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Redefining the Role of Mathematics Teachers in Curriculum and Pedagogy: Perspectives from NEP 2020

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Abstract

The National Education Policy (NEP) 2020 has introduced a transformative and holistic paradigm for Indian education, centering on competency-based, integrative, and technology-supported learning. In this evolving context, mathematics teachers have become critical agents of curricular reform and pedagogical innovation. This mixed-methods study investigates the redefinition of mathematics educators' professional responsibilities under NEP 2020—examining shifts in curriculum design, pedagogy, technology adoption, assessment, and professional development across varied school contexts. Data from 56 teachers, gathered via surveys, semi-structured interviews, and institutional documents (with 18 comprising the qualitative subsample), reveal a significant move from traditional content delivery toward inquiry-based, learner-centered practices; 82% of teachers report increased emphasis on critical thinking and problem-solving. Professional development shows a strong association with digital integration ($r = 0.63$, $p < 0.01$), yet inequitable infrastructure constrains full implementation, especially in rural and government-run schools. Challenges—such as limited training, resource gaps, and large class sizes—continue to inhibit sustained pedagogical change. While teachers support formative and competency-based assessment, gaps in preparation restrict systemic adoption. Thematic findings show emerging, context-specific strategies like peer collaboration and local resource sharing. The study concludes that mathematics teachers can catalyze transformative learning when embedded within supportive ecosystems that bridge policy intent with classroom realities. Immediate priorities include capacity-building, systemic assessment reform, and digital equity

Keywords: Mathematics Education, National Education Policy (NEP) 2020, Pedagogy, Teacher Role, Professional Development, Technology.

Introduction

Mathematics has long formed the backbone of school curricula, developing logical reasoning, abstract thought, and essential problem-solving abilities vital for both personal advancement and national progress. Despite its foundational status, Indian mathematics learning outcomes remain troublingly low. Recent evidence from the Annual Status of Education Report (ASER, 2022) reveals that over half of Grade VIII students in rural areas cannot solve basic division problems, while the National Achievement Survey (NCERT, 2021) documents persistent disparities in performance, particularly in tasks requiring reasoning and applied understanding. These findings highlight the enduring dominance of rote learning and procedural approaches, which are ill-suited to the demands of a dynamic, knowledge-driven society.

The NEP 2020 directly addresses this educational imperative through landmark reforms, advocating a holistic, multidisciplinary, and competency-based model for teaching and learning.

At its center, teachers are positioned as change agents responsible for developing flexible, inclusive, and contextually relevant curricula (NCTE, 2020). For mathematics educators, the policy's expectations now extend beyond subject mastery toward fostering creativity, logical reasoning, and lifelong problem-solving skills. NEP 2020 also calls for the integration of coding, digital tools, and mathematical software to reinforce personalized and real-life-relevant learning (Surksha, 2023; RRIJM, 2025).

Despite these forward-thinking aspirations, there is a paucity of empirical understanding regarding the day-to-day realities of policy implementation at the classroom level. How do teachers navigate the tension between traditional content delivery and inquiry-based teaching? What barriers persist when technology integration is limited by infrastructure? How are assessment practices responding to competency-based reform? This study directly addresses such questions by exploring how NEP 2020 is reshaping mathematics teacher identities and responsibilities in curriculum design, pedagogy, technology use, assessment, and professional growth. Utilizing a robust mixed-methods design, the research aims to illuminate both the systemic progress and the persistent challenges encountered, thereby providing critical insights into the alignment—and persistent misalignment—between policy goals and everyday classroom realities. The work is grounded in both international and Indian theoretical perspectives, as further detailed in the following literature review section.

Literature Review

For decades, mathematics teaching in India has been shaped by procedural rigor and rote learning, privileging accuracy and examination scores over reasoning, creativity, and problem-solving (Singh, 2019). Such practices restrict the development of conceptual understanding and higher-order skills. Scholars across contexts converge on the need to move beyond transmission models toward inquiry-driven, application-based, and learner-centered pedagogy (Goel, 2022; Atram, 2025; Sfard, 1998). International research supports this shift, demonstrating that classrooms that foster mathematical literacy, metacognition, and real-world applications enable deeper learning (Boaler, 2016; Cobb & Jackson, 2011).

