding the integration of Online and Digital education:

1. **Digital Gap:** The digital divide that exists between educators and students is exacerbated by differences in access to ICT resources and digital literacy levels.
2. **Inadequate training and ICT skills:** It's probable that teachers and learners don't have the skills and background necessary to successfully integrate ICT into their class preparations. This includes inadequate training on how to successfully integrate ICT into curriculum delivery, as well as a lack of competency with digital tools, software programmes, and internet resources.
3. **Resistance to change:** Some teachers may be reluctant to use online and digital learning in their classrooms due to a fear of technology, a reluctance to change tried-and-true methods of instruction, or concerns about the complexity or time commitment of integrating ICT into the classroom.
4. **Inability to Use Technology:** When it comes to ICT infrastructure, many educators, students, and educational institutions—especially those in poor countries—have limited access to computers, digital devices, and internet connectivity.
5. **Pedagogical challenges:** When incorporating online and digital-based education into all sector education, it is imperative to reevaluate pedagogical techniques and instructional tactics in order to fully utilise digital tools and resources. When creating and executing ICT-enhanced lessons, teachers and learners may encounter difficulties.
6. **ICT Resource Quality:** Online and digital resources, such as educational software, digital information, and online courses, differ greatly in terms of their quality and applicability. Finding current, high-quality resources that support their pedagogical objectives and curriculum goals may be difficult for teachers.
7. **Issues with Technology and Infrastructure:** Technical concerns such as software compatibility issues, hardware malfunctions, and irregular internet connectivity can cause disruptions to online and digitally enabled teaching and learning activities. In the classroom, this may lead to dissatisfaction and inefficiencies.
8. **Cost and Resource Constraints:** Implementing online and digital-based learning initiatives in school is expensive since it requires purchasing infrastructure, software licences, technology equipment, and ongoing maintenance and support. Initiatives to

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integrate ICT may face challenges in being adopted and sustained due to a lack of financing and resources.

Suggestions and recommendations for policy makers and stakeholders on how to overcome the challenges and better integrate of Online and Digital education:

Promoting the long-term integration of digital and online learning at all educational levels requires a multifaceted approach that addresses a number of problems and promotes continuous quality improvement. These are some possible strategies.

1. **Institutional Guidance and Assistance:** Establish institutional policies, leadership structures, and resources that promote and prioritise the use of online and digital education from K–12 to higher education. Finance projects aimed at professional development, software licencing, and technology infrastructure.
2. **All-inclusive Professional Development:** Give educators thorough and ongoing professional development opportunities to improve their digital and ICT skills, pedagogical expertise, and confidence in integrating technology into their instruction.
3. **Interests and Needs of Students:**
   In the event that ICT and digital education serve as the cornerstone of the technical solution for the classroom, then student computer literacy needs to be taken into account, and their views need to be valued and appreciated (Kapenieks, 2010).
4. **Open Educational Resources (OER):** Provide free and easily available digital content through the development and promotion of open educational resources. Urge teachers to share lesson plans, multimedia presentations, and other teaching resources in OER repositories.
5. **Cooperative alliances:** Collaborative partnerships with technology companies, educational organizations, and community stakeholders to leverage expertise, resources, and funding opportunities for online and digital integration initiatives. Collaborate on research projects, pilot programs, and curriculum development efforts that promote effective use of technology in primary to higher education.
6. **Infrastructure for Accessible Technology:** Regardless of financial background or place of residence, give all students and teachers equal access to technology infrastructure and resources.
7. **Resources in Multiple Languages:** Provide multilingual ICT and digital resources that address India's linguistic diversity and give teachers and students access to content in the

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languages that they choose. In order to reach a larger audience, encourage the translation of classic texts and cultural items into digital formats.

