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ANALYZING THE EFFECTIVENESS OF ICT MODELS IN TEACHER EDUCATION AS PER NEP-2020

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ABSTRACT

The study examines the effectiveness of ICT models in teacher education within the framework of India's National Education Policy (NEP) 2020. As digital transformation reshapes global education, ICT has become central to enhancing teacher preparedness, instructional quality and professional competence. The paper highlights NEP-2020's emphasis on digital infrastructure, multilingual e-content, teacher capacity building, blended learning and the establishment of NETF to promote the integration of technology in education. Various ICT models Blended Learning, Flipped Classroom, TPACK, SAMR, LMS-based instruction, Virtual Classrooms and Open Educational Resources (OER) are analyzed in terms of their pedagogical strengths and implementation challenges. Comparative evaluation reveals that while blended and flipped approaches enhance active learning, models like TPACK and SAMR support deeper integration of technology with content and pedagogy. LMS platforms such as DIKSHA and SWAYAM further promote structured learning pathways and analytics-based progress tracking. The findings indicate that ICT models significantly enhance teacher competencies, including digital literacy, instructional design skills and assessment proficiency. Evidence shows improved student engagement, better learning outcomes and increased teacher confidence when technology-supported pedagogies are systematically adopted. The study also notes major challenges: digital divide, insufficient training, infrastructure gaps, language barriers and resistance to change. To strengthen ICT implementation, the paper recommends continuous professional development, better digital infrastructure, multilingual content creation, public-private partnerships and strong monitoring mechanisms. The study concludes that ICT-enabled teacher education, aligned with NEP-2020, is essential for building a future-ready teaching workforce capable of navigating technologically enriched learning environments.

KEYWORDS: NEP-2020, Digital Pedagogy, Blended Learning, Flipped Classroom, Teacher Competency, Professional Development

INTRODUCTION

Information and Communication Technology (ICT) has gone forth as a transformative forcefulness in spherical teaching, reshape traditional pedagogics and enable dynamic, student-centre scholarship experience. With digital peter, multimedia resources and interactive political program turn increasingly accessible, ICT has revolutionized the agency teacher teach and learners mesh with cognition. In the Indian education

system, this digital duty period has become yet to a greater extent significant in the last-place decade, peculiarly with the intro of the National Education Policy (NEP) 2020, which positions applied science as a decisive driver of educational reform and quality sweetening. Teacher education in India has historically been characterise by theory-heavy curricula, limited desegregation of digital resource and minimum opportunity for existential learning through engineering science. As

a result, many pre-service and in-service Teacher have sputter to comprise ICT meaningfully into their instructional drill. Recognizing these break, NEP-2020 envisions a technologically empowered teaching community equip with digital literacy, innovative pedagogic acquisition and the power to pursue diverse learners through ICT-enabled scheme. The policy invest unattackable vehemence on machinate Teacher who are not only proficient users of engineering science but also capable of desegregate ICT seamlessly within curriculum planning, assessment and schoolroom interaction.

The increasing popularity of national digital acquisition platforms such as DIKSHA, SWAYAM, PM-eVidya, NISHTHA and assorted virtual classroom has further quicken the adoption of ICT in teacher pedagogy. To strengthen teacher cooking, multiple ICT-base modeling such as blended encyclopaedism, flipped classrooms, LMS-supported instruction, TPACK (Technological Pedagogical Content Knowledge), SAMR (Substitution-Augmentation-Modification-Redefinition) and immersive virtual learning environments are straightaway being incorporate into Teacher didactics broadcast. These models enhance instructional plan, promote active and collaborative learning, support differentiated didactics and chip in significantly to teachers' technological authority and professional growth. Examine the effectivity of these ICT models is essential in evaluating how successfully NEP-2020's vision is being transform into praxis. Such analysis reserve educators and policymakers to understand the impingement of ICT on teach competency, classroom innovation and learner outcomes. Additionally, it highlights tenacious challenges such as digital divide, inadequate infrastructure, modified ICT preparation and resistance to technical change.

The present enquiry report calculate to examine the effectiveness of ICT example in teacher training within the model of NEP-2020. It evaluates current practices, identifies challenge, brush up outcome and proposes recommendations for fortify digital integrating in teacher preparation, thereby contributing to the creation of a time to come-ready and digitally competent teaching workforce.

