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NEP-2020 oriented digital technology integration to teacher education for teachers

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ABSTRACT

Quality education for preservice and in-service teachers can be assured by integration of Digital Technology in teacher education, as emphasized in the National Education Policy (NEP) 2020. The study is a qualitative study that aims to analyse NEP 2020 to identify elements of digital technology with thematic analysis and content analysis methods with inter-coder method maintaining consistency. A single policy document of NEP 2020 of English version was used as a secondary source of data for analysis. Findings revealed 30 major elements of 'Technology' reduced to 8 major themes of 'Digital Technology'. Findings emphasize on the elements of core technology concept for teacher education, along with fostering integration of advanced and emerging technologies. It was found to show essentiality of data analytics technologies, importance of digital technologies in creating digital ecosystem in education. Findings show digital devices and online tools, educational platforms and resources, essential for digital integration for educational assessment and evaluation. findings emphasize on Continuous Professional Development through technology infused approach including online modes and online platforms for multidisciplinary teacher preparation with pedagogical innovation and bridging digital divide. Findings shows its implications in redesigning of curriculum for educational technology incorporating emerging digital tools, and policy framework for educational training and research incorporating disruptive technologies for teachers.

Keywords: Digital technology, NEP-2020, teacher education, pre-service teachers, in-service teachers

BACKGROUND

The National Education Policy (NEP) 2020 is a remarkable sign of a pivotal shift in the academia of education in India, prioritizing integration of digital technology, and to address longstanding challenges in teacher education in India. Historically, traditional method, limited resources and unequal information accessibility in rural areas has been the central constraints of pre-service and in-service teacher training (Aithal and Aithal, 2023). NEP 2020 envisions a technology-driven method and approach for empowering teacher and teacher educators, aligning with global trends where pedagogical skills and professional development are enhanced by digital tools and techniques (UNESCO, 2020). Due emphasis has been given on multi-disciplinary, competency-based training, leveraging platforms like SWAYAM, and DIKSHA which are helpful in bridging the gaps in teacher preparation (Government of India, 2020). Some part studies indicate revolutionizing role of digital technology in teacher education by fostering personalized leaning, interactive teaching and learning, continuous upskilling. For instance, online modules enable in-service teachers to access information resources flexibly and with improvement of classroom practices (Kumar and Singh, 2024). Researches highlights the potential of NEP 2020 to integrate artificial intelligence (AI), and Virtual Reality for immersive training though the challenges of digital divide persist (Sharma, 2023). Without equitable technology adoption, the marginalized groups may be excluded that shows inequalities (Patel & Mehta, 2024).

In context of pre-service teacher education, digital simulation is supposed to prepare teacher for real-world of teaching, promoting critical thinking and adaptability among teachers (Gupta & Rao, 2025). Furthermore, technology, as per NEP 2020, aligns with sustainable development goals, that promotes lifelong learning through digital technology (United Nations, 2015). Other countries also show similar evidences, such as technology infused teacher training in Singpore that shows higher learning outcomes in teacher efficacy and student engagement (Tan & Wong, 2022). In methodological context, content analysis methods are appropriate for dissecting policy documents, such as NEP 2020, allowing thematic extraction to inform practice (Krippendorff, 2018). In India, professional development was reflected through digital technology platforms, though infrastructure and lack of training hinder full realization (Joshi & Verma, 2024). Learning with digital technology is reflected in NEP 2020 that advocates digital technology important for enhancing inclusivity (Maurya & Sharma, 2023). NEP promotes online education to address access barriers with teacher readiness for digital pedagogy (Dubey, 2024). Blended learning models has brought transformations in teacher training programme under NEP 2020 for pre-service teachers (Kumari, 2024). Blended learning approach for pre-service teachers align with Technology-integration under NEP (Waseem et al. 2025). Digital assessment, and Information and Communication Technology (ICT) adoption are major challenges in teacher education (Amin et al., 2025). Adaptive technologies and teacher training are reflected in NEP 2020 as the leveraging technology for transformative leaning (Verma, 2025). Teacher role in teacher education has been transformed by NEP guidelines (Kakodkar et al., 2024). Digitalized

