From Policy Vision to Pedagogical Reality: Nurturing Scientific Temper through NEP 2020 and NCFSE 2023.

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Abstract

Promotion of Scientific Temper has always been at the heart of the democratic and intellectual evolution of India. This article explores the alignment between NEP 2020 and NCFSE 2023 in developing Scientific Temper among learners. The study also discusses Piaget's constructivism, Vygotsky's social scaffolding, Dewey's inquiry-based pragmatism, and Kolb's experiential learning, in understanding the development of Scientific Temper among learners. The analysis highlights that NSCFSE 2023 translates the philosophical mandates provided by NEP 2020 within real classrooms. At the same time, the article also discusses the challenges in the execution process and the potential of emerging technologies to bridge these gaps. The study concludes that the development of Scientific Temper among learners not only requires policy support but also a transformative shift at the classroom level. Changes at the grassroots level are an important step towards this direction.

Keywords: *Scientific Temper, NEP 2020, NCFSE 2023, Transformative Shift*

1. Introduction

The idea of fostering Scientific Temper in India is deeply rooted in its intellectual traditions. Thinkers like Swami Vivekananda emphasised rational inquiry, experiential learning, and the pursuit of truth, challenging blind beliefs and

encouraging individuals to seek knowledge through reason and experience. These ideas reflect the core principles of Scientific Temper and provide an early philosophical foundation for its development in the Indian context. In the modern period, the concept was more explicitly articulated by Jawaharlal Nehru in 1946, in his book 'Discovery of India'. He referred to scientific temper as "a way of life, process of thinking, a method of acting and associating with fellow men" (p. 512). He conceptualized it as a way of thinking characterized by objectivity, critical reasoning, and openness to new ideas. This vision was further institutionalized through Article 51A(h) of the Indian Constitution, which recognizes the development of Scientific Temper and the spirit of inquiry as a fundamental duty of every citizen, thereby placing education at the centre of this transformative goal. In the contemporary educational landscape, this vision is reinforced by the National Education Policy 2020, which promotes inquiry-based and experiential learning over rote memorization. The National Curriculum Framework for School Education 2023 further operationalizes these principles by providing a structured approach to curriculum design, pedagogy, and assessment. Together, these frameworks aim to create an educational environment that nurtures Scientific Temper through critical thinking, problem-solving, and evidence-based understanding.

In the present era, characterized by rapid technological advancement and widespread access to digital information, the need for a Scientific Temper has become more significant. The proliferation of misinformation, particularly through digital and social media platforms, poses serious challenges to informed decision-making and rational thinking. In such a context, the ability to critically evaluate information, the distinction between evidence-based claims and unverified assertions, and to adopt a questioning attitude is essential. Scientific Temper, therefore, serves as a crucial tool in enabling individuals to navigate the complexities of the information age with clarity and responsibility. Furthermore, the growing influence of technology in everyday life, including areas such as health, environment, and public policy, requires citizens to engage with issues that demand analytical reasoning and evidence-based judgment. Developing Scientific Temper equips learners with the cognitive skills necessary for problem-solving, logical analysis, and ethical decision-making (Hissaria & Grover, 2026). This makes it not only an educational objective but also a

societal necessity, reinforcing the importance of embedding scientific temper within contemporary educational frameworks.

In this regard, the National Education Policy 2020 represents a transformative step in reimagining the Indian education system by placing strong emphasis on holistic, multidisciplinary, and competency-based learning. Complementing this vision, the National Curriculum Framework for School Education 2023 provides a detailed curricular and pedagogical roadmap for translating policy ideals into classroom practices. Together, these two frameworks aim to create an educational environment conducive to the development of a Scientific Temper among students.

2. Theoretical Framework: The Cognitive Foundations of Inquiry

The cultivation of Scientific Temper is not an isolated pedagogical outcome; rather, it is an evolutionary cognitive process rooted in established theories of human learning. These frameworks suggest that a rational, inquiring mind is constructed through a series of intellectual shifts, moving from passive acceptance to active, evidence-based scepticism.