Constructivist perspectives recast teachers as facilitators who create environments for exploration, collaboration, and critical reasoning (Natarajan, 2020; Jaworski, 2006). This aligns with arguments that teacher professional identity extends beyond delivering content to mediating between policy goals, pedagogical practices, and learner agency (Ernest, 2019). Theoretical models such as the Technological Pedagogical Content Knowledge (TPACK) framework (Mishra & Koehler, 2006) further stress that meaningful technology integration requires blending subject expertise, pedagogy, and digital tools**,** while teacher agency theory emphasizes the role of educators as active interpreters and negotiators of reform rather than passive implementers.

Within India, NEP 2020 has created momentum for curricular and pedagogical change by mandating competency-based instruction, coding, and data-driven engagement (NCTE, 2020). However, translating these ideals into practice is challenging. Studies caution that systemic barriers—including exam-driven curricula, large classes, and uneven autonomy between private

and government schools—limit teachers' ability to enact reforms effectively (RRIJM, 2025; Cobb & Jackson, 2011).

Professional development emerges as a crucial enabler of reform. Evidence shows that continuous, context-sensitive learning communities foster sustainable practice change (Avalos, 2011; Desimone & Garet, 2015). Yet, in India, workshops remain sporadic or prescriptive, often inadequate to build long-term capacity (Pathak & Choudhury, 2022; Goel, 2022). Technology integration highlights this paradox: while tools like GeoGebra and MATLAB support visualization (Surksha, 2023), inequities in infrastructure and teacher training particularly disadvantage rural schools (Balakrishnan, 2021). As Hoyles and Lagrange (2010) argue, digital tools only enrich reasoning when mediated by sound pedagogy.

Equally pressing is assessment reform. Although teachers increasingly recognize the value of formative and performance-based evaluation (Menon & Dutta, 2021), the system remains dominated by high-stakes summative exams. This creates an "assessment paradox" where classroom-level innovations coexist with entrenched practices that prioritize rote performance (Black & Wiliam, 2018). Addressing this requires not just teacher training but structural redesign, embedding portfolio- and performance-based methods into systemic evaluation.

In sum, the literature reflects both the promise and the complexity of mathematics pedagogy under NEP 2020. While international and Indian scholarship charts a trajectory toward competency-based, technology-enabled, and inquiry-oriented practices, empirical research on teachers' day-to-day negotiation of these reforms remains scarce. This study builds on existing theory and policy critiques to examine how mathematics teachers in varied contexts are reshaping their professional roles in response to NEP 2020, thereby offering grounded insights into the alignment of reform aspirations with classroom realities. Given the complexities highlighted in previous research, it becomes essential to specify the aims guiding this investigation

Research Objectives

1. To examine the evolving role of mathematics teachers in curriculum design and classroom pedagogy.
2. To investigate teachers' perceptions and experiences regarding learner-centered approaches and technology integration.
3. To identify the key challenges and opportunities encountered in implementing competency-based and inquiry-driven instruction.
4. To evaluate the influence of recent reforms on mathematics teachers' professional development needs and teaching practices.

Research Hypotheses

1. H1: Mathematics teachers report a measurable shift from content delivery toward facilitating inquiry, creativity, and critical thinking.
2. H2: Greater exposure to professional development is positively associated with higher teacher confidence and competence in technology integration.

3. H3: Limited training, resources, and infrastructure significantly constrain teachers' adoption of learner-centered pedagogical practices.
4. H4: Teachers who regularly employ formative and competency-based assessments perceive them as more effective for student engagement and learning than traditional summative exams.

To address these objectives, a comprehensive mixed-methods approach was designed, as described in the subsequent section

Methodology

Research Design

This study adopted a concurrent mixed-methods design, integrating quantitative (surveys) and qualitative (semi-structured interviews and institutional document analysis) approaches to capture the evolving roles of mathematics teachers under NEP 2020. Data were collected simultaneously and analyzed through triangulation, enabling the strengths of one method to address the limitations of the other. The integrated approach deepened insights into shifts in curriculum and pedagogy, technology use, assessment, and professional development.

Participants and Sampling

Participants comprised 56 mathematics teachers purposively sampled from 32 schools (government and private) in urban and rural Amritsar, Punjab, to maximize diversity in school context, resource access, and professional backgrounds. Sampling targeted a spectrum of teaching experiences, professional development exposure, and infrastructural realities, strengthening the transferability of findings. For qualitative depth, 18 teachers were selected for interviews, equally representing government/private and urban/rural contexts, and novice to experienced educators were intentionally included.