education reforms classrooms through NEP online shift (Agarwal, 2022). Teacher training institutions are positively influenced by the provision of 'Study Webs of Active Learning for Young Aspiring Minds', 'SWAYAM', under NEP 2020 (Bari and Goswamee, 2024). Digital training programmes are emphasized by the teacher education reforms under NEP 2020 (Singh, 2025). NEP 2020 stress on promoting technology-enabled learning for digital competence (Patil & Kumar, 2024). Digital divides as challenges are addressed through integrating technology in education as per NEP 2020 (Singh 2025). Policy Implementation in teacher education programme, such as B.Ed. includes digital literacy (Premachandran, 2025). Digital applications in higher education via NEP 2020 use MOOCs and blended learning (Acharya, 2025). Technology in teacher education is highlighted by critical analysis of pedagogical impact of NEP 2020 (Khuntia, 2025). Transformational digital technology creates a platform for teacher professional development, as given in NEP 2020 (Panda, 2025).

Thus, reviews of literatures related to NEP 2020 support the digital vision of NEP 2020, and further reflects the requirement of implementation in teacher education, but shows research gaps in the study of digital technology integration for pre-service and in-service teacher education, and gap of identification of the elements of technology under NEP 2020, and lack of associating the recommended technological aspects with online and offline software tools and techniques useful for teacher education. Therefore, the study tends to bridge these gaps, and objectives were determined.

OBJECTIVES

1. To explore elements of digital technology of NEP 2020 for pre-service teachers and in-service teachers;
2. To analyse NEP 2020 in terms of digital technology integration in pre-service teacher education programme;
3. To analyse NEP 2020 in terms of digital platforms for in-service teacher education development;
4. To analyse NEP 2020 in terms of digital competency enhancement among pre-service and in-service teachers;
5. To analyse NEP 2020 in terms of strategies for Equitable Digital Technology Accessibility for teacher education;
6. To analyse NEP 2020 in terms of Online Education for Teacher Education
7. To identify online-offline software tools for integrating the digital technology elements of NEP 2020 into teacher education.

METHODOLOGY

Present study is a qualitative study implying content analysis method to explore NEP 2020 provisions on digital technology. Content analysis was used as a systematic technique for replicability and to compress large textual document into fewer categories based on explicit coding rules (Krippendroff, 2018). A single policy document of 'National Education Policy' 'NEP'

(2020) of the 'Government of India' was analysed. It included secondary source of data as the NEP 2020 policy document consisted of 66 pages as a PDF file in English Version accessed from Indian government official website.

Certain keywords implied to search for identification of related contents were:

i) 'Technology',
ii) 'Digital',
iii) 'Online' and
iv) 'Teacher education'

Contents of NEP 2020 policy document were extracted by use of text extracting tool 'Grok' as a large language model. Elements were extracted and thematic categorization was implied for reduction and classification. Besides entire policy document, the study highlighted the chapters of NEP 2020 highly concerned with the keywords, as given below:

1) Teachers (chapter 5),
2) Teacher Education (Chapter 15).
3) Technology integration (Chapter 23)
4) Online Education (24).

Thematic extraction from the document was based on deductive coding including the codes:

i) 'Digital platforms'
ii) 'Equitable access'
iii) 'Professional development'
iv) 'Teacher competencies'

Inter-coder reliability was simulated through iterative reviews to ensure consistency, data quality, credibility and replicability. Ethical considerations were ensured with accurate representation of the NEP 2020 policy document without alteration. The study was delimited to interpretative nature of qualitative analysis and focused on a single source in English version.

