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From Syllabus to Spark: How NCFSE 2023 is rewiring the DNA of India's Scientific Temper

Prof. Mohd. Moshahid

Dean, School of Education & Training, Maulana Azad National Urdu University (MANUU), Hyderabad, INDIA. (A Central University, Accredited Grade A+ by NAAC). Email: mohdmoshahid13@gmail.com

Dr. Md. Afroz Alam

Assistant Professor (Education), CTE Darbhanga, School of Education & Training, Maulana Azad National Urdu University (MANUU), Hyderabad, INDIA. (A Central University, Accredited Grade A+ by NAAC). ORCID: https://orcid.org/0000-0002-7902-0586 Email: afroz@manuu.edu.in, afrozmanuu@gmail.com

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ABSTRACT

The National Curriculum Framework for School Education (NCFSE), 2023 is a landmark step forward in the journey of education in India and provides the base framework for the grand vision of National Education Policy (NEP) 2020 with the learner at the centre. The study provides a thorough analysis of the main structural and educational changes proposed by the new framework, particularly in terms of the standard scientific education. The policy statement makes a compelling case against the "banking model" of education that entails passive reception of information and rote memorization and instead suggests a more sophisticated competency, experiential and inquiry-driven education model. A holistic qualitative document analysis gives a comprehensive study of the whole transformation process. This article discusses the system's transition to holistic and outcome-based assessments under the PARAKH initiative, the strategic inclusion of Indian Knowledge Systems (IKS), in today's scientific discourse, and the cognitive and

developmental soundness of the new 5+3+3+4 educational structure. The results suggest a significant change in the stated intent of the curriculum. This is a significant national move away from passive science education toward active scientific inquiry through ongoing study, observation and testing hypotheses. The article provides a detailed analysis and contextualisation of the key implementation challenges that jeopardise the success of the framework. The report notes the effect of these educational policy measures. It points to the glaring deficit of infrastructure in poorly resourced schools, the vital need for continuous professional development to transform teachers into inquiry facilitators and the continuing digital divide that needs to be bridged in a timely and equitable manner if this bold framework is to be implemented in classrooms across the subcontinent.

Introduction

The release of National Curriculum Framework for School Education (NCFSE) 2023 is a paradigm shift in the educational structure of India, from the erstwhile educational paradigms. The NCFSE attempts to realise and implement the main aim of National Education Policy (NEP) 2020, which is to bring back the epistemological and pedagogical principles that lay at the heart of how science is taught, understood and assessed in Indian educational institutions. The national educational system has been mired in structural stasis for decades, with curriculum design and classroom interactions geared around standardized summative assessments, and the rigid delivery of canonical books. The new framework is intended to make scientific knowledge more democratic by connecting the teaching methodology with the cognitive and developmental stages of learners through the revolutionary 5+3+3+4 structure. It seeks to change the paradigm of education from an exclusionary model of science education to one which is deeply experiential, cognitively appropriate and closely related to the immediate socio-environmental reality of the learners.

In India, scientific education has mostly followed what critical education thinker Paulo Freire called the “banking model” of instruction. In this narrow, teacher dominated paradigm, children have long been viewed as passive recipients of decontextualized scientific data, fixed taxonomic categories and abstract mathematical equations delivered by teachers. In this transmissive approach, science was purposely drained of its vibrancy and became a dry exercise in rote memorization, mostly directed towards high-stakes board examinations.

The result was a collection of student groups asked to keep track of scientific advancements, but not to participate in the iterative, hypothesis-driven, and intrinsically creative processes that lead to understanding science. The undue emphasis on rote learning killed the spirit of inquiry and analytical reasoning. This has resulted in an increasing gulf between theoretical research and practical use of scientific ideas to real-world problems.

The banking model is totally eliminated in the NCFSE 2023 due to serious systemic deficiencies and a strong, competency based and research oriented framework is proposed based on constructivist principles of education. The design turns the classroom into a dynamic laboratory for critical assessment, observation and experimentation. The teacher is no longer the primary source of information, but the facilitator of exploration. The main purpose of this structural change is to create a real 'scientific way of thinking' in every student. At its heart this mentality includes reason, impartiality and a forward-looking perspective.

The framework emphasizes practical and cooperative approaches to problem-solving. It is a convergence of different disciplines and local knowledge systems. In this framework, education moves from the rote memorization of established scientific facts to the active engagement in the scientific method. This is a radical change from passive observation in science to active engagement, providing students with methodological tools and cognitive flexibility to explore, question and navigate autonomously the complex worlds of nature and the physical.

