

Conceptual Reflections on Developing Scientific Interest and Problem-Solving Ability in Secondary Education: Implications from NEP 2020

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Abstract

The National Education Policy (NEP) 2020 has once again targeted to foster scientific interests and problem-solving skills of the secondary school students. This conceptual paper seeks to investigate the significance of these cognitive and affective attributes as key elements of education in the twenty-first century. It critically evaluates the major features of the NEP 2020 that promote experiential learning, critical thinking and inquiry-based pedagogy to shift the focus from rote memorisation to conceptual comprehension and application. The study is based on educational theories and policy directives and it presents a conceptual framework that integrates objective of comprehensive and diverse education of NEP 2020 with scientific interest and problem-solving skills. The research also analyses the pedagogical consequences to the instructors, curriculum designers and school administrators in creating scientific mentality in learners. This work contributes to the body of knowledge in providing a proper foundation for subsequent empirical studies and teaching practices that are in line with national educational objectives.

Keywords: Science, Scientific Interest, Secondary Education, NEP 2020

Introduction

Modern education is based on the need to provide students with the abilities, attitudes and orientations necessary for the meaningful engagement with the world around them. In addition to the transmission of knowledge, one of the main aims of education in modern society is the development of reason, curiosity and the ability to solve issues logically and clearly (Chauhan 2004). This view of science sees it not as an academic expertise but as a full-blown way of thinking about and comprehending the natural and social world. The Latin word *scientia* means “knowledge”. The term “science” is described as a systematic body of information developed via observation, analysis, experimentation and interpretation (National Science Teaching Association 2000). Science, however, is a disciplined way of coming to know the truth and is defined by objectivity, scepticism, and a continual search for evidence (National Science Teaching Association 2000). It is more than a compendium of thoughts and facts. It is not static but rather dynamic, growing via the cycles of inquiry and confirmation, based on empirical evidence and the conviction that all events may ultimately be explained by reason and observation (National Science Teaching Association 2000). Science becomes a necessary teaching tool in an effort to promote an open-minded, fact-based and enquiring worldview, which is close to the goals of liberal and democratic societies.

Attitude is defined by G. W. Allport (1935) as “a mental and neural state of readiness, organised through experience, exerting a directive or dynamic influence upon the individual’s response to all objects and situations with which it is related”. Attitude is everything in this bigger scientific picture. Attitude is the mental and emotional orientation of an individual toward some object, idea or experience (Thurstone 1931). It is typically mirrored in the patterns of thought and behaviour of the individual. It is a learned inclination to react to individuals or circumstances in a good or negative way all the time (Thurstone 1931). Attitudes are developed as a function of a number of elements including social contact, education, culture and experience. They shape how people perceive information, participate with the environment around them, and make decisions. Learning environments play an important role in how students learn, how curious they are, their ability to work in teams and their creativity. They also have a big impact on their school achievement and their social and personal development. Attitude change is via exposure, reflection and cognitive progress. It is, thus, one of the major

goals of education to foster progressive and optimistic attitudes, especially as pupils begin to comprehend complicated social and scientific truths.

The relationship of the realms of science and attitude gives rise to scientific interest, a necessary disposition that encourages the spirit of inquiry and logical reasoning. Having a “scientific interest” is to have a tendency to think and act in a way that is in accordance with the principles of scientific inquiry such as objectivity, curiosity, open mindedness and the search of truth. It represents a frame of thought that prefers facts to guesswork, consistency to conflict, and reason to superstition. A scientific interest, Baumel (1967) notes, is shown in “an open-mindedness, a desire for accurate knowledge, confidence in procedures for acquiring knowledge, and an expectation that the solution of a problem will come through the use of verified knowledge.” Moreover, in creating a scientific mindset, it is not enough to study scientific principles; it is necessary to build an autonomous, critical and introspective way of thinking. Students taught to think scientifically will think critically about information, make informed choices, and address challenges systematically. Such thinking is essential for success in scientific work and responsible citizenship in a continually changing world. It has a huge impact on how youngsters approach school, make life decisions, and handle societal difficulties as a consequence.

Secondary education is described by the UNESCO International Bureau of Education as “a level of education that bridges basic education and tertiary education, providing learners with general knowledge, skills and values necessary for lifelong learning, citizenship and employment” (UNESCO International Bureau of Education 2013). The secondary education level is a unique stage in the students’ educational experience, as pupils transition from fundamental foundational learning to more specialised and abstract thinking. Often referred to as adolescence, these are the years when kids are beginning to develop higher order cognitive skills, moral reasoning, and a sense of both academic and personal identity. Secondary education has a huge impact on future academic and career pathways. It also provides a foundation for developing the values and the abilities necessary for life-long learning. At this stage of their growth, children are ready to tackle complex ideas, challenge existing theories and connect their learning to real life problems. Secondary school is the best place to develop a scientific mentality and problem-solving skills. Students are introduced to the systematic logic of scientific subjects, and begin to appreciate the wider ethical and societal consequences of science and technology. Education currently should focus on inquiry, thinking and experimenting (National Education Policy 2020 2020) rather than mindless memorisation.