ICT IN TEACHER EDUCATION

ICT in teacher breeding denote to the purposeful consolidation of digital tools, political platform, devices and communication technology to enrich and transform the education-learning mental process for both pre-service and in-service teachers. It include a all-encompassing spectrum of technical ingredient such as ironware (calculator, tab, smartboards, projectors), software (con direction system, video conferencing program, depicted object creation tools), online resourcefulness (Open Educational Resources, digital libraries, tocopherol-content depository) and emerging digital didactics (pretence, virtual science laboratory, augment and practical reality, AI-based adaptive scholarship instrument). These components collectively empower teachers to design scholar-concentrate, interactive and innovative instructional practice session. It supports Teacher in planning technology-integrated lessons, creating engaging multimedia system content and alleviate blended and on-line memorize environs. ICT tools stimulate high-society thinking by enabling inquiry-ground learning, collaborative job figure out and geographic expedition through digital simulations. They as well strengthen valuation practice through digital assessment tools that provide immediate feedback, information analytics and personalise eruditeness insights. Moreover, ICT promote flexibility and approachability by help anytime-anyplace acquisition, assure that teacher can quest for continuous professional development at their own pace.

The National Education Policy (NEP) 2020 emphasizes integrate ICT across teacher educational activity curriculum to enhance digital teaching, strengthen professional competency and make future-quick teachers. To support this goal, teacher Department of Education insane asylum are increasingly utilise digital platforms such as DIKSHA, SWAYAM, NISHTHA and respective LMS-based environments. To bring home the bacon a clearer understanding of ICT desegregation, the play along table (or conceptual framework) typically lean commonly use ICT shaft and their specific covering in teacher education order from content creation instrument and interactive platforms to assessment applied science and practical learning environments. Such categorisation helps educators select appropriate instrument free-base on

pedagogic needs and learning outcomes.

ICT Tools Commonly Used in Teacher Education

ICT Tool	Use in Teacher Education
Learning Management Systems (LMS)	Course delivery, assignments, assessments
Video Conferencing Platforms	Online classes, webinars
Digital Content Libraries	Lesson planning, e-resources
Simulation Tools	Virtual labs, micro-teaching practice
Multimedia Tools	Interactive teaching materials
Mobile Apps	Continuous learning, communication

ICT enables teachers to access a wealth of digital content, participate in professional scholarship communities and take evidence-based educational recitation. As NEP-2020 promotes a tech-aim education system, ICT competency has turn a kernel requisite for teachers at all levels.

NEP-2020 Vision for ICT Integration

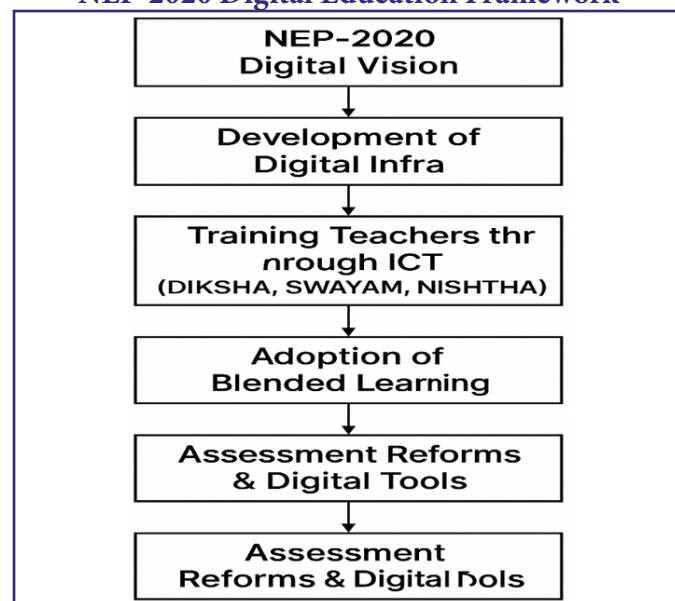
NEP-2020 pose a holistic, futuristic and transformative visual modality for incorporate ICT into all levels of teacher education in India. Realise the rapid technological modification regulate the Education Department landscape, the policy identify digital competency as an essential necessary for modern Teacher. It underline the cosmos and strengthening of digital infrastructure in teacher didactics institutions, include impudent schoolroom, gamy-pep pill internet connectivity, digital libraries and access to devices that support technology-enhanced learning. By prioritizing digital content development, NEP-2020 encourages the creation of high-timber e-determine fabric, interactional faculty, OER-based resourcefulness and multilingual digital content that can be get at through interior platforms such as DIKSHA, SWAYAM and NISHTHA.