8. **Integration of Curriculum and Pedagogical Assistance:** Include digital and online learning in teacher education courses and pedagogical frameworks. Offer direction, materials, and assistance in creating and executing lesson plans, teaching techniques, and evaluation procedures that are enhanced by digital and online platforms.
9. **Research and Evidence-Based Approaches:** Promote scholarly work and research on models, best practices, and efficient tactics for integrating online and digital learning into all facets of education. Encourage academic staff and students to do research, case studies, and assessments that add to the body of knowledge about digital and online integration, as well as the improvement of educational quality at all levels.
10. **Evaluation and assessment:** Provide trustworthy techniques for assessment and evaluation in order to gauge the impact and success of programmes integrating digital and online learning into teacher preparation. To determine your strengths, shortcomings, and opportunities for development, get input from educators, students, and other stakeholders.

By implementing these measures in a coordinated and methodical way, educational institutions may overcome these obstacles and support the sustainable integration of online and digital education for ongoing quality improvement.

Finding and Thematic Discussion of the study

This study is a significant attempt to examine how digital and online learning guarantee inclusive, reasonably priced, and sustainable education in the twenty-first century. The review indicates that the topic of online and digital education equality in the twenty-first century is receiving more attention and research as technology becomes more integrated into the educational setting. Digital education encompasses more than just technology; it also involves equitable access, significant engagement, and long-term prospects.

Implication of the study:

In light of NEP-2020, research on online and digital education in providing inclusive, accessible, and sustainable education for 21st-century educators and learners has a number of important ramifications for practice, policy, and future scholarly investigation.

a. **Implication for Curriculum and Pedagogical innovation:** The study supports NEP-2020's emphasis on integrating technology-enabled, competency-based, and experiential learning techniques. To create adaptable and interesting learning environments,

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institutions should use AI-assisted platforms, virtual labs, and learning management systems (Mishra, et al., 2021).

b. **Implication for educational policy:** The study emphasises how crucial it is to improve digital infrastructure in every area in order to achieve NEP-2020's goal of equal education. It suggests that legislative measures to increase internet penetration, device access, digital libraries, and multilingual learning platforms are necessary. To lessen inequality, policy changes must also give priority to underprivileged populations' digital inclusion (MHRD, 2020; UNESCO, 2020).

c. **Implication for Teacher Professional Development:** The results suggest that educators need continual professional development in digital pedagogy, ICT tools, online evaluation, inclusive teaching practices, and digital ethics. The NEP-2020 idea for ongoing teacher training via virtual teacher development programs and platforms like DIKSHA becomes essential (Kaur & Sing, 2021). For online education to be implemented successfully, teachers must be digitally prepared.

d. **Implication for Equity and Inclusion:** The report emphasises how important it is to provide digital possibilities for all students, particularly those from low-income households, rural locations, linguistic minorities, and students with impairments. It suggests the necessity of community-based digital learning centres, multilingual material, and assistive technologies. This is in line with the inclusive education and universal access goals of NEP-2020 (Jena, 2020).

e. **Implication for Sustainable Access and Affordability:** The topic emphasises how crucial it is to use low-cost technology solutions, open-source platforms, free digital textbooks, and OERs. Digital learning models that are sustainable must not put a financial strain on families. In order to meet India's sustainable development goals, institutions must make sure that digital education stays cheap (UNESCO, 2019).

f. **Implication for institutional practices and governance:** Institutions must create strong academic management systems, improve cyber-security, and fortify digital governance. According to NEP-2020, blended learning models are a sustainable future paradigm for Indian education, and the study supports this shift (MHRD, 2020).

g. **Implication for evaluation and assessment:** According to the research, authentic, competency-based, and technology-supported evaluation systems as suggested by NEP-2020 must replace traditional exam-centric evaluations. Fairness, dependability, and accessibility for all students must be guaranteed via digital assessment procedures (Brown & Green, 2020).

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h. **Implication for future research:** Research on digital divide factors, long-term learning outcomes, learner engagement, teacher technology acceptability, AI in education, and sustainability approaches is made possible by this topic. The implementation of NEP-2020 across states and disciplines can be guided by such evidence (Dhawan, 2020).

In conclusion this research topic has significant ramifications for developing an inclusive, sustainable, and future-ready digital learning ecosystem in India. The report recommends a thorough change that benefits teachers and students and advances the nation's long-term educational growth by adhering to the NEP-2020 principles.