The journey toward Scientific Temper begins with Jean Piaget's Constructivism, which suggests that learners build mental structures (schemas) through interaction with their environment. When a learner encounters information that contradicts a deeply held belief, such as a scientific fact challenging a traditional myth, they experience a state of "Cognitive Disequilibrium". It is at this very stage that the seeds of scientific temper are sown. If the learner, instead of dismissing the contradiction through dogma, chooses to resolve this tension by modifying their mental structures based on new evidence (accommodation), they are practicing the foundational Scientific Temper traits of rationality and objectivity.

This internal cognitive shift is given a social dimension through Lev Vygotsky's emphasis on the Social Zone of Proximal Development. Vygotsky argues that higher-order thinking is a product of social interaction and "Scaffolding." In a classroom where dialogue and questioning are encouraged, a student learns to move beyond subjective, idiosyncratic beliefs toward a shared objective reality. Through peer review and logical discourse, scientific temper transcends from

being a personal trait to become a social responsibility, a collective commitment to truth-seeking through collaborative inquiry.

This theoretical progression finds its functional heart in the pragmatism of John Dewey, for whom "Inquiry" is the very essence of education. Dewey suggests that authentic learning is triggered by a "Problematic Situation" that demands a solution. When a student is taught to view every "fact" not as a final truth but as a "Hypothesis" to be tested, they are traversing Dewey's path of Reflective Thinking. This transition from a passive recipient of information to an active investigator is the core psychological shift required to fulfill the constitutional mandate of the spirit of inquiry and reform.

Finally, this cognitive and social development is operationalized through David Kolb's Experiential Learning Cycle. By moving through a continuous loop of "Concrete Experience", "Reflective Observation", "Abstract Conceptualization", and "Active Experimentation", the learner essentially embodies the Scientific Method. In this cycle, every observation fosters healthy scepticism, and every experiment reinforces evidence-based reasoning.

Ultimately, the confluence of these theories describes a learner who does not merely know science as a collection of facts but possesses a Scientific Temper, a resilient cognitive framework that prioritizes empirical validation, logical consistency, and the courage to change one's mind on the emergence of superior evidence.

3. Methodology

This study adopts a qualitative and theoretical research design based on document analysis. It critically examines key policy documents, namely the National Education Policy 2020 and the National Curriculum Framework for School Education 2023, along with relevant scholarly literature. A thematic analysis approach has been used to interpret the alignment between policy vision and pedagogical practices in fostering scientific temper.

4. Conceptual Understanding of Scientific Temper

The conceptualisation of Scientific Temper transcends the boundaries of formal scientific education, moving beyond the mere acquisition of facts to represent a specific habit of mind. It is essentially a mental disposition characterized by a

commitment to evidence-based reasoning in all spheres of life, not just within the laboratory. Scientific Temper is characterized by rationality, objectivity, healthy scepticism, universalism, freedom from prejudice, and bias (Dhar, 2009; Bardapurkar, 2019).

To develop Scientific Temper, learners don't need to acquire formal science education (Sharma, 2020). To understand Scientific Temper is to recognize it as a synthesis of cognitive dimensions that work in an interconnected manner. At its inception, Scientific Temper is fuelled by an innate curiosity, a persistent drive to uncover the underlying mechanisms of the natural and social world. However, this curiosity is disciplined by rationality, the logical framework that ensures one's conclusions are consistent and derived from sound premises rather than emotional or traditional biases.

This rational inquiry is further refined by the dual pillars of 'Objectivity' and 'Scepticism'. Objectivity requires the learner to cultivate a disinterested perspective, where personal desires or cultural prejudices are set aside in favour of empirical reality. Complementing this is a healthy, constructive Scepticism; this is not a cynical rejection of ideas, but a principled refusal to accept claims, be they traditional dogmas or modern "fake news", without a rigorous demand for empirical proof. In this conceptual framework, the traditional components of the scientific method - Observation, Hypothesis, and Experimentation, are not just steps in a textbook but are the functional tools through which this temper is expressed.