FINDINGS

1. Elements of Digital Technology in NEP 2020 for pre-service teachers and in-service teachers

By thematic analysis of the NEP 2020 document, 30 elements of digital technology were identified by the qualitative tool of Artificial Intelligence by the coding of search 'technology'. Further, the elements identified were classified by specific characteristics of elements. By thematic analysis after text extraction, 30 elements were reduced to classify into 8 major themes, having different number of elements of digital technology of NEP 2020. The results obtained are given below:

i) Elements of Core Technology concept for teacher education

Four foundational key technology terms were identified referring to broad and digital and technological paradigms in teacher education, which are given below:

a. Technology (p.56, para. 23.1; p. 58, para. 24.1)
b. Digital (p.58, para. 24.1; p. 59, para. 24.2)
c. Online (p.58, para. 23.10; p. 59, para. 24.1)
d. ICT (Information and communication Technology) (p.56, para. 23.2; p. 57, para. 23.6)

'Technology' (Tech) can be characterized by various terms like Digital-Tech, Disruptive-Tech, Emerging-Tech, Information-Tech and similar other terms. 'Digital' term precedes several terms like Digital Resources, Digitalization, Digital technology, Digital information Digital contents and several other similar terms. Similarly, 'Online' terms precede various aspects like Online education, online platforms, online training, online mode and so on. 'ICT' is commonly used term for various tools and technologies including hardware, software, online-offline platforms.

ii) Advanced and Emerging Technologies for teacher education

Five, though not limited, emerging and advanced technologies were identified that highlights the cutting-edge fields for learning, training, assessment, certification and research, which are given below:

a. Artificial Intelligence (AI) (p.3, para. 23.10; p. 59, para. 24.1)
b. Machine Learning (p.3, para. 2)
c. Virtual Reality (p.57, para. 23.5)
d. Blockchain (p.57, para. 23.5)
e. Natural Language Processing (p.57, para. 23.5)

AI is the technology based on Large Language Model including machine learning with algorithms for pre-training to enable to generate contents, and transform contents, such as ChatGPT, Gemini, Grok, Gamma.ai, Canva.ai etc. Machine learning is the base of training the machine with coding with supervised, unsupervised and mixed approach to enable AI tool to accept the prompts and to respond accordingly. Virtual Reality the technology creating immersive environment with sensors for change of direction and magnitude of virtual objects which are visualized through a mobile, such as Oculus Go, Oculus Rift, Samsung Gear, and Sony Play Station. Blockchain Technology is the technology that assures the secure business and trade, and useful for certificate accessibility after training in education. Natural Language Processing is the technique in which higher level language, like our natural speech spoken in a mother language like Hindi or English, or other regional language can be converted and translated into machine language and to get result of query, such as, AI tools like ChatGPT, Grok, Gemini, and other AI tools understand our natural language and give us output accordingly.

iii) Data analytics Technologies for teacher education

Five major elements of digital technologies identified for data analytics useful for teacher education in data processing, data analysis (quantitative and qualitative), and AI applications for teaching and learning, and research, which are given below:

a. Big Data (p. 3, para. 2)
b. Data Science (p. 3, para. 2)
c. Data Annotation (p. 57, para. 23.5)
d. Image Classification (p. 57, para. 23.5)
e. Speech recognition (p. 57, para. 23.5)

Big Data refers to a large data set in thousands and millions that can be analysed by tools like Python and other data analytic tools. Data Science is the technology that deals with how to manage data and process to get expected output. Data Annotation is the technique for labeling data (text, image, audio, etc.) to make it usable for machine learning models. Image classification is a computer vision task where AI model categorizes image into predefined classes. Speech Recognition is the technology that lets computers understand spoken language and convert it to text, such as Siri, Google Assistant transcribe voice commands.

iv) Digital Technologies for Disciplines and Foundation in teacher education

Three core elements of academic field of digital technologies were identified, which are foundational requirements in teacher education for creation of digital learning environment, which are given below:

a. Computer Science (p. 3, para. 2)
b. Software (p. 57, para. 23.6)
c. Hardware (p. 57, para. 23.6)

Computer science is the study to deal with technology related to computer hardware engineering and software engineering. Software is the output of programming for specific purpose, like SPSS is a software that is useful for data analysis. Hardware is the physical, electronic or electrical device, such as keyboard, monitor, touch pad, printer, digital camera etc. which function by installation of software.

v) Digital Devices and Tools for teacher education

Three major elements of digital technologies as the digital devices and tools were identified for teaching and training in teacher education including physical and interactive hardware for educational purposes like teaching, presentation and assessment, which are given below:

a. Smart Boards (p. 57, para. 23.6)
b. Handheld Devices (p. 57, para. 23.6)
c. Computing devices (p. 59, para. 24.2)