➢ **Limitation of the study:**

- Many students do not have access to sufficient digital gadgets.
- Inequality between rich and poor, urban and rural, and gender groups is brought about by the digital divide.
- Social interaction was restricted by online and digital learning.
- There are less opportunities for collaborative learning while learning online.
- The emotional connection between students and professors is diminished by digital learning.
- A lack of motivation and self-control in online and digital education.
- Online platforms are unable to fully duplicate the actual presence and hands-on experience required for subjects like science labs, vocational training, and performing arts.
- Online and digital learning has problems with credibility and quality.
- Overuse of screens can result in health problems such eye strain, headaches, bad posture, disturbed sleep, and screen fatigue.
- Due to the scarcity of content in regional languages, students may encounter difficulties in online and digital learning.
- Assessing practical skills in online and digital learning is challenging.

Conclusion:

In summary, a key factor in changing the educational landscape to meet the needs of teachers and learners in the twenty-first century is the integration of online and digital learning. Through the use of technology, educational institutions may guarantee sustainability through the encouragement of lifelong learning, affordability through the reduction of expenses related to traditional education, and inclusivity by reaching a larger audience. The NEP-2020 offers a framework for utilizing digital technologies and platforms to improve educational

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quality and get people ready for future problems. NEP-2020 is a strong advocate for technology and fair access to digital learning, but in order to prioritise activities, implementation guidance requires good evidence syntheses. There aren't many formal meta-analytic studies combining effect numbers from Indian contexts; instead, the majority of recent Indian articles are policy criticisms, narrative reviews, small-scale empirical case studies, or qualitative content analyses of NEP papers. Recent literature contains examples of policy assessments and reviews from Indian researchers. When putting online and digital education initiatives into action, stakeholders must work together and be creative in order to establish a more welcoming inclusive and accessible educational environment. Online and digital-based education integration have been essential to the development of inclusive affordable, high-quality, sustainable education among all level in 21st century era. In the present, online, digital and blended learning models, opportunities for individualised professional development, and ICT-enabled collaborative learning communities are becoming more prevalent. To ensure equitable and sustainable online and digital integration in student and teacher training, challenges such as the digital divide, limited access to technology, and pedagogical hurdles persist despite progress. For all educational levels, addressing these challenges and promoting continuous quality improvement requires the establishment of cooperative alliances, easily available technologies, encouraging institutional guidelines, and thorough professional development. Ultimately, the long-term, sustainable integration of digital and online learning into all educational levels could ultimately determine the direction of education by giving educators and learners alike the opportunity to pursue lifelong learning and innovation.

References:

Al Mamun, A., Hossain, M. A., Salehin, S., Khan, M. S. H., & Hasan, M. (2022). Engineering students' readiness for online learning amidst the COVID-19 pandemic: Scale validation and lessons learned from a developing country. *Educational Technology and Society*, *25*(3), 30–45. https://www.scopus.com/inward/record.uri?eid=2-s2.0 85133763033&partnerID=40&md5=49b91c22c98fa6051c635186e03d8960

Baker, M., & Lund, K. (1997). Promoting reflective interactions in a computer supported collaborative learning environment. *Journal of Computer Assisted Learning*, (13), 175-193.

Bess, K. D., Fisher, A. T., Sonn, C. C., & Bishop, B. J. (2002). *Psychological sense of community: research, applications, and implications.* New York, London: Kluwer Academic/Plenum Publishers.

EduInspire-An International E-Journal
An International Peer Reviewed and Referred Journal (www.ctegujarat.org)
Council for Teacher Education Foundation (CTEF, Gujarat Chapter) Email:- ctefeduinspire@gmail.com

Bhat, R. A., Kumar, S., Najar, A. A., & Deshpande, A. (2021). A Systematic Review of Online Learning during COVID-19 Crisis: An Indian Experience. *Scholedge International Journal of Multidisciplinary & Allied Studies*, *8*(3), 18-27. http://dx.doi.org/10.19085/sijmas080301

Brown, A., & Green, T. (2020). *Teaching and Learning in the Digital World*. Routledge.