Crucially, a nuanced understanding of Scientific Temper necessitates a clear distinction between "Scientific Knowledge" and "Scientific Temper." While the former refers to the body of information generated by the sciences that satisfies demanding epistemic standards (McCain & Kampourakis, 2020), the latter is the cognitive mechanism used to evaluate and apply that information. One may possess an advanced degree in a scientific discipline yet lack a scientific temper if they fail to apply critical inquiry to their personal or social beliefs. Conversely, a layperson may exhibit a profound scientific temper by applying logical analysis to daily decision-making. Thus, as visualized within the Indian educational context, Scientific Temper is the intellectual armour that allows an individual to navigate a complex, often irrational world with a mind that is open to new ideas yet anchored in the uncompromising demand for evidence.

5. Promotion of Scientific Temper: From Policy to Practice

The vision of fostering a scientific temper is deeply embedded within the philosophical foundations of the National Education Policy 2020, which advocates a shift from rote memorization towards inquiry-based, discovery-oriented learning (Ministry of Education, 2020). The policy envisions learners as active participants in the construction of knowledge, capable of questioning assumptions, analysing information, and applying concepts in real-world contexts. This marks a significant transformation from traditional pedagogical approaches that have historically prioritized content coverage over conceptual understanding.

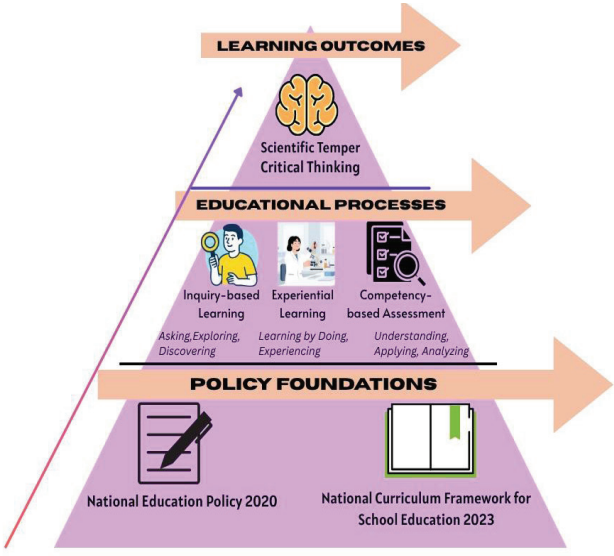
The emphasis on experiential learning, critical thinking, and problem-solving within NEP 2020 reflects a deliberate attempt to align education with the principles of scientific inquiry. The policy emphasises early exposure to inquiry-based learning and hands-on activity among learners. For instance, coding and computational thinking are introduced from foundational stages to foster analytical abilities and problem-solving capabilities (Sharma & Gupta, 2022). By encouraging learners to engage with concepts through observation, experimentation, and reflection, the policy creates a strong foundation for the development of scientific temper. At the same time, this vision is inherently aspirational and relies on effective curricular and pedagogical translation for its realization.

This is where the National Curriculum Framework for School Education 2023 assumes a crucial role. The NCFSE 2023 operationalizes the broad goals of NEP 2020 by providing concrete guidelines for curriculum design, teaching-learning processes, and assessment practices. It integrates scientific temper across disciplines rather than confining it to science subjects alone, thereby promoting a more holistic understanding of rational inquiry and evidence-based reasoning. Malik and Trivedi (2025) highlight that aligned with NEP 2020, NCFSE 2023 also integrates Play-Based and Inquiry-Based Learning, right from basic education. This alignment between NEP 2020 and NCFSE 2023 is particularly evident in their shared emphasis on learner-centered education. While NEP articulates the need for fostering curiosity and critical thinking, NCFSE translates this into classroom practices such as project-based learning, interdisciplinary exploration, and activity-oriented instruction. This

continuity between policy vision and curricular execution reflects a coherent reform strategy aimed at transforming the culture of learning (Prakash, 2025; Raj, 2024). As illustrated in Figure 1, the development of scientific temper is structured as a progression from policy foundations to learning outcomes.

Figure 1

Policy-to-Practice Framework for Development of Scientific Temper



5.1. Pedagogical Alignment and Classroom Practices

A key dimension of promoting scientific temper lies in the transformation of pedagogical practices. The National Education Policy 2020 underscores the importance of moving away from passive learning towards interactive and participatory approaches that engage students in meaningful cognitive processes. This includes encouraging questioning, fostering dialogue, and enabling learners to construct knowledge through experience.