A key factor of the policy is comprehensive teacher training in ICT-found pedagogy. NEP-2020 promotes the adoption of meld get word surround that compound online and brass-to-face modes to create flexible, scholar-pore instructional spaces. It preach for the use of Learning Management Systems (LMS), interactional digital pecker and emerging engineering to enhance instruction efficiency and student engagement. The policy besides underscores the indigence for continuous and competency-

ground professional development, enable Teacher to elevate their digital attainment through modular, self-paced and experiential learning opportunity. NEP-2020 highlight the potential of ICT to support inclusive educational activity by providing assistive technologies and approachable digital resource for diverse learners. By imbed ICT across syllabus, pedagogy, assessment and professional exploitation, the insurance envisions a future-quick teacher hands equal to of introduce, adjust and leading educational transformation in the digital era. Key supply include-

- i. Establishment of National Educational Technology Forum (NETF) to provide a platform for free substitution of ideas on engineering use.
- ii. Promotion of digital teaching method so teacher can in effect integrate digital tools in classrooms.
- iii. Blended scholarship as a stock exercise aggregate on-line and offline modes.
- iv. Inflate SWAYAM, DIKSHA and NISHTHA for teacher capacity building.
- v. Developing ICT curriculum for pre-service teacher education.
- vi. Inclusive technology to stand students with special needs.
- vii. Stress on creating eminent-quality e-cognitive content in multiple Amerind languages through AI transformation tools.

NEP-2020 Digital Education Framework



NEP-2020 position Teacher as digital facilitator capable of designing meaningful, applied science-enrich learning experiences. By spot ICT as an

indispensable component part of both course of study and pedagogics, the policy typeset a strong foundation for ICT-driven teacher education.

ICT Models in Teacher Education

Teacher education programs more and more rely on various ICT models to tune up curriculum delivery, instructional design and assessment practices. These models facilitate teacher trainee train firm digital competence and align with the pedagogical first moment of NEP-2020. The most widely implemented ICT theoretical account are analyzed below.

- Blended Learning Model- A compounding of face-to-face teaching and online instruction, the go learning model allows teacher to merge traditional classroom interaction with digital hear environments.

Use-

- Provides tractability for learners to consider at their own pace.
- Enables accession to recorded lectures, tutorials and multimedia system lessons.
- Enhances fight through online quiz, discussion meeting place and collaborative activities.

Limitation- Requires stable cyberspace connectivity, self-discipline and digital readiness among trainees.

- Pitch Classroom Model- In this framework, apprentice first research subject independently through online videos, readings or modules, while classroom sentence is dedicated to enforce knowledge through treatment and problem-solving.

Use-

- Elevate high-order thinking and reflective learning.
- Encourage active involution and well classroom interaction.

Limitation-Teacher must curate or create high-quality digital content and ensure scholar retrospect materials beforehand.

- Technological Pedagogical Content Knowledge (TPACK) Model- TPACK incorporate technology with pedagogy and open subject matter, facilitate

teachers form informed decisions about digital pecker selection.

Use-

- Assists teacher in selecting appropriate ICT tools aligned with pick up objectives.
- Support good lesson planning and instauration of technology-enhance teaching strategies.

Limitation- Call For extensive training and uninterrupted professional development for good implementation.

- Substitution, Augmentation, Modification, Redefinition (SAMR) Model- The SAMR modelling explicate progressive stages of technology consolidation, from basic permutation to full redefinition of learning tasks.

Use-

- Encourages teacher to bit-by-bit kick upstairs their digital teaching practices.
- Support origination by avail educators redesign learning bodily process using forward-looking technologies.

Limitation- Accomplish the “Redefinition” level is challenging in rural or resource-restrain teacher education contexts.

- LMS-Based Larn Model- Learning Management Systems such as DIKSHA, SWAYAM, Moodle and Google Classroom are widely apply for direct digital learning.

Use-

- Efficient trend management, including contentedness delivery and scheduling.
- Carry on-line assessments, quizzes and assignments.
- Tracking apprentice progress through analytics and digital portfolios.

- Virtual Classroom Model- Virtual classrooms use lively video sessions, digital control board, breakout way and interactive tools.