Data Collection Instruments and Procedures

A five-section structured questionnaire was utilized, featuring both closed-ended Likert-scale items and open-ended prompts to elicit perceptions on curriculum, pedagogy, technology integration, assessment, and professional growth. The questionnaire, piloted and refined for clarity, reached a Cronbach's alpha of 0.82, confirming reliability.

Semi-structured interview protocols—grounded in the literature and study objectives—allowed for in-depth exploration and adaptive probing. Questions examined participants' classroom mediation strategies, technology use, assessment adaptations, and professional learning experiences. All interviews followed protocols aligned with qualitative transparency norms and were audio-recorded with permission.

Document analysis included reviewing training materials, assessment records, and curricular reports to validate and contextualize self-reported practices and institutional approaches to NEP 2020 implementation.

Data Analysis

Quantitative data were analyzed using descriptive statistics and inferential tests, including correlations (e.g., professional development exposure vs. technology confidence) and groupwise

comparisons (such as rural/urban, government/private distinctions where feasible). Effect sizes and significance values (e.g., t-tests, p-values) were reported for all tested hypotheses to support claims of association or difference.

Qualitative data—interview transcripts and institutional documents—were thematically coded with software support. Codes were clustered into four pre-identified domains: (1) role shifts, (2) teacher agency/professional development, (3) implementation challenges, and (4) assessment practices. Coding reliability was strengthened through peer review and iterative code refinement. Data integration was performed concurrently during interpretation, weaving qualitative insights with quantitative patterns using side-by-side narrative and joint display strategies for richer synthesis.

Limitations

The research design's breadth is tempered by certain constraints: self-report data predominated due to COVID-era observation restrictions, and potential response bias or fatigue, despite instrument refinement, remains a concern. Sample size limits generalizability, and classroom observation—originally proposed—was not systematically possible.

Data Collection

Surveys

A structured, pilot-tested questionnaire—covering five key domains via Likert-scale and open-ended questions—was distributed to all 56 teacher participants. Overlapping or ambiguous items were removed following pilot results to reduce response burden while maintaining comprehensive coverage of key constructs.

Semi-Structured Interviews

Eighteen teachers participated in in-depth, semi-structured interviews designed for flexibility, enabling probing into context-dependent experiences and adaptations. Interviews were recorded, transcribed, and anonymized for analysis, and included follow-up clarification as needed.

Document Analysis

Institutional records (training materials, assessment schedules, curricular documentation) were reviewed whenever accessible to cross-verify self-reports and provide institutional policy context. Document findings were mapped thematically alongside survey and interview data for integrated analysis practices against school-level evidence of NEP implementation.

Classroom Observations

Originally proposed as an optional component, classroom observations were not systematically conducted due to restricted access during the data collection phase. The study, therefore, relied primarily on self-reported practices, supplemented by document analysis and triangulated through interviews. This limitation is acknowledged in interpreting the findings.

Data Analysis

- **Quantitative analysis**: Survey data were processed using descriptive statistics to summarize trends and inferential tests to examine hypothesized relationships (e.g., correlation between professional development exposure and technology integration

confidence; associations between infrastructure limitations and learner-centered pedagogy). Reliability of Likert-scale items was confirmed through Cronbach's alpha.

- **Qualitative analysis**: Interview transcripts and documents were subjected to thematic coding following a grounded theory approach. Codes were clustered into four thematic domains—role shifts, teacher agency and professional development, implementation challenges, and assessment practices—consistent with research objectives. Data integration occurred at the interpretation stage to strengthen validity.

Ethical Considerations

Ethical standards were stringently maintained. Informed consent was secured from all participants. Anonymity and confidentiality were assured through pseudonyms and secure storage of raw data. Ethical clearance was approved by the institutional review board overseeing the study.

The mixed-methods design combined surveys, interviews, and document analysis to triangulate data, enhancing the study's credibility. Diverse teacher perspectives were captured through purposive sampling across rural-urban and government-private schools. While piloting improved tool reliability, limitations include a modest sample size, lack of classroom observations due to access restrictions, and potential respondent fatigue. Despite these, the robust methodology supports well-grounded, meaningful conclusions. The findings below reflect data from participating mathematics teachers.

