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Barriers to NEP 2020 in Engineering Institutions: Infrastructure, Access, and Equity

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Abstract

To transform higher education in India by promoting experiential learning, digital integration and equitable access, The National Education Policy (NEP) came into light. But there are certain infrastructural barriers to limit its effective implementation in engineering education. The research article critically examines the challenges that hinder the NEP'S transformative vision. As per NEP, the traditional mode of rote-based learning stands in contrast to the in-person, project-oriented method. Other loopholes such as inadequate training facilities and more importantly faculty ready resist the shift towards the outcome-based education. In addition, the other inequities in physical facilities such as out-dated labs, insufficient classrooms amenities and their poor maintenance undermine practical learning opportunities, at the same time; the digital divide persists specially in rural areas where there are very fewer opportunities for accessing internet, digital tools and other technical support. Such hindrances create more disparities for the implementation of NEP 2020. By highlighting such barriers this paper emphasizes the need for systematic capacity building, well infrastructural investment, and brighter management level. Bridging Physical and technical inequalities and providing adequate opportunities is a vital thing for realizing the importance of a future ready, inclusive and practical engineering education ecosystem, as per the NEP 2020.

Keywords: NEP 2020, Engineering Education, Experiential Learning, Digital Divide, Infrastructure Equity

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Introduction

Introduction The National Education Policy (NEP) 2020, which was endorsed by the Government of India following over three decades of policy inaction, is a paradigm shift in the country's vision and operationalization of education. The policy aims to transform Indian education through multidisciplinary approaches, which focus on holistic learning and skill development for global competitiveness. The policy focuses on flexibility, creativity, and output-based learning to transform higher education, including professional programs like engineering.

The Times of India (2020) reported that NEP 2020 seeks to establish equal access to superior education. This will enable India to become a knowledge superpower in the 21st century. The educational transformation requires students to move from memorization toward conceptual understanding while uniting different academic fields into comprehensive knowledge systems and replacing rigid programs with adaptable student-centered learning methods. The policy suggests the establishment of a four-year undergraduate program, which would enable flexible course selection and multiple entry and exit points, and credit accumulation through Academic Bank of Credits (ABC), and expanded digital learning options via SWAYAM and DIKSHA platforms. The new policies bring major changes to engineering education because this field operates at the point where scientific knowledge meets technological advancement and economic development.

Review of the Literature

Traditional method vs. practical Learning:

The chalk and talk approach that dominated engineering education in India enabled students to receive knowledge passively and remember it, whereas this said approach functions for certain technical topics, this approach does not cultivate high order in thinking, problem solving skills and creativity among the students. The vision of NEP 2020 breaks the previous norm by promoting constructivist models such as project based leaning (PBL), flipped classrooms, case-based methods, and practical models of learning which enables students like co-creators of knowledge.

However, most of the engineering faculties, specifically the ones from Tier 2 and Tier 3 universities, have had no or very little contact with these modern techniques. According to TruScholar (2022), the majority of the teachers keep on resorting to the old ways of teaching—their digital pedagogy is untrained, and they are not equipped to create an interdisciplinary or problem-based curriculum. Their own educational experiences, which mostly consisted of examination-based, textbook-based teaching, have made them so used to the rote learning methods. The staff find it difficult too, to make this switch to student-centered instruction, in which the focus is no longer on content delivery but rather on teaching discussions and mentoring, and facilitating the creation of collaborative learning spaces. For example, the implementation of a flipped classroom requires a tremendous amount of planning that includes pre-class content selection, interactive class creation, and

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assessment of learning outcomes. Besides, many of the faculties find it hard to grasp and practice the techniques without having dedicated support systems and continuous mentoring.

Lack of Training Infrastructure :

In order to develop faculty as per contemporary pedagogy and enhancement of potentiality, All Inndia Council of Technical Education (AICTE) introduced various initiateives, such as-

- ATAL Academy (AICTE Training and Learning): Provides short-term training courses on AI, IoT, cybersecurity, and pedagogy.
- ATTT (AICTE Teacher Training Toolkit): For first-time teachers to grasp teaching strategies.

NITTT (National Initiative for Technical Teachers Training): Focuses on integral development of engineering educators through an eight-module certification.

Though laudable in conception, such platforms lack spread and uncertain quality. As reported in The Times of India (2023), huge chunks of faculty—particularly those in distant or poorly funded institutions—stay outside the ambit of such training initiatives owing to digital illiteracy, ignorance, or institutional inertia. Majority are one-shot, short- term interventions and not part of a systematic and ongoing professional development (CPD) framework.