On this realisation, the National Education Policy (NEP) 2020 provides a paradigm-shifting approach to rethinking the role of education in the progress of the individual as well as the nation (National Education Policy 2020 2020). NEP 2020 emphasises the need for a shift from content heavy curriculum to curricula that promote conceptual understanding, critical thinking, creativity and practical application. It envisages an education system that empowers the student to be interested, have a scientific attitude and be able to question and find solutions on their own. The policy especially emphasises the need of experiential and inquiry-based learning in an attempt to bridge the gap between academic knowledge and real-world problem-solving (National Education Policy 2020 2020). The NEP suggests an integrated and comprehensive curriculum that integrates interdisciplinary learning, freedom of topic choice and creative teaching approaches to cater to different learning preferences and styles. In thus doing it aims to develop moral and emotional intelligence as well as cognitive skills. National Education Policy 2020 2020). NEP 2020 highlights the need to build scientific attitude and problem-solving skills as the core aim of education in the twenty-first century by emphasising both fundamental and higher order cognitive skills.

This conceptual study is at the interface of science, attitude, scientific mindset, secondary education and policy change to investigate how educational philosophy and practice might be adapted to foster scientific interests among students. The discussion attempts to build a conceptual framework based on theoretical viewpoints and legislative directions to guide curriculum creation, teaching and future research within the framework of NEP 2020.

Rationale of the Study

In an era of rapid scientific and technological change, the focus of education should be on critical thinking, inquiry and problem solving rather than the traditional focus on knowledge delivery. One of the basic aims of secondary education is the creation of a scientific mind-set – curiosity, objectivity, reason, and open-mindedness to evidence. Thus, children are developmentally ready to work with complex thoughts and abstractions. But most of Indian education is still based mainly on memorisation and exam-oriented teaching, making it difficult to nurture actual scientific thinking. In this setting, the National Education Policy (NEP) 2020 becomes a pioneering framework for the promotion of conceptual knowledge, inquiry-based learning, scientific temper and problem-solving abilities. The conceptual framework of this study is the investigation of how these capacities could be successfully integrated into secondary education through the eyes of NEP 2020. The study will focus on theoretical viewpoints, definitions, and policy orientations to acquire a complete knowledge of how to create a scientific mentality and problem-solving abilities in accordance with the updated educational vision. The gap in the research is the relationship of educational philosophy, cognitive development, and policy change. It gives insights that can impact future pedagogical practices, curriculum development and teacher training programs.

Objectives of the Study

1. To conceptually analyze the meaning and nature of scientific interest and problem-solving ability in the context of secondary education.
2. To explore the educational and psychological significance of scientific interest for learners at the secondary level.
3. To examine the implications of NEP 2020 for fostering scientific interest and problem-solving ability in Indian schools.

Methodology

The present study is an effort to examine and critically analyse the ideas of scientific interest and problem-solving skills within the context of secondary school and the National school Policy (NEP) 2020 through a conceptual technique. The study does not collect empirical data but uses a range of secondary sources such as educational theories, academic literature, governmental papers and curriculum frameworks. The study aims at the construction of a consistent conceptualisation of the development of scientific thinking through education by integrating terminology, examining theoretical views and assessing policy objectives. This qualitative method allows the researchers to do reflective and thematic analysis and can be employed to address the philosophical and pedagogical challenges of educational reform in India.

Delimitation of the Study

The present study is conceptually limited to the analysis of scientific interest and problem-solving abilities within the scope of secondary education as envisaged in the National Education Policy (NEP) 2020. There is no empirical data collection or statistical analysis. The attention is limited to theoretical, psychological and pedagogical viewpoints, particularly in Indian educational system.

Interpretation

Review of Related Literature

1. Prastika, Wati and Suyidno (2019) carried out research “The Effectiveness of Problem Based Learning in Improving Students’ Scientific Literacy Skills and Scientific interests” using one-group pre-test and post-test design to 29 students at SMAN 5 Banjarmasin. The research consisted of scientific literacy assessment and attitude survey. The result showed that there are moderate improvements of scientific literacy (n-gain=0.55) and scientific interest (n-gain=0.57) that indicates the usefulness of PBL to enhance students’ knowledge and attitude toward science.
2. Hasrawati, Ikhsan, and Hajidin (2020) in the study “Improving Students’ Problem-Solving Ability and Learning Motivation Through Problem-Based Learning Model in Senior High School” used quasi-experimental

method with two groups, the first group was given PBL learning and the second group was given conventional learning. The results indicated that the students in the PBL group improved significantly more than the control group in problem-solving skills and learning motivation. Talk about favourable effects of PBL on student engagement and cognitive capacity.