Conceptual Framework

The National Curriculum Framework for School Education (NCFSE) 2023 recommendations for educational reforms are mainly based on Constructivism and Theory of Experiential Learning. The framework is opposed to the traditional methods of teaching and believes that learning is an exciting, flowing and continuous process. Learners are active cognitive participants, not just passive recipients of knowledge, who transform and reconstruct ideas, interpretations and conceptual frameworks by integrating current experiences with existing knowledge. The conceptual basis is constructivist teaching, inquiry and discovery based teaching. The classroom is designed to help students work actively on nontraditional scientific issues and topics. The student does not receive answers from the Authority. His job is to reveal truths, using keen observation, sound hypotheses, and experimental investigation that will teach the rudiments of the scientific method.

The experiential approach corresponds to the holistic developmental trajectories advocated by the framework, especially the shift to the 5+3+3+4 curriculum model. The structural change is more than an

administrative change. This is a tactical maneuver in the developmental psychology of cognition. It provides a detailed description of the phases of cognitive and psychosocial growth and offers helpful educational tools. The model provides "purposeful educational delivery" giving "access to complex abstract thinking, focused academic attention and advanced theoretical development at all intermediate and secondary levels of a child's education. The purposeful deferral is intended to ensure that the fundamental scientific concepts are first internalized through concrete, play-oriented, and multisensory learning experiences in the early stages of development. It offers a gradual transition from empirical inquiry to complex abstract reasoning and promotes a strong scientific attitude within the normal cognitive growth of the learner.

Objectives of the Study

- To study the recommendations for enhancing science education in NCFSE 2023.
- To study the structural re-arrangement (5+3+3+4) and its special impact on scientific curriculum at different cognitive levels.
- To comprehend integration of Indian Knowledge Systems (IKS) in present day science education.
- To identify possible barriers and challenges in the implementation of the framework

Methodology of the Study

The basis of this research is a qualitative study of the papers. The main source of information is the official document of the National Curriculum Framework for School Education (NCFSE) 2023, particularly the norms of teaching and assessment of science. The content was organized into the main areas of curricular structure, teaching methods, synthesis of knowledge, reforms in evaluation and barriers to implementation using theme analysis.

Analysis and Interpretation

Table 1: Structural Progression of Science Education (5+3+3+4 Design)

Stage	***Age Group***	***Pedagogical Approach***	***Science Focus***
Foundational	*3–8 years*	*Play-based, experiential*	*Observing nature, developing curiosity, basic physical exploration.*
Preparatory	*8–11 years*	*Discovery-based, interactive*	*Introduction of formal scientific concepts through play and discovery.*

Middle	*11–14 years*	*Inquiry-driven, disciplinary*	*Science as a separate discipline; integration of Physics, Chemistry, Biology.*
Secondary	*14–18 years*	*Specialization, interdisciplinary*	*Deep abstract reasoning, specialization, and real-world applications.*

The development shown in Table 1 is quite apparent. The NCFSE 2023 is designed to transmit scientific knowledge gradually, not abstract ideas. The Foundations and Preparations stages are about the sensory involvement and enquiry, ensuring that the abstract ideas, like gravity, evaporation etc. are well grounded in the physical experience before they are formally introduced in Middle and Secondary levels. The analysis of the development of the structure conducted in the previous framework shows that the new curriculum shows a well-designed, deliberate and psychologically integrated developmental course. The NCFSE 2023 develops the growth of scientific learning cognitively in a systematic way and avoids the pedagogical mistake of burdening the young learners with complex and abstract scientific ideas which often proves unsuccessful. The Foundational and Preparatory stages of the framework are focused on rich sensory experiences, open-ended play-based discovery, and the natural development of student curiosity. This intentional pedagogical design ensures that fundamental but intangible scientific concepts such as the invisible forces of gravity or the thermodynamic processes of evaporation are initially rooted in the students' concrete physical experiences and contextual environmental observations.

The development of a sound experience base in the early years of the curriculum gives the students the cognitive structures needed when these phenomena are codified, numerically quantified, and rigorously evaluated at Middle and Secondary stages. This therefore avoids the premature use of higher abstractions, so that older pupils can understand the more complex scientific theories thoroughly and in relation to their practical experience, instead of being constrained to depend on mechanical, rote learning of ideas they have never physically met.