Additionally, there is minimal coordination among these programs and the requirements of individual disciplines. For instance, case-based pedagogy training in engineering ethics or design thinking in mechanical engineering is usually unavailable or under construction. Further, several faculty members do not wish to undertake these programs because of workload demands, bad incentives, or doubts about their utility.

In addition, language limitations, inadequate digital infrastructure, and absence of real- time mentorship commonly hinder learning under such programs. Even among the faculty, there is a digital divide—urban, self-governing institutions' faculty members are more likely to have their needs met by online learning than their semi-urban and rural institution counterparts.

The absence of institutional structures to monitor, acknowledge, or require continuous faculty development makes the issue worse. Unlike global norms in which professional learning communities, instructional design teams, and innovation teaching labs facilitate faculty development, Indian engineering colleges work independently with limited organized support systems.

Leadership Shortcomings and Administrative Capability:

One of the least recognized but most important hurdles to pedagogical reform is the dearth of academic leadership and administrative talent. NEP's success in retooling pedagogy depends upon visionary institutional leaders with the ability to manage change, build innovation cultures, and energize faculty buy-in. Yet, many

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engineering schools lack leaders with strategic vision, with change management competencies, or even minimal exposure to pedagogical reforms.

According to the IJABS, 2021, an administrator is often appointed based on seniority or research qualifications and not for his or her leadership or organizational development capabilities. As such, they are less inclined or prepared to spearhead pedagogical innovations, nor to bring faculty toward new pedagogical models.

Administrative departments may also have little specific HR capacity, training budgets, or data systems for handling professional development programs. The nonacademic staff that is supposed to take care of timetabling, course enrollment, performance appraisal, etc., usually has no training in handling reforms. This leads to weak planning, dispersed implementation, and poor monitoring of faculty training programs.

Further, NEP's thrust on autonomy and decentralized governance demands a paradigm shift in the way engineering institutions function-away from bureaucratic

Management towards participatory, transparent decision-making However, in the absence of institutional preparedness or leadership readiness, most colleges slip into token compliance, such as holding a one-day FDP instead of substantial change.

The other challenge is the absence of mentorship systems. Faculty work largely in isolation without collaboration with peers, interdepartmental discussion or exposure to experienced mentors. The institutional lack of FDCs offers little opportunity for faculty to critically reflect on practice, immerse themselves in emergent pedagogies, or redesign courses collaboratively.

Infrastructure Challenges and Digital Divide:

In order to implement the transformative vision of NEP 2020 there should be strong physical and digital capacity of facilitating practical and technologically supported learning. In India, in engineering education, and to enable a learner centric experience, especially workshop, laboratories, high speed internet, smart classrooms, and e-learning platforms are most required. However, there are clear differences with regard to the facilities particularly between Tier1 and Tier 2 institutions and rural and urban engineering institutions.

Research Methodology

The present research employs the qualitative research methodology in order to synthesize data including secondary sources. This research methodology enables a holistic comprehending of NEP 2020 implementation and the hindrances that the engineering colleges have been struggling with.

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Results / Findings

Physical and Laboratory Shortfalls:

NEP 2020 emphasises on project based and practical learning including multidisciplinary innovation centers, capstone projects that requires well equipped physical space. Unfortunately there are fewer aminities in rural, and semi urban engineering institutions in India.

As per ResearchGate 2022, AICTE approved colleges in rural areas do not possess updated labs for the technical courses to the extent of 65 per cent. In most colleges, current labs consist of outdated hardware, minimal consumables, and outmoded manuals that render them incompatible with today's industry requirements. The students in these institutions mostly depend on theoretical simulations rather than actual experimentation, which lowers their practical exposure and employability.

Furthermore, the equipment-to-student ratio is precariously low in most schools. For example, a CNC machine or microcontroller kit may be shared among 40–50 students during a session, significantly cutting down on time and intensity of interaction. Workshops intended for mechanical or civil engineering education are often devoid of sophisticated tools, 3D printers, or safety equipment.

The NEP's appeal for innovation labs, making spaces, and inter-disciplinary project studios continues to be the stuff of dreams for these colleges. Even funding pressures, steep maintenance costs, and unavailability of trained lab technicians add to the problem. Centrally funded institutions such as IITs or NITs have gone a long way in creating state- of-the-art infrastructure, but the overwhelming majority of private and state-level colleges are functioning under extreme resource crunches.

In most states, government colleges are still functioning from buildings more than three decades old without any operational instrumentation laboratories, poor power backup, and no centralized maintenance system, physical modernization being a long-drawn-out and uneven process.