3. Karmila, Wilujeng, and Sulaiman (2021) carried out a research titled “Effectiveness of Problem-Based Learning (PBL) Assisted by Google Classroom to Scientific Literacy in Physics Learning” by using quasi-experimental approach. The study indicated that the combination of PBL and digital platforms significantly increased students’ scientific literacy, showing the possibilities of combining novel pedagogies and technology to promote science education.

4. Suryani, 2023, Research “Improving problem-solving skills on mathematics subjects by applying problem-based learning” using classroom action research in two cycles with secondary school students. The results suggested that the PBL strategies had an important role in improving students’ mathematical problem-solving skills. These results indicate that PBL techniques are useful in developing critical thinking within the domain of mathematics.

5. In the action research study “Problem-Based Learning on Students’ Attitude Toward Science”, Rahmadani (2023) applied PBL in two cycles to find out the influence of PBL toward students’ attitude toward science. The percentage of positive attitude perceptions grew from 69.69% to 71.73%. This indicates that implementing PBL was effective in developing a more positive attitude toward science learning among the children.

6. Safitri, Chotimah, Hudha, and Rahardjanto, (2023) in the research “Application of Problem-Based Learning to Improve Problem-Solving Skills and Creative Thinking Skills of Class XI Students” utilising quasi-experimental design with pre and post-test to find out the usefulness of PBL. The results indicated that the students’ problem solving and creative thinking skills were significantly enhanced and validated the effectiveness of PBL in boosting higher order cognitive skills.

7. Nisa’, Nasrullah, Hidayat, Mahuda, and Bhat (2023) in their empirical study titled “Problem-Based Learning in Improving Problem-Solving Ability and Interest in Learning Mathematics” used a quasi-experimental method with control and experimental groups. The results showed that students who were exposed to PBL had considerable improvement in problem solving abilities and the motivation for mathematics. The findings revealed that PBL is an excellent method to increase the cognitive and emotional aspects of mathematics teaching.

8. Arora (2023) in her research entitled “A Study on Problem Solving Ability Among Students of Govt. Senior Secondary School: A Comparative Analysis” employed Problem Solving Ability Test (PSAT) for comparing the students of different streams. The results of the investigation showed that there was a significant variance in problem-solving ability. This underlined the need for specific educational approaches to address the specific needs of diverse groups of students.

9. Singh, Deshwal, Pooja, Kumar and Sahil (2023) in their analytical paper “Implementation of New Education Policy (NEP) 2020 in India: Some Issues and Challenges in the Perspective of Higher Education System” pointed out the challenges in the implementation of NEP 2020 in higher education. The authors pointed out the constraints of faculty training and infrastructure constraints and stressed the necessity to surpass these hurdles to establish an atmosphere conducive to the growth of scientific interests.

10. Balakonda (2024) has carried out a secondary data analysis in the research titled “Integrating Critical Thinking and Problem-Solving Skills in Mathematics Education within the Framework of NEP-2020” to examine the alignment of NEP 2020 with the worldwide best practices. The study concluded that NEP 2020 encourages experiential learning and critical thinking, however issues like poor teacher preparation and lack of resources limit its successful implementation indicating the need for structural reforms to realise the policy’s objectives.

11. Bohra, Arya, Ali, Yadav, and Bohra (2024) conducted a critical analysis of the goals and projected outcomes of NEP 2020 in their study “Evaluating the Positive Impacts of NEP 2020: A Critical Perspective”. The writers observe that the policy emphasises critical thinking and education at large. They contended that executions should be carried out in a deliberate way so that its revolutionary effect on education might be realised.

12. Nagamani et. al (2024) carried out a research on the implementation of NEP 2020 by higher education institutions and their challenges. The survey was done to identify the challenges in implementation. The biggest concerns were a lack of information about legislation and poor internet infrastructure. If higher education is to foster scientific and problem-solving interests, these shortcomings must be corrected immediately.

13. Kaur (2024) in his qualitative study titled “Challenges in Achieving Successful Implementation NEP 2020: A Study of Himachal Pradesh” examined the challenges in the implementation of NEP 2020 at societal, financial and educational levels. The study highlighted the significance of applying suitable strategies for the scenario to tackle the challenges and develop the ability to think critically and solve problems.