CASY Digital Equity Framework (2021). WWW.CASEY.VIC.GOV.AU

Dewey, J. (1916). *Democracy and Education.* New York: The Macmillan Company.

Dhawan, S. (2020). Online Learning: A Panacea in the Time of COVID-19 Crisis. *Journal of Educational Technology Systems*, *49*(1), 5–22.

Ferrante, P., Williams, F., Büchner, F., Kiesewetter, S., Muyambi, G., Uleanya, C., & Utterberg, M. M. (2024). In/equalities in digital education policy–sociotechnical imaginaries from three world regions. *Learning, Media and Technology*, *49*(1), 122–132. https://doi.org/10.1080/17439884.2023.2237870

Gottschalk, F., & Weise, C. (2003). Digital equity and inclusion in education: An overview of practice and policy in OECD countries. *OECD Educ Work Pap*. 2023;(299). https://doi:10.1787/7cb15030-en

Jena, P. (2020). Impact of Pandemic COVID-19 on Education in India. *International Journal of Current Research*, *12*(7), 12582–12586.

Kapenieks, J. (2010). Action research for creating knowledge in e-learning environment. *In: 8th International JTEFS/BBCC conference "Sustainable development. Culture. Education"*, Paris, France.

Kar, S. (2023). Digital Infrastructure for Knowledge Sharing–DIKSHA: A Review. *Journal of Data Science, Informetric, and Citation Studies*, *2*(2), 143-5. https://doi.org/10.5530/jcitation.2.2.21

Kaur, G., & Singh, D. (2021). Teachers' Readiness for Online Teaching in the Indian Context. *Journal of Educational Research and Practice*, 11(2), 45–59.

Koehler, M., & Mishra, P. (2009). What is technological pedagogical content knowledge (TPACK)? *Contemp Issues Technol Teach Educ*, *9*(1):60–70.

Kumar, R., & Ganesh, R. S. (2022). Dealing with online and blended education in India. *49*(2), 195-201. https://doi.org/10.1007/s40622-022-00320-1

Les Robinson, (2009). *A summary of Diffusion of Innovations*. ChangeoLogy: the Book.

Liao, P. A., Chang, H. H., Wang, J. H., & Sun, L. C. (2016). What are the determinants of rural-urban digital inequality among schoolchildren in Taiwan? Insights from Blinder-Oaxaca decomposition. *Computers & Education*, *95*, 123–133. https://doi.org/10.1016/j.compedu.2016.01.002

Luo, J., & Chan, C. K. Y. (2022). Qualitative methods to assess intercultural competence in higher education research: A systematic review with practical implications. *Educational Research Review*, 37. https://doi.org/10.1016/j.edurev.2022.100476

Mayer, R. E. (2001). *Multimedia Learning* (3rd ed.). New York: Cambridge University Press.

Mayer, R. E. (2022). Cognitive theory of multimedia learning. In R. E. Mayer & L. Fiorella (Eds*.), The Cambridge handbook of multimedia learning* (3rd ed., pp. 57–72). Cambridge University Press.

EduInspire-An International E-Journal
An International Peer Reviewed and Referred Journal (www.ctegujarat.org)
Council for Teacher Education Foundation (CTEF, Gujarat Chapter) Email:- ctefeduinspire@gmail.com

Mayer, R. E. (2024). The Past, Present, and Future of the Cognitive Theory of Multimedia Learning. *Educational psychology Review, 36*(8), 1-25. https://doi.org/10.1007/s10648-023-09842-1

Means, B., Toyama, Y., Murphy, R., & Baki, M. (2013). *The effectiveness of online and blended learning.* U.S. Department of Education.

MHRD (2020). *National Education Policy 2020*. Ministry of Human Resource Development, Government of India.

Mikhailov, A., Tikhonov, A., & Fedulov, V. (2024). Digital inequality in education: Features of manifestation and types of discrimination during COVID-19 pandemic. *Education and Information Technologies*, 1-12.

Mishra, L., Gupta, T., & Shree, A. (2021). Online Teaching-Learning in Higher Education During Lockdown. *Educational Research Review*, *31*, 100–114.