Digital Infrastructure and Access Limitations

The NEP heavily promotes technology-based teaching, learning, assessment, and administration, focusing on platforms such as SWAYAM, DIKSHA, e-Samarth, AICTE Virtual Labs, and MOOCs. But digital infrastructure gaps persist as a serious bottleneck, especially among Tier 2 and Tier 3 institutions.

Over 50% of rural colleges lack reliable access to high-speed internet, and network outages repeatedly cut off digital instruction, as per a report by ETEducation.com (2023). Wi-Fi campuses remain an amenity of top-tier schools. Even where there is internet, bandwidth will be lacking to stream video lectures, access virtual labs, or hold hybrid classes.

Device access is also a key obstacle. Most students and instructors in under-resourced areas do not have personal laptops or tablets, and instead still use smartphones, which are not suitable for writing code, executing

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simulations, or using CAD tools. The digital divide, therefore, is not simply a matter of internet access but also device access, data price, and technical skill.

In addition, usage of such platforms as SWAYAM and DIKSHA is still remarkably low in rural institutions. As ETEducation observes, despite making available free and high- quality, top-faculty-curated content, these platforms are very underutilized because of awareness deficits, language constraints, and a lack of digital mentorship. Most institutions do not mainstream such tools in the formal curriculum but opt to treat them as add-ons instead of key instructional resources.

Faculty preparedness for digital pedagogy is also a concern. There are many instructors in rural colleges who have no training in the use of Learning Management Systems (LMS), capturing lectures, or administering online exams. There are few IT support staff available, and in some colleges, even the most basic infrastructure to host virtual classes (projectors, smart boards) does not exist. This virtual chokepoint greatly inhibits learners' access to the flexible, blended, and self- paced learning environment that NEP 2020 promises.

Equity Issues in Remote Areas

Maybe the widest-reaching effect of infrastructure disparity is on educational equity. The digital divide and physical divide mentioned earlier have resulted in the production of several layers of access to NEP reforms—where students at urban, well-funded institutions disproportionately benefit, while their counterparts in far-flung or tribal areas lag further behind.

As highlighted in the ETEducation.com report (2023), the education divide between urban and rural areas is being exacerbated by unequal adoption of NEP-led platforms and reforms. For instance, the technical students from Delhi, Pune, and Benguluru etc, are able to get engaged with virtual classes from IIT professors and they are able to attend national hackathon, and watch real time cloud simulations while the students from Bihar, Andhra Pradesh, Odisha and some of the districts of Northeast are lacking such facilities.

The gap between these two categories not only influence learning but also career opportunities that results in exclusion from knowledge economy. Students from urban engineering institutions are offed preparation for industry certifications, internships, and international collaborations, whereas students from rural engineering institutions are left behind for such facilities and they are struggling with old content.

Finally, the inequality with regard to infrastructure works as a multiplier of hindrances which is not just for hindering pedagogy and curriculum change. It effects tens millions of students from the change to engage in transforming India’s engineering education scenario.

Discussion / Analysis

To implement, NEP 2020 effectively in engineering education in India badly necessitates overcoming hindrances at the following levels-systematic, infrastructural and digital Traditional methodology like rote-based learning limited to train the faculty, and leadership loopholes stem from constraints to experiential

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learning, when some deficits like infrastructure and digital divide further enlarge inequities in access. The results highlights that the vision of NEP 2020 to be realised. Engineering institutions in India require strategic investments in physical and digital resources. Moreover, more practical faculty development frameworks and improved institutional leadership, systematic changes as mentioned in the paper cannot be achieved by just isolated interventions or token policy compliance.

Unless the long-term endeavours for shaping the vision of NEP 2020 in Indian engineering institutions to eradicate the layered nature of the barriers from entrenched pedagogical practices and out-dated institutional evaluation systems. All the challenges need to be addressed holistically to bridge the gap to realise the vision brought by NEP 2020.

Conclusion

For NEP 2020 to be implemented in engineering education effectively, systemic, infrastructure, and digital barriers must be addressed. Experiential learning is limited by rote-based customs, inadequate faculty training, and leadership deficiencies, while access disparities are made worse by infrastructure deficiencies and digital injustices. It is crucial to close these gaps via resource investment, capacity building, and fair digital access. By tackling these issues comprehensively, engineering schools will be able to fulfil NEP 2020's goal of inclusive, adaptable, and future-ready technical education, which will promote creativity, skill improvement, and wider social impact.

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