Smart Board is an interactive whiteboard, Interactive Flat Panel having software 'Teach-Infinity', that lets a teacher write and draw to teach. Handheld device is a portal gadget which can be hold by hand, such as Smartphone, Tablets, Handheld Scanner etc. Computing Device is an electronic device that can process data, such as Laptop, Desktop, Tablet and Smartphone.

vi) Educational platforms and resources for teacher education

Four major elements of digital technology were identified as the educational platforms

and resources that reflects specific initiatives and digital contents mentioned in NEP 2020 for teaching-learning and training with e-resources, which are given below:

a. NETF (National Educational Technology Forum) (P. 56, para. 23.3; p. 57, para. 23.4)
b. DIKSHA (P. 57, para. 23.6; p. 58, para. 23.10)
c. SWAYAM (P. 57, para. 23.6; p. 58, para. 23.10)
d. E-content (P. 57, para. 23.6)

The 'National Educational Technology Forum' ('NETF'), has a provision to promote technology to improve digital infrastructure, bridge digital divides and enhance learning outcomes. The 'Digital Infrastructure for Knowledge Sharing', 'DIKSHA', is an India's national platform, useful for school education, hosting e-contents and supporting teachers, with e-books, videos, quizzes etc. The 'SWAYAM' is India's 'MOOC' ('Massive Open Online Courses') platform that offers free certified online courses from top universities with video lectures, resources, assessment and certifications. E-contents such as e-books, videos, podcasts and other online resources, for self-study and digital classroom.

vii) Technologies for educational assessment and evaluation in teacher education

Two major elements of digital technologies were identified for educational, assessment, and evaluation to assist teacher education teachers for testing and adapting learning, which are given below:

a. Adaptive Testing (P. 57, para. 23.5)
b. Online Assessments (P. 58, para. 23.11; p. 59, para. 24.3)

Adaptive testing is a technology-based examination approach in which questions adjust difficulty based on responses, used in online exams and skill assessments.

viii) Ethical, Social, and Access Issue mitigation technologies in teacher education

Four major elements of digital technologies related to mitigation of ethical issues, social issues, and access issues were identified to ensure security that concerns around responsible use, equity and risks in utilization of technologies in teacher education, which are given below:

a. Privacy (p. 57, para. 23.7)
b. Data Protection (p. 57, para. 23.7)
c. Ethical Issues (p. 57, para. 23.7)
d. Digital divide (p. 59, para. 24.2)

Privacy is required to balance technology use with data protection and security for safeguarding student data in digital learning platform and ensuring confidentiality. Ethical issues such as misusing data, breaching confidentiality, cyberbullying, Biased AI can mislead and so must be aware of these issues. Digital divide can be bridged with digital literacy with knowledge of information accessibility, availability, transformation, transfer, collection and protection.

2. NEP 2020 for digital technology integration in pre-service teacher education programme

Analysis with respect to the second objective revealed that:

a. NEP 2020 emphasizes technology infused multidisciplinary teacher preparation.
b. In Chapter 15, NEP mandates four-year integrated teacher education program, (B.Ed. programs) in higher education institutions (HEIs), incorporating pedagogy and technology (p. 42, para 15.1; p. 43, para. 15.5).
c. Digital tools are useful to imply for grouping teachers in modern advances of technology (p. 43, para. 15.8).

3. NEP 2020 for digital platforms for in-service teacher education development

a. NEP 2020 highlights Continuous Professional Development (CPD) through online modes and online platforms.
b. Chapter 5 indicates 50 hours of annual CPD programme using online modules (p. 22, para. 5.15).
c. Chapter 23 promotes 'Study Webs of Active Learning for Young Aspiring Minds', ('SWAYAM') for in-service teachers, and 'Digital Infrastructure for Knowledge Sharing', ('DIKHSA') for school education supported by in-service teachers.

4. NEP 2020 for digital competency enhancement among teachers

a. NEP 2020 Stresses on digital technology for pedagogical innovation and competence.
b. In Chapter 23, 'National Education Technology Forum' ('NETF') facilitates tech-based teacher development (p. 56, para. 23.3; p. 57, para. 23.5) for pre-service and in-service teachers.
c. Chapter 24 highlights on online training programmes for teacher competencies, like in assessments based on technology (p. 58, para. 23.11; p. 59, para. 24.3) for in-service and pre-service teachers.