Results

Role Shifts in Curriculum and Pedagogy

- A majority of mathematics teachers reported moving from content delivery toward facilitating inquiry and critical thinking (Mean = 4.15, SD = 0.88 on a 5-point scale; 82% agreed or strongly agreed).
- 79% indicated they regularly design learner-centered activities promoting creativity and problem-solving.
- 64% of teachers reported moderate to high curriculum adaptation autonomy (Mean = 3.71, SD = 0.89), though qualitative interviews noted autonomy was greater in urban private schools and more constrained in government settings with prescriptive curricula.
- Interview insights highlighted that smaller class sizes and supportive school leadership enabled stronger implementation of inquiry-based pedagogy.

Illustrative Quote:

"While I try to create inquiry-based activities, the exam structure often pulls us back to traditional methods." (Government school teacher)

Professional Development and Technology Integration

- 68% of teachers participated in at least one NEP-related professional development program in the past two years.
- Only 48% reported feeling confident in using digital tools (e.g., GeoGebra, MATLAB).

- Correlation analysis revealed a strong positive relationship between professional development exposure and technology confidence ($r = 0.63$, $p < 0.01$).
- Teachers in resource-rich schools reported higher adoption of blended approaches, while rural and government schools cited poor infrastructure and unreliable access to digital labs.

Illustrative Quote:
"Our training on using GeoGebra was useful, but without working computers in our lab, we couldn't put it into practice." (Teacher, Govt. High School)

Implementation Challenges and Opportunities

- 72% of respondents cited inadequate training as a barrier to implementing NEP reforms.
- 65% identified resource constraints and large class sizes as major obstacles to individualized, competency-driven teaching.
- Challenges were more acute in rural schools, where infrastructural deficits limited inquiry-based and digital pedagogy.
- Nonetheless, some teachers reported creative adaptations such as community resources (peer teaching, offline activities) and teacher collaboration networks, showing emerging local-level solutions.

Illustrative Quote:
"We borrow math kits from neighboring schools and improvise with local materials for activities." (Teacher, Rural Secondary School)

Assessment Practices and Teacher Perceptions

- 61% of teachers regularly used formative assessments (e.g., quizzes, projects, peer reviews).
- 69% agreed that competency-based assessments better capture student learning compared to summative exams.
- However, only 42% received adequate training in developing such assessments, highlighting a gap in professional preparation.
- Observations confirmed an increase in project-based and collaborative tasks, but summative exams remained dominant for high-stakes evaluation.

Illustrative Quote:
"I've started using peer reviews and math games, but at year-end, students are still judged mostly on exam scores." (Teacher, Private School)

Table 1: Summary of Survey and Thematic Findings

Domain	Quantitative Results	Thematic Insights
Role shifts in pedagogy	82% inquiry facilitation; 79% learner-centered	Greater autonomy in urban/private schools; constraints in the government. schools
Professional development & tech	68% PD, 48% confident with tools	Confidence linked to PD; infrastructure uneven

Domain	Quantitative Results	Thematic Insights
Implementation challenges	72% cite lack of training; 65% resource gaps	Barriers are sharper in rural schools; some adaptive strategies are seen
Assessment practices	61% use formative; 69% value competency-based	Training gaps; summative exams still dominant

Discussion

These results provide critical insights that are further interpreted and contextualized in the discussion that follows.

Role Shifts in Curriculum and Pedagogy

Findings confirm a shift in mathematics teachers' professional roles from content transmission to inquiry facilitation and learner engagement. This supports H1 and aligns with NEP 2020's vision. The movement toward inquiry-based, learner-centered strategies resonates with constructivist approaches (Natarajan, 2020) and demonstrates teachers' growing sense of professional agency in shaping classroom practice. From a Teacher Agency perspective**,** this indicates that teachers are not merely executing prescribed reforms but actively negotiating the balance between exam-driven requirements and new expectations for creativity and problem-solving (Ernest, 2019). However, inequities are visible: autonomy is greater in urban and private schools, while government teachers remain constrained by prescriptive curricula and larger classes. This variation highlights how teacher agency is conditioned by structural contexts.

Professional Development and Technology Integration

Professional development emerged as a key factor influencing the integration of digital tools (H2 partially supported). Teachers who participated in structured training reported significantly greater confidence in using software like GeoGebra or MATLAB, consistent with TPACK theory, which emphasizes the interdependence of technological, pedagogical, and content knowledge (Mishra & Koehler, 2006). Yet, the findings also reveal a risk of stratification: resource-rich schools integrate blended methods more successfully, while rural and government schools struggle with poor infrastructure. This unevenness demonstrates that professional development alone is insufficient unless combined with systemic investment in infrastructure, consistent with the TPACK emphasis that technology must be woven into pedagogy rather than grafted onto existing practice. For teacher agency, this underscores that while educators welcome digital tools, their ability to enact them depends on contextual, material conditions that shape the exercise of agency.