The National Curriculum Framework for School Education 2023 builds upon this vision by recommending specific pedagogical strategies that support the development of scientific temper. Classrooms are envisioned as spaces where students actively investigate phenomena, collaborate with peers, and reflect on

their learning (National Council of Educational Research and Training, 2023). Activities such as experiments, fieldwork, case studies, and problem-solving tasks are emphasized as means of promoting inquiry and critical analysis.

Importantly, the framework also recognizes the role of teachers as facilitators of learning rather than mere transmitters of information. This shift in teacher roles is central to fostering scientific temper, as it creates opportunities for students to explore ideas independently while receiving guidance and support. Karmarkar and Chattopadhyay (2024) assert that the teachers need to possess Scientific Temper as their inner qualities primarily reflect on the learners. However, the effectiveness of such pedagogical transformation is closely linked to teacher preparedness and professional development.

While both NEP 2020 and NCFSE 2023 highlight the need for continuous teacher training, the actual implementation of such initiatives may vary across contexts. In settings where teachers are adequately supported and equipped with the necessary skills, the transition towards inquiry-based pedagogy is likely to be more effective. Conversely, in contexts with limited resources or high student-teacher ratios, adopting these approaches may require gradual adaptation and sustained institutional support.

5.2. Assessment Reforms and Their Role in Developing Scientific Temper

Assessment practices play a crucial role in shaping learning outcomes and influencing classroom behaviour. Recognizing this, the National Education Policy 2020 advocates a shift from high-stakes, memory-based examinations towards competency-based assessment that evaluates understanding, application, and analytical skills. This shift is essential for fostering scientific temper, as it encourages learners to engage deeply with concepts rather than relying on rote memorization. The policy also advocates the idea of an adaptive/formative system of assessment, where students will be assessed on various dimensions, making the assessment more holistic and also in a continuous manner (Singhal & Wadhwa, 2020).

The National Curriculum Framework for School Education 2023 further elaborates on this approach by emphasizing formative assessment, continuous evaluation, and the use of diverse assessment tools. These include projects,

portfolios, presentations, and reflective exercises, which provide a more comprehensive picture of student learning and promote higher-order thinking skills. The alignment between policy and practice in this domain represents a significant step towards creating an assessment system that supports the development of scientific temper. By valuing reasoning, interpretation, and problem-solving, such assessment practices reinforce the importance of inquiry and evidence-based thinking.

At the same time, the transition to competency-based assessment is a complex process that requires careful planning and implementation. Given the longstanding emphasis on standardized examinations in the Indian education system, adapting to new forms of assessment may take time. However, the gradual introduction of such reforms, supported by appropriate training and resources, has the potential to create a more conducive environment for nurturing scientific temper.

6. Challenges and Future Prospects: Bridging the Implementation Gap

The transition from the visionary mandates of NEP 2020 and NCFSE 2023 to the functional reality of the Indian classroom is fraught with a complex web of systemic and cultural challenges. The most immediate bottleneck lies in the domain of Teacher Capacity Building. The lack of teacher training in modern pedagogies and the absence of monitoring mechanisms pose additional hurdles (Govindharaj et al, 2023). While the new frameworks advocate for inquiry-based pedagogy, a significant portion of the current teaching workforce has been trained within a traditional, transmissive model of education. Expecting educators who were themselves evaluated on rote memorization to suddenly facilitate Socratic Dialogue or Cognitive Disequilibrium requires more than just a policy directive; it necessitates a profound, long-term overhaul of both pre-service and in-service professional development programs. Without this "pedagogical retraining", Scientific Temper remains a sophisticated term on paper that fails to reach the student's desk.

Furthermore, the infrastructural divide presents a material barrier to the empirical dimensions of Scientific Temper. In many regional contexts, particularly in underfunded government schools, the lack of basic laboratory facilities renders the experimentation phase of the learning cycle nearly impossible. Along with

this, the digital divide continues to be a major obstacle, limiting the potential of technology-driven learning for marginalised communities (Raaj, 2024). This is compounded by a deeply entrenched Examination-Oriented Culture that prioritizes high-stakes board results over the complex and time-consuming process of critical inquiry. When the metrics of success remain tied to the reproduction of textbook facts, both students and teachers are disincentivized from pursuing the sceptical questioning and hypothesis-testing that define a scientific mind.