Use-

- Facilitates actual-time communication between teacher educator and trainees.
- Hold Up collaborative scholarship, group activities and peer discussion.
- Open Educational Resources (OER) Model- Free-Base on the employment of free, shareable and openly certify study materials.

Use-

- Offers cost-effective access to high-tone teaching resources.
1. Provides planetary content, case studies and multimedia cloth to enhance teacher knowledge.

Comparison of Major ICT Models

Model	Strength	Limitation
Blended Learning	Flexible and interactive	Needs digital access
Flipped Classroom	Promotes higher-order learning	Content preparation burden
TPACK	Holistic knowledge integration	Requires training
SAMR	Encourages innovation	Hard to implement fully
LMS Model	Centralized management	Requires technical skills
Virtual Classroom	Effective for remote learning	Internet dependent
OER Model	Free resources	Quality varies

These modeling align with NEP-2020 principles advance dynamic digital didactics, collaborative eruditeness and teacher empowerment.

Effectiveness of ICT Models in Teacher Education as per NEP-2020

ICT poser embedded within teacher breeding plan have demonstrated considerable effectiveness in improving Teacher' professional competencies, enhancing instructional character and further pedagogic foundation. With the implementation of NEP-2020, the consolidation of ICT has get more integrated, purposeful and aligned with the broader end of creating a digitally endow teach ecosystem. These models have strengthened Teacher' technological confidence and improved their ability to design, implement and evaluate applied science-

integrated example. For instance, the TPACK model aid teachers balance technological, pedagogic and content knowledge, insure meaningful integration of digital tools. Similarly, the SAMR model abide a reformist transformation of classroom practices from interchange traditional tasks with digital versions to redefine memorise through innovational digital experiences.

Improvement in Teacher Competency- ICT models importantly tone teacher competence by building digital literacy and technological smoothness. Teacher gain the ability to plan on-line instructional mental faculty, evaluate the quality of digital content and effectively utilize various assessment tools such as quizzes, analytics dashboard and digital rubric. Get Wind Management Systems (LMS) further support teacher competence by enabling them to cut across student progress through learning analytics, monitor participation and customize instructional scheme based on data-driven insights.

Enhanced Pedagogical Skills- ICT integrating enrich pedagogic acquisition by promoting the use of interactive content, multimedia system display, animation and simulation-establish memorise environments. Models such as flipped and blended check fracture classroom toward fighting interlocking, where learners participate in discussions, trouble-solving tasks and collaborative bodily function. The TPACK theoretical account enables Teacher to meaningfully align technology with pedagogy and subject content, ensue in to a greater extent consistent and in force teaching-learning processes.

Accession to Quality Training Resources- Digital platforms significantly amplify access to high-character professional development materials. DIKSHA and SWAYAM put up free, integrated and course of study-aligned course of instruction for teacher training. NISHTHA heighten Teacher capacity through competency-based modules that emphasize digital pedagogy, judgment strategies and classroom direction. Open Educational Resources (OER) offer a wealth of spherical donnish cognitive content, enable continuous professional learning and exposure to innovative teaching practices.

Personalized and Self-Paced Learning- ICT enable

individualised see nerve pathway by allow Teacher to access education anytime and anywhere. AI-based weapons platform urge tailored content establish on individual performance, interests and eruditeness needs. This flexibleness profit both deadening and fast learners, ensuring that each teacher build at their ain pace without academic pressure.

Collaboration and Peer Learning- Virtual schoolroom, discussion forum and online professional study community foster collaboration among teachers across regions. Such place boost the communion of best practice, co-instauration of learning materials and participation in collaborative undertaking, which enhance creativity, critical thinking and job-solving skills.

Comparative Outcomes- Research studies consistently indicate that Teacher civilize with ICT mannikin demonstrate higher point of classroom founding, meliorate student fight, better appraisal accuracy and enhanced get word issue. ICT-trained teacher are more reflective, adaptive and professionally surefooted, contributing to overall educational improvement.