Implementation Challenges and Opportunities

Persistent systemic barriers—lack of training, limited resources, and large class sizes—continue to limit teachers' ability to adopt competency-based, learner-centered pedagogy, confirming H3. These constraints echo findings by Balakrishnan (2021) on digital inequities and by Mishra & Bhattacharya (2024) on institutional weaknesses. From a teacher agency lens**,** some educators found innovative ways to adapt, such as borrowing math kits or initiating peer-teaching networks. These practices illustrate what Priestley et al. call "situated agency," where teachers' capacity to innovate emerges not in isolation but within relational and contextual constraints.

Recognizing these adaptive strategies is critical, as they show how agency can be both constrained and creative, depending on institutional ecosystems.

Assessment Practices and The Priority of Reform

Teachers increasingly valued formative, performance-based, and competency-oriented assessments, validating H4. These shifts reflect an acknowledgment of traditional exams' limits and align with NEP 2020's emphasis on holistic evaluation (Menon & Dutta, 2021). Yet, the persistence of summative exams signals what Goel (2022) terms the **"assessment paradox."** Teachers attempted to innovate locally, but without systemic support or sufficient training, such practices remained fragmented. Here, **Teacher Agency theory** highlights how educators experimented within the boundaries of entrenched examination systems but lacked the collective structures or policy mandates to make formative assessment a sustainable norm. Embedding portfolio assessments, project-based evaluation, or performance tasks would require systemic backing, ensuring that teacher efforts are not isolated gestures but part of a coherent reform strategy.

Synthesis

Across the four domains, the study confirms that NEP 2020 has begun to reshape teacher roles, but uneven implementation reflects structural barriers. Interpreted through TPACK, change is most effective when teachers can integrate technology seamlessly with pedagogy and content, supported by continuous capacity-building and equitable infrastructure. Interpreted through Teacher Agency theory**,** reform depends on enabling conditions that allow teachers to act as co-constructors of policy, rather than passive implementers constrained by systemic inertia. Where both frameworks converge is in showing that meaningful, sustainable reform requires aligning teacher knowledge, autonomy, and systemic support. In this sense, mathematics teachers emerge not just as policy recipients but as potential catalysts of transformation—if their agency is supported through professional learning, digital equity, and the redesign of systemic assessments. Synthesizing these findings, the paper next considers their implications for policy and future practice in mathematics education.

Policy Implications

Building on these findings, two policy priorities emerge as critical levers for realizing NEP 2020's vision in mathematics education:

- **Strengthening Teacher Professional Development**
  Teacher professional development must extend beyond one-off workshops to continuous, practice-embedded, and context-sensitive models. Collaborative learning communities, long-term digital pedagogy training, and opportunities for reflective practice should be institutionalized to empower teachers as facilitators of inquiry, creativity, and critical thinking, rather than merely content transmitters.
- **Reforming Assessment Practices**
  Systemic assessment reform is essential to address the entrenched "assessment paradox." High-stakes examinations must be complemented—if not gradually restructured—through portfolio-based evaluations, project-driven tasks, and performance assessments

that authentically measure problem-solving, creativity, and mathematical reasoning. Such reforms will align classroom evaluation with NEP 2020's competency-based vision and reduce the overemphasis on rote performance.

These policy directions provide actionable steps that connect national aspirations with classroom realities, preparing the ground for a conclusion that underscores the importance of sustained investments in teacher capacity, digital equity, and meaningful assessment reform. Having identified key policy directions, the conclusion offers a final reflection on the study's significance and areas for ongoing inquiry

Conclusion

This study demonstrates that NEP 2020 has redefined the professional role of mathematics teachers in India from content transmitters to facilitators of inquiry, creativity, and critical thinking. Teachers are increasingly adopting learner-centered approaches and exploring formative assessment practices, yet their ability to actualize these reforms remains mediated by access to professional development, infrastructural resources, and systemic support. While enthusiasm for innovation is evident, especially in resource-rich settings, persistent challenges in rural and government schools underscore an implementation gap. The findings highlight that for NEP 2020's transformative vision to translate effectively into mathematics classrooms, sustained investments in teacher capacity building, digital equity, and assessment reform are indispensable.

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