Perhaps the most sensitive challenge, however, is the Socio-Cultural Barrier. Scientific Temper, by its very nature, encourages the questioning of authority and established dogmas. Deep-rooted superstitions and beliefs can hinder the acceptance of scientific reasoning in certain communities (Ramesh, 2022). This creates a unique double burden for the student, who must navigate a rationalistic environment in school and a potentially dogmatic one at home. Future implementation must therefore position Scientific Temper not as an anti-belief system but as a pro-evidence framework that empowers students to make informed decisions in the secular and professional realms of the modern era.

Looking toward future prospects, the integration of emerging technologies offers a promising avenue to bypass some of these traditional hurdles. Chookaew et al. (2024) suggest that AI-based platforms promote active engagement rather than passive learning. AI-driven simulations and virtual labs can provide high-fidelity inquiry environments even in schools lacking physical laboratories, allowing students to manipulate variables and observe causal relationships in real-time. Moreover, the shift toward competency-based assessments, if implemented with technical integrity, could finally decouple learning from memorization. The future of Scientific Temper in India depends on a sustained policy support system that moves beyond rhetoric to provide the financial and structural stability needed for these reforms to take root. By viewing these challenges not as dead ends, but as design constraints, the Indian education system can move toward a future where the spirit of inquiry is a lived reality for every citizen.

7. Discussion and Conclusion

The integrated analysis of the National Education Policy 2020 and the National Curriculum Framework for School Education 2023 reveal a coherent and

forward-looking approach to fostering scientific temper within the Indian education system. The two frameworks complement each other effectively, bridging the gap between policy intent and classroom practice (Prakash, 2025). While NEP 2020 provides a broad philosophical and conceptual foundation emphasizing inquiry, critical thinking, and experiential learning, NCFSE 2023 translates these ideas into actionable curricular and pedagogical strategies. This alignment reflects a well-structured reform trajectory that connects vision with implementation.

A significant strength of this integrated approach lies in its emphasis on continuity and coherence across multiple dimensions of education. The consistent focus on learner-centered pedagogy, competency-based assessment, and interdisciplinary learning indicates a deliberate effort to transform traditional teaching-learning processes. Such alignment reduces fragmentation within the system and enhances the potential for achieving intended outcomes related to the development of scientific temper. Moreover, the integration of these principles across disciplines moves beyond a subject-specific understanding of science and promotes a broader culture of rational inquiry and evidence-based reasoning.

At the same time, a critical reflection suggests that the effectiveness of these reforms is closely linked to contextual realities. The diversity of educational settings in India, characterized by variations in infrastructure, institutional support, and teacher preparedness, may influence the extent to which these policy provisions are realized in practice (Khandelwal, 2024). In this regard, teachers emerge as key agents in mediating the transition from policy to practice. Their ability to adopt inquiry-based and experiential pedagogies depends not only on training but also on continuous professional support and conducive working conditions.

Overall, the combined vision of NEP 2020 and NCFSE 2023 offers a robust and promising framework for fostering scientific temper among learners (Raaj, 2024). While certain challenges related to implementation and contextual variability remain, the strong alignment between policy vision and curricular execution provides a solid foundation for long-term educational transformation. With sustained efforts in teacher development, infrastructural support, and systemic coherence, these reforms hold significant potential for nurturing a

rational, reflective, and scientifically oriented citizenry.

The successful cultivation of scientific temper in Indian classrooms is an essential prerequisite for India's socio-economic progression and democratic health in the 21st century. The NEP 2020 and NCFSE 2023 provide a vital roadmap, but they are not the destination. The true critical appraisal reveals that policy intent is futile without sustained structural reform, particularly in teacher education and assessment practices, and a sensitive, sustained engagement with socio-cultural barriers. The move must be from scientific knowledge transmission to authentic scientific inquiry, thereby empowering future citizens with the cognitive tools to navigate a complex, misinformation-laden world with rationality and empirical scepticism.

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