Table 2: Paradigm Shift in Science Pedagogy and Assessment

Parameter	***Traditional "Banking" Model***	***NCFSE 2023 Model***
Role of Student	*Passive recipient of facts*	*Active investigator (doing science)*
Primary Methodology	*Rote memorization, lecturing*	*Hands-on experiments, Inquiry &*

		Discovery
Knowledge Base	*Strictly Western/Modern Science*	*Modern Science enriched with IKS*
Assessment Focus	*High-stakes, year-end exams*	*Competency-based, Holistic Progress Cards*
Assessment Body/Tool	*Standardized Board Exams*	*PARAKH, Semester systems*
Parameter	*Traditional "Banking" Model*	*NCFSE 2023 Model*

There is a systematic departure from established frameworks shown in Table 2. A basic change in classroom dynamics is required to differentiate between the Discovery Approach (a student directed inquiry with teacher encouragement) and the Inquiry Approach (a systematic formulation of hypothesis and experimentation). Also, if assessments are associated with specific "Learning Outcomes" (e.g., create a model to explain capillary action) instead of simply the regurgitation of a term, this is a sign of a shift toward more authentic science. The critical scrutiny of the pedagogical and assessment frameworks points to a major and systematic departure from the established legacy patterns that have traditionally governed Indian science education.

This transition is a subtle but important epistemological differentiation between the Discovery and Inquiry Approaches. The main approach is the deep and true view of nature that the students hold. The teacher has become not an authority, but a strategist who provokes natural curiosity and self-exploration. Through the Inquiry Approach, students are required to draw up hypotheses, conduct controlled experiments and validate empirically in a systematic manner, reflecting the methods of the scientific community. The two pedagogical methods can be implemented effectively only if there is a radical change of the traditional classroom model from teacher-centered instruction to learner-centered education.

A comprehensive review of these assessment methods would be useful in the educational transition. By linking assessments to specific, measurable "Learning Outcomes" we have effectively eliminated rote memorization. Example: Instead of asking a student to recite the textbook definition of capillary action, ask them to build and explain a working model of it. This is a big shift from how students are traditionally evaluated. It corresponds to the new model of focusing on how students can integrate, apply, and demonstrate scientific principles in real-world scenarios, rather than memorizing theoretical concepts.

Core Pillars of Science Pedagogy in NCFSE 2023

The philosophy of the NCFSE 2023 is based on the educational principle that science must be viewed as a process of investigation in development not as a static body of knowledge. This requires a deep reformation of education, especially the introduction of scientific research elements and the basics of logical thinking. The syllabus does not require the students to remember scientific theories and formulae like laws of thermodynamics. It also provides a systematic way to answer the important questions of why and how. The aim is to develop a robust scientific attitude and to provide students with the cognitive instruments to think logically, critically assess the evidence, and modify the conclusions in the light of new empirical data.

In addition, one of the elements of this cognitive shift is a fundamental part of adaptive learning from experience. According to NCFSE 2023, concrete and practical experiences of the Foundational Stage should be the base of scientific education. The method is a "learning through doing" technique for early education, ensuring that young students understand basic physical principles like gravity or evaporation before they are transformed into complex theories or mathematical calculations.

The study makes a subtle yet important educational distinction between the "Discovery" and "Inquiry" approaches to help educators create an interactive learning environment. The student can explore the natural world by himself or herself, without the intrusion of the teacher. The educator helps to discover intriguing ideas and to find interesting concepts. The Inquiry method involves a more intensive and systematic engagement. Learners assume the role of research scientists. Students ask unfamiliar questions and explore ecological anomalies. They systematically observe. They formulate specific hypotheses and conduct controlled experiments. In effect, these elementary principles of education strive to bring the scientific method to the masses, transforming the traditional Indian classroom from a passive lecture hall into a veritable laboratory of critical analysis, empirical inquiry and continual practical investigation.

Major Findings

The NCFSE 2023 study has highlighted important results. They highlight several novel structural and pedagogical reforms which can bring about a transformative change in the Indian scientific education system. The focus is on the adoption of a new education system, the 5+3+3+4 system that aptly marries advances in the teaching of science with the basic tenets of cognitive developmental psychology. This is why the educational program is built in such a way that real disciplinary specialization is postponed until secondary school. It ensures that the necessary cognitive frameworks have been developed before the introduction of complex topics. The framework stresses on the need to develop a scientific attitude of

thinking. It involves a systematic shift from the rote memorization of scientific facts to an inquiry based environment that focuses on the critical questions of 'why' and 'how'. This cognitive shift is systematically embedded through the need for experiential learning from the very beginning of formal education at the foundational stage.