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: a framework for teacher knowledge. *Teach Coll Rec*, *108*(6), 1017–54. https://doi.org/10.1111/j.1467-9620.2006.00684.x

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., & Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *Systematic Reviews*, *10*(1), 89. https://doi.org/10.1186/s13643-021-01626-4

Petticrew, M., & Roberts, H. (2008). *Systematic reviews in the social sciences: A practical guide*. John Wiley & Sons.

Puentedura, R. R. (2009). As we may teach: educational technology, from theory into practice. *Apple.*

Puentedura, R. R. (2020). SAMR- A research perspective. http://hippasus.com/rrpweblog/archives/2020/01/SAMR_AResearchPerspective.pdf

Rawat, M., Bhati, S., & Sehra, B. (2025). An overview of practice and policy for digital equity and inclusion in education. *International journal of Research in Special Education*. *5*(1), 111-114. https://www.rehabilitationjournals.com/special-education-journal/

Reich, J. (2019). Teaching our way to digital equity. *Educ Leadersh*, *76*(5). https://www.ascd.org/el/articles/teaching-our-way-to digital-equity

Rogers, E. M. (1962). *Diffusion of innovations*. New York: Free Press.

Rogers, E.M. (1995). *Diffusion of innovations*. New York: Free Press.

Shank, D. B., & Cotten, S. R. (2014). Does technology empower urban youth? the relationship of technology use to self-efficacy. *Computers & Education*, *70*, 184–193. https://doi.org/10.1016/j.compedu.2013.08.018

Shokeen, A., & Kaur, B. (2025). Evaluating Perception of Delhi Government School Teachers towards the DIKSHA Platform: A TAM-Based Analysis. *Indian Journal of Educational Technology*, *7*(1). https://journals.ncert.gov.in/IJET/article/download/858/345/1389?utm_source=chatgpt.com

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An International Peer Reviewed and Referred Journal (www.ctegujarat.org)
Council for Teacher Education Foundation (CTEF, Gujarat Chapter) Email:- ctefeduinspire@gmail.com

Shubham, Vats. (2024). NEP2020: The Future of Digital Learning in India. *International Journal of Scientific Research and Engineering Development*, *7*(4). https://doi.org/10.5281/zenodo.13166112

Shulman, L. (1986). Those who understand: knowledge growth in teaching. *Educ Res*, *15*(2), 4–14. https://doi.org/10.2307/1175860.

Stahl, G., Koschmann, T., & Suthers, D. (2006). *Computer-supported collaborative learning: An historical perspective*. *In: Cambridge handbook of the learning sciences*. Cambridge, UK: Cambridge University Press.

UNESCO (2019). *Digital Learning for Sustainable Development*. Paris: UNESCO.

UNESCO (2020). Education in a post-COVID world: Nine ideas for public action. https://en.unesco.org/sites/default/files/education_in_a_post-covid_world-nine_ideas_for_public_action.pdf?utm_source=chatgpt.com

UNESCO (2020). *Education in a post-COVID-19 World*. UNESCO Futures of Education Report.

Ventrella, F. M., & Cotnam-Kappel, M. (2024). Examining digital capital and digital inequalities in Canadian ele mentary Schools: Insights from teachers. *Telematics and Informatics*, *86*, 102070. https://doi.org/10.1016/j. tele.2023.102070

Wani, T. A., & Ali, S.W. (2015). Innovation Diffusion Theory Review & Scope in the Study of Adoption of Smartphones in India. *Journal of General Management Research*. *2*(2), 98-115.

Yuen, A. H. K., Park, J., Chen, L., & Cheng, M. T. (2018). The significance of cultural capital and parental medi ation for digital inequity. *New Media & Society*, *20*(2), 599–617. https://doi.org/10.1177/1461444816667084

Zhang, D., & Livingstone, S. (2019). Inequalities in how parents support their children's development with digital technologies: Parenting for a digital future: Survey report. https://www.lse.ac.uk/media-and communications/assets/documents/research/preparing for-a-digital-future/P4DF-Report-4.pdf