5. NEP 2020 Strategies for Equitable Digital Technology Accessibility for teacher education

a. NEP 2020 focuses on bridging digital divide promoting digital literacy.
b. Chapter 24 seeks the attention of educational stakeholders towards eliminating digital divides by means of affordable digital devices (p. 59, para. 24.2).
c. Digital technology tools are required to be availed to Divyang students and the students of remote areas (p. 57, para. 23.6) for Equitable Digital Technology Accessibility in teacher education.

6. NEP 2020 in terms of Online Education for Teacher Education

a. NEP 2020 emphasizes on online education for teacher education through digital technology, and pilot studies for online modes.
b. Chapter 24 recognizes the importance of online education during disruptions due to any unexpected situation like pandemic situation (p. 59, para. 24.1).
c. Teacher training education can be promoted integrating digital platforms (p.58, para. 23.10).

7. Online-offline software tools for integrating the digital technology elements of NEP 2020 into teacher education

By the Markmap online visualization tool, the eight themes were obtained after reduction of 30 elements of digital technology of NEP 2020 for teacher education by thematic analysis (specific to first objective). The related online and offline tools are listed below.

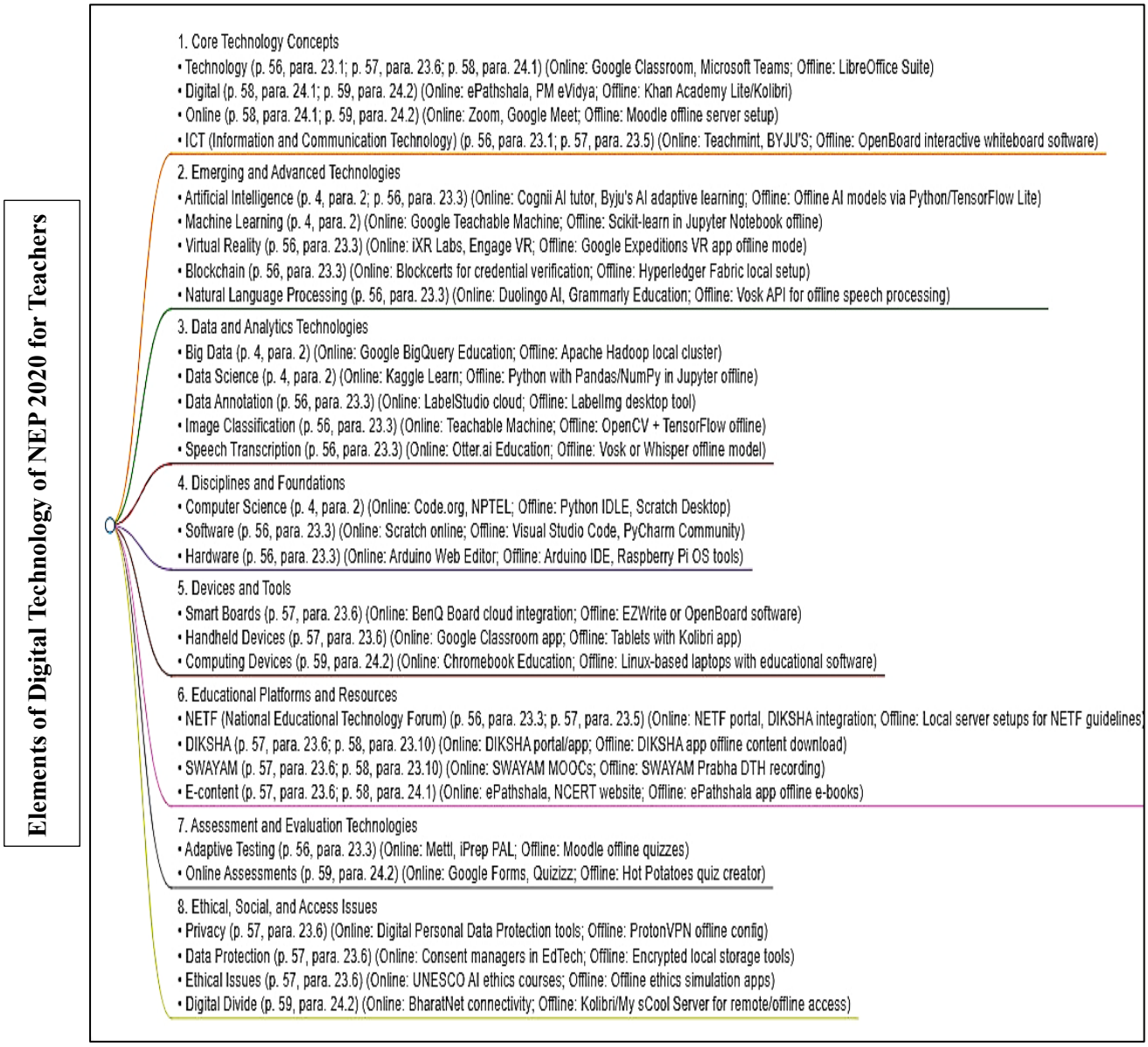

Fig.1. Mindmap of Online and offline tools under the elements of digital technologies

Besides the tool listed (Fig.1), there are various other disruptive tools for teachers of teacher education, such as, AI tools for presentation (Gamma and Beautiful), e-collaboration tools (MS-Team, Google Meet, Zoom), digital resources like PM e-vidya, e-pathshala ('NCERT', 'National Council of Educational Research and Training'), assessment tools (Quizizz, Google Form), digital devices like BenQ, and other emerging disruptive technologies for translation like Anuwadini, Big data analysis tools like Python, SPSS etc. The list has limited search, though it can reveal more similar other alternative online platforms or tools, and offline tools for trainee teachers of teacher education.

DISCUSSION