The study also examines the conscious integration of Indian Knowledge Systems (IKS) into the broader scientific curriculum. The NCFSE 2023 does not consider IKS a pseudo-scientific alternative to modern empiricism, but a major transdisciplinary progress. It links the ancient ecological wisdom with the modern scientific understanding, fusing the contemporary environmental science with the traditional sustainable ecological practices like creating baoris (stepwells) by applying the ancient indigenous knowledge of mathematics and astronomy. These academic accomplishments are based on a comprehensive reform of the methods of assessment. The proposal is to replace the existing rote method of learning with PARAKH (Performance Assessment, Review and Analysis of Knowledge for Holistic Development) and to move to a semester system in secondary education. Establishing robust performance-oriented evaluation frameworks is advantageous for the practical appraisal of scientific skills and analytical reasoning, as opposed to mere data retention.

Discussion

The findings of this study lead us to envisage a radical shift in the epistemological foundation of science education as articulated in the NCFSE 2023, conceptualised as an ongoing, dynamic and iterative process of intellectual inquiry rather than a fixed body of unalterable truths. Framework, thus, states the methodology of teaching is experiential and practical education. This finally answers the age-old criticism of the Indian education system that it produces competent examinees but without the inventive, analytical and practical skills that are needed for real scientific progress.

The curriculum will combine theoretical principles with practical application, and students will be able to change variables, question assumptions and engage with emerging issues. The conscious embedding of Indian Knowledge Systems (IKS) in the rigorous methods of modern Western research provides a strong local view on global issues. The epistemological synthesis has two goals: to motivate the learners to a deep cultural grounding and civilizational continuity and to seek objective, empirically substantiated scientific knowledge.

The curriculum makes science relevant and accessible by relating complicated scientific theories to the familiar traditions of the original people, ecological knowledge, and the mathematical feats of history.

The requirement to deconstruct the established culture of high-stakes testing that is the hallmark of the Indian educational environment is a key systemic obstacle to the long-term viability and efficacy of this ambitious competency-based education approach. To make the transformative educational vision outlined in the NCFSE 2023 a tangible classroom reality across India, it is imperative to systematically dismantle the deep-seated societal and institutional bias of rigid, summative, year-end board evaluations and instead embrace the continuous, formative, and holistic assessment practices suggested by PARAKH.

Educational Implications

The successful implementation of the ambitious NCFSE 2023 frameworks has immediate pedagogical implications at different levels of education. What is required is a radical re-structuring of the teaching workforce. Educators will need to shift from the "sage on the stage" to the role of dynamic facilitator of continuous inquiry. This radical change demands the immediate establishment and activation of massive, systematic constructivist retraining programs to equip instructors with the necessary skills to lead discovery learning classes. These educational objectives are intrinsically tied with the deplorable status of infrastructure. Experiential learning has to be practised on daily basis and for that schools, especially in rural, disadvantaged and chronically underprivileged communities need to equip themselves with localized and accessible laboratory facilities and fundamental learning instruments like the Jaadui Pitara. Practical scientific research can deepen educational inequality without deliberate investment in infrastructure.

At the macroeconomic policy level the challenge is to bridge the vast digital divide. The framework incrementally encourages the use of artificial intelligence, advanced digital tools, and virtual simulations to enhance scientific modeling and data analysis, but policymakers need to put in place robust technological equity provisions. There is a need for coordinated legislative and financial initiatives to ensure equitable access to digital infrastructures and to prevent the continued systematic marginalization of socioeconomically disadvantaged and geographically isolated learners in the country’s transition to an integrated, modern science education system based on technology.

Conclusion

The National Curriculum Framework for School Education (NCFSE) 2023 is a radical and revolutionary framework for the future of science education in the Indian sub-continent. Its goal is to supplant the old ways of passively gathering knowledge with a lively student-centered culture of inquiry. It aims to replace high stakes summative testing with a more holistic and multidimensional evaluation.

This is the essence of a real and lasting scientific attitude." The power of a comprehensive policy statement is as much a function of the transformative potential of grassroots implementation. The education sector is at the turning point in the implementation of the education system in 2026-2027, and is faced with systemic and structural difficulties requiring concentrated legislation and considerable budgetary outlays. The huge deficits in localized physical school infrastructure must be closed. The digital divide must be actively closed to assure full technological equity. The massive, nationwide program to fully retrain the teaching workforce must be implemented. These are fundamental prerequisites to moving this theoretical curricular vision into actual classroom practice.

The NCFSE 2023 has the remarkable potential to ignite an educational renaissance provided these major structural barriers are effectively, expeditiously, and equitably addressed by the relevant stakeholders. Ultimately, it seeks to develop a resilient, future-oriented generation of critical thinkers, empathic inventors and resilient problem-solvers, well prepared to face and solve complex global challenges – from the rapid development of climate change to impending ecological disasters – with a vital combination of rigorous scientific knowledge and essential humanistic values.

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