Effect of ICT on Teacher Professional Skills

Skill Area	Improvement Level
Digital Literacy	Very High
Content Creation Skills	High
Pedagogical Innovation	Moderate—High
Assessment & Evaluation Skills	High
Classroom Engagement	Moderate
Confidence in Technology Use	Very High

■ = Level of improvement based on qualitative analysis

ALIGNMENT WITH NEP-2020 GOALS

The integration of ICT good example into teacher education aligns close with the transformative finish delineate in NEP-2020, which envisions a technologically empowered and future-ready training system. One of the central aims of the policy is to equip both Teacher and assimilator with twenty-first-100 skills such as vital thinking, creativeness, quislingism, communication and digital literacy. ICT-enable teacher breeding directly supports this object glass by fostering digital fluency, encourage forward-looking instructional plan and boost competence-establish learning approaches.

NEP-2020 also emphasizes the importance of

inclusive and equitable educational activity, ensuring that various learners including those with disabilities can get at quality learning experience. ICT models significantly bring to this purpose through the utilization of assistive applied science, screen referee, captioning tool, textual matter-to-speech practical application and adaptative learnedness platforms. These tools serve Teacher create accessible and differentiated learning environments, so get ahead NEP's visual sensation of universal and inclusive education.

the insurance policy highlight the need to tone up teacher instruction insane asylum through improved base, gamy-quality breeding curriculum and engineering science-enrich pedagogical practices. ICT models play a essential theatrical role in raising institutional standards by supporting blended learning ecosystem, enable digital resource existence and prepare teacher training to a greater extent taxonomic, vaporous and scalable. Platforms such as DIKSHA, SWAYAM and NISHTHA embody NEP's destination of democratizing admission to integrated, high-quality professional development. At Long Last, ICT desegregation work a digitally empower teaching force, able of navigate and chair learning in technologically advanced classrooms. These excogitation enhance teaching efficiency, advance uninterrupted learning and machinate teachers to guide scholar in a rapidly evolve digital club. Overall, ICT models have proven extremely effective and powerfully aligned with NEP-2020 reform priorities.

CHALLENGES IN IMPLEMENTING ICT MODELS

Challenge in Implement ICT Models

Despite the raise toleration of ICT-enable didactics and the strong policy support provided by NEP-2020, several challenge go on to handicap the good effectuation of ICT simulation in Indian teacher education. These challenges reflect infrastructural, pedagogical, socio-cultural and systemic gaps that must be speak to ensure meaningful technology integration.

- **Digital Divide-** A significant digital divide hang in between urban and rural regions, creating unequal admittance to ICT opportunity. Many teacher trainees, particularly in rural and tribal areas, lack personal digital twist such as laptops

or smartphones. Unreliable electricity supplying and low-speed internet connectedness far restrict their ability to take part in online training program or get at digital learning resourcefulness. This inequality directly bear on the uniform adoption of ICT models across teacher education institutions.

- **Short Teacher Training-** Many pre-service and in-service teacher lack equal exposure to digital tools and ICT-establish pedagogical method. Traditional teacher education broadcast oftentimes focus on theoretical face, providing limited handwriting-on experience with applied science. As a outcome, Teacher may feel underconfident in designing digital example, utilize LMS political program, or desegregate multimedia and AI-found prick effectively. Continuous professional development in ICT is all the same not uniformly follow up across institutions.
- **Infrastructure Limitations-** A large number of Teacher training college withal engage with minimum digital base. Insufficient numbers of estimator, outdated computer software, lack of smart classrooms, limited bandwidth and absence seizure of maintenance support embarrass the fluid espousal of ICT model. Without robust substructure, models like blended learning, practical simulations or digital appraisal cannot be implemented effectively.
- **Resistivity to Change-** Some teachers persist in to prefer traditional chalk-and-talk method acting and view technology integration as an extra encumbrance kinda than an enhancement. This immunity much stems from fearfulness of technology, deficiency of familiarity with digital gimmick and misconceptions about ICT boil down Teacher roles. Such position slow down institutional efforts to take over innovative commandment-watch practices.
- **Cybersecurity and Data Privacy Concerns-** With increase reliance on digital platforms, awareness of cybersecurity drill is of the essence. However, many teacher trainee are unaware of safe online demeanour, data protection norm, password protection and endangerment associated with phishing or digital fraud. Circumscribed cybersecurity breeding poses threats to both teachers and students in digital

learning environments.

- **Linguistic and Cultural Barriers-** Most digital educational content is usable chiefly in English or Hindi, confine accessibility for learners from diverse linguistic backdrop. Local language digital content, context-specific good example and culturally relevant resources remain unequal. This restriction reduces the inclusivity and range of ICT-found Teacher education.