14. Balakonda (2024) conducted action research as a part of NEP-2020, on how to teach maths and at the same time teach the students how to solve the problems and think critically. The action analysis suggested that increased training of teachers and adoption of new teaching methods are of utmost importance to achieve the goals of NEP 2020. The study highlighted the significance of such interventions in enhancing students’ problem-solving and critical thinking skills.

15. Neelofar and Bai executed a study named “Awareness and Attitude of Secondary School Teachers Toward NEP 2020 with Reference to School Education” in 2024. To find out what the teachers thought about NEP 2020, polls were used. Results demonstrated a moderate level of comprehension and generally positive opinions. Therefore, professional development programs are essential to improve the implementation of policies and to inspire students to take an interest in science.

16. Rawan carried out a policy study in 2025 entitled “The NEP 2020 and Its Transformative Role in Mathematics Education” to investigate the possible impact of NEP 2020 on mathematics education. The results demonstrated that the policy rewarded grasping concepts and addressing issues. This illustrates that technology and innovative methods of education are being used to make arithmetic more attractive and helpful.

Research Gaps

Despite the growing academic interest in scientific approach and problem-solving skills in the NEP 2020, several important research gaps still exist. Much research has been done on the effect of contemporary pedagogies like Problem-Based Learning on students’ performance (Prastika, Wati, and Suyidno 2019; Hasrawati, Ikhsan, and Hajidin 2020; Safitri et al. 2023), but very few studies have provided a purely conceptual synthesis linking these abilities to the specific needs of NEP 2020 at the secondary level. Further, there are not many holistic theoretical models, which relate the principles of NEP 2020 to the development of scientific temper and inquiry-based learning in diverse educational situations. Results from empirical research are difficult to generalise as they often employ diverse methods, focus on certain competences or are limited to small, regional samples. Moreover, little is known regarding the influence of teacher training, systemic implementation challenges, and contextual aspects on the development of a scientific attitude and problem-solving skills (Kaur 2024; Nagamani et al. 2024). These gaps indicate the need for a conceptual study that considers a holistic view of these domains to understand better how NEP 2020 can systematically promote a scientific mentality and cognitive resilience in secondary school pupils.

Findings from the Review of Related Literature

1. Benefits of PBL: Some research (Prastika et al., 2019; Safitri et al., 2023) show that PBL has a large impact on the increase of students’ attitude toward science and the development of talents such as critical thinking, curiosity, interest and questioning. It also helps children to develop a science interest of their own.

2. Best Problem Solving by PBL: The PBL technique is more effective when students can find, evaluate and address academic and practical problems (Hasrawati et al, 2020; Nisa', et al, 2023; Suryani, 2023) notably in the fields of maths and science.
3. Integration of Digital Platforms Improves Learning: Collaborative use of digital resources to help learning Karmila et al. (2021) demonstrated that project-based learning (PBL) combined with online tools such as Google Classroom can help high school students learn more about science and ask better questions.
4. Alignment with NEP 2020 Vision: Many studies (Balakonda, 2024; Neelofar & Bai, 2024, for example) claim that the skills that students acquire through project-based learning (PBL) and the development of a scientific mindset are fully in accordance with the changes suggested by NEP 2020 in the functioning of schools that focus on promoting critical thinking, experiential learning, and holistic development.
5. Teachers' Attitudes and Awareness Matter: As stated by Neelofar and Bai (2024), teachers' attitudes and perceptions of NEP 2020 are a very significant factor to enable the learners to think scientifically and solve the problems in the classroom. Teachers need training and support to be able to properly apply policies.
6. Execution Challenges: Lack of cash or skilled teachers is one of the challenges with the execution of NEP 2020 changes. Another difficulty is the divergence between policy and practice that may prevent students from understanding the science in the way that it was meant to be understood.
7. Enhanced Interest and Involvement in STEM: Active learning approaches according to NEP 2020 have boosted students' interest in the domains of science and technology and created a good image of scientific education (Rahmadani, 2023; Nisa' et al., 2023).
8. Context Matters a Lot: Rawan (2025) and Arora (2023) believe that to be able to successfully execute the recommendations of NEP 2020 and train in scientific thinking, they need be contextualised to varied social, cultural and geographical situations.
9. NEP 2020: A Transformational Framework NEP 2020 is a magnificent framework to rethink education and if implemented in a good way, can be a great source for high school students to learn more about science and problem-solving skills (Singh et al 2023; Bohra et al 2024).
10. Critical thinking: The application of critical thinking in the subjects such as physics and mathematics was one of the major methods to link the educational practices with the outcome-based strategy of NEP 2020 (Balakonda, 2024).

Pedagogical Strategies Suggested by NEP