NEP 2020 emphasizes on the elements of core technology concept for teacher education and fosters integration of advanced and emerging technologies. Data analytics Technologies are referred as essential for teacher education development. The study reflects the importance of digital technologies in creating disciplines, and digital ecosystem in teacher education including digital devices and online tools, as highlighted in NEP 2020. Educational platforms and resources can strengthen the teachers of teacher education institutions. NEP 2020 talks of essentiality of integration of technologies for assessment and evaluation skills among teachers of teacher training. It also focuses on digital competencies in ethical, social, and access issues mitigation technologies in teacher education.

Findings align with the transformative agenda of NEP 2020 that refers digital technology playing central role in revitalizing teacher education. Digital integration for pre-service teacher through B.Ed. programmes echoes global shifts towards tech-savvy educators (Sharma, 2023). In-service teacher professional development through CPD via online platforms addresses motivation gap, as observed in post-NEP studies (Kumar & Singh, 2024). However, the matter concerning equity highlights risks of exacerbating divides without infrastructure, consistent with critiques (Patel & Mehta, 2024). The emphasis of NEP 2020 on NETF and pilots suggests proactive adaption to disruption like Artificial Intelligence (AI), outcomes may be hindered due to lack of implementation lags (Gupta & Rao, 2025). Further, NEP 2020 emphasizes on integration of digital learning tools and platforms with teacher education to promote inclusivity (Maurya & Sharma, 2023; Dubey, 2024). Overall, 'National Education Policy', NEP 2020, fosters to develop technology-enabled ecosystem, nonetheless, there is a requirement of proper monitoring system for inclusive impact on teacher education.

There are various online and offline tools and platforms which can be integrated to teacher education for empowering both teacher educators and trainee teachers, such as presentation with Gamma and Beautiful, e-collaboration with MS-Team, Google Meet, Zoom, digital resources management with PM e-vidya, e-Pathshala, assessment with Quizizz and Google Form), emerging disruptive technologies for translation like Anuwadini, Big data analysis with Python and SPSS for educators for quality teacher education. Thus, digital technology integration for pre-service teachers, and in-service teachers is required associating various online and offline software, platforms, tools and techniques with the elements of digital technology of NEP 2020.