Strategies to Strengthen ICT Models in Teacher Education

To ensure that ICT models achieve their full potential in teacher instruction, a comprehensive and well-align set of scheme is required. These scheme address training, infrastructure, curriculum, partnership and valuation chemical mechanism, line up nearly with NEP-2020's vision for technology-enabled education.

1. **Continuous Professional Development (CPD)-** Regular, structured and competency-based professional developing programs are essential for enhancing teachers' digital science. CPD should include mitt-on breeding workshop, online certification grade, peer-learning communities and mentoring support. Exposure to existent-time digital tools, multimedia content creation, virtual simulation and AI-establish teaching aids enables teachers to gain sureness and mix ICT effectively into their classroom practices.
- **Fortify Digital Infrastructure-** Robust digital infrastructure forms the backbone of ICT-enabled teacher Education Department. Institutions must be fit out with high-fastness cyberspace, bright classrooms, update computers, projector, digital labs and entree to plug LMS political platform. Establishing digital libraries with tocopherol-volume, daybook, OERs and multimedia system resources ascertain that both teachers and trainee can affiance meaningfully with engineering science-incorporate learning.
- **Developing Multilingual Digital Content-** To guarantee inclusivity and wider reaching, it is important to develop mellow-quality digital mental object in multiple Indian languages. NEP-2020 further the role of AI-free-base translation putz to create localize and culturally relevant E-content. Such multilingual resources arrive at ICT learning approachable to trainees from diverse lingual scope and bridge the digital

mental object gap.

- **Promote Public-Private Partnerships (PPP)-** Collaboration with technology companies, EdTech platforms, universities and NGOs can strengthen teacher education ecosystems. PPPs can support software package development, digital platform access, capacitance-building workshops and the introduction of innovative tools such as VR/AR labs, analytics dashboards and AI tutors. These partnerships elaborate institutional capabilities while reducing fiscal burdens.
- **Integrating ICT into Curriculum-** ICT should be embedded as a compulsory portion in pre-service teacher education political platform. Curriculum must admit structured modules on TPACK, SAMR, blended learning, digital assessment, cyber safety device and on-line pedagogy. Integrating ICT within instruction, sort of than treating it as an add-on subject, see to it abstruse adoption of technology-free-base educational activity practices.
- **Monitoring and Evaluation-** Continuous monitoring is essential to determine the effectualness of ICT modeling. Institutions can apply memorize analytics, digital portfolios, LMS data, classroom notice and assessment effect to evaluate teacher onward motion. Evidence-free-base evaluation helps rarify training programs, distinguish gaps and amend the overall quality of digital teacher education.

These strategies will serve India build a digitally competent teaching workforce, fulfilling the vision of NEP-2020.

CONCLUSION

ICT desegregation has get a cornerstone of contemporary teacher education, reshaping traditional pedagogical practices and outfit teachers with the competencies call for in a digital era. NEP-2020 has played a catalytic role in speed up this transformation by lay firm emphasis on digital pedagogy, technological proficiency and flexible get wind surround. Through its centering on tone digital infrastructure, kick upstairs online professional development and embedding ICT across curriculum and assessment, the insurance sets a clear charge for future-ready teacher preparation. ICT models such as blended learning, TPACK, SAMR and LMS-based

organisation have present important potency in raise teacher' technical and pedagogical skills. These mannikin have enabled teacher trainees to design interactive object lesson, incorporate multimedia resourcefulness, conduct digital assessments and facilitate collaborative learning experience. As a result, teacher education program have become more learner-revolve about, engaging and inclusive, back diverse learning want and kick upstairs continuous professional growth. the successful implementation of ICT in teacher education stay on to face challenge, admit the digital divide, infrastructural limitations, inadequate grooming and linguistic disparities in digital substance. Addressing these gaps requires a coordinated access that includes robust CPD initiatives, elaboration of digital infrastructure, development of multilingual and culturally relevant contentedness and partnerships with technology providers. In alignment with the vision of NEP-2020, strengthening ICT integration will chip in to building a technologically competent and groundbreaking teaching hands. A digitally invest teacher biotic community will be good position to conduct scholar, surrogate 21st-century skills and navigate the chop-chop develop educational landscape painting. Ultimately, good ICT borrowing in teacher training will represent a vital role in shaping an equitable, efficient and future-ready breeding system.

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