IMPLICATIONS

- Findings reflect the implications of the elements of digital technologies given in NEP 2020 for re-designing of curriculum including digital tools to ensure availability and accessibility of e-contents and e-resources with digital platforms for pre-service and in-service digital competencies integrating Artificial Intelligence (AI) platforms.
- Integration of 'SWAYAM' platform into in-service teacher training programme is useful for enhancing accessibility of information and knowledge for rural learners and teachers.

- Targeted investments in digital technology devices and broadband with NETF can strengthen a partnership of government and technology firms with teacher education to ensure equity strategies.
- Elements of digital technologies are useful for developing training module with extension activities for pre-service and in-service teachers in education.
- Classroom digitalization, library automation, and self-paced learning platforms can be developed as teaching-learning and training management integrating online digital platform.
- Future policy framework can be determined with the identified elements of digital technologies by Policymakers and accordingly funding provision can be encouraged for teacher education development.
- Teacher educators can adopt digital technology for inclusive practices, and skilled workforce should be fostered aligned with '4th Sustainable Development Goal', 'SDG4' (Maurya & Sharma, 2023; Amin et al., 2025).

CONCLUSION

Thirty major elements of Digital Technology were identified, though not limited, by content analysis of NEP 2020, and those elements were reduced to eight major themes. These themes are- Elements of Core Technology concept for teacher education; Advanced and Emerging Technologies for teacher education; Data analytics Technologies for teacher education; Digital Technologies for Disciplines and Foundation in teacher education; Digital Devices and Tools for teacher education; Educational platforms and resources for teacher education; Technologies for Assessment and Evaluation in teacher education; and, Ethical, Social, and Access Issue mitigation technologies in teacher education. It was also highlighted that for integrating digital technologies in pre-service teacher education, NEP 2020 mandates technology-integrated B.Ed. programmes, giving due emphasis on multi-disciplinary inputs with digital pedagogy (Govt. of India, 2020, p. 43). For in-service teacher training programmes using digital technology tools, NEP 2020 policy requires annual Continuous Prfessional Development (CPD leveraging digital platforms like 'SWAYAM' for teacher skill enhancement (Govt. of India, 2020, p. 22). Further, for enhancing teacher competencies with digital technology, the national educational policy highlights digital technology fostering innovative teaching, and integrating with National Educational Technology Forum (NETF) guiding Artificial Intelligence (AI) and virtual Reality (VR) applications (Govt. of India, 2020, p. 56). NEP 2020 is found to highlight the implementing strategies with affordable digital devices and inclusive digital platforms to ensure an equitable access to digital resources for teachers (Govt. of India, 2020, p. 59). Finally, priorities have been given in the national education policy to online mode of education highlighting digital education with digital platforms promoting flexible self-pace learning, teaching and training for empowering teachers before and after training and maintain quality education (Govt. of India, 2020, p. 59).

SUGGESTIONS

Based on study of NEP 2020 oriented digital technology integration for the teacher trainees including pre-service teachers, and in-service teachers, some specific measures can be adopted for NEP implementation and technology integration for teacher education:

- Mandatory digital literacy courses should be integrated in teacher education programme like B.Ed. for preparation of pre-service teachers for tech-infused classrooms, focusing on multi-disciplinary approach of NEP 2020.
- SWAYAM and DIKSHA module for in-service CPD should be expanded to boost teacher digital skills among trainees.
- NETF-guided pilots for AI and VR should be developed in teacher education training programme, evaluating efficacy of teachers.
- Affordable digital devices should be allocated in rural areas to ensure equitable access of information for technological advancement among in-service teachers.
- Online assessment and digital evaluation should be an integral part of teacher training.
- Partnership with tech-companies developing digital technologies should be encouraged in teacher education for teacher competency in emerging technology.
- Orientation programme on digital ethics, security, privacy and integrity should be organized in teacher education.
- Monitoring mechanisms for technology integration should be established using data analytics in teacher education.
- Bilingual and multilingual digital content platforms should be developed to support diverse linguistic need in teacher education.
- Research grants for researches focused on digital impact of emerging technology on teacher education development should be encouraged.
- Upgradation of educational training system with disruptive technologies, advanced software and digital tools should be assured for proper training in teacher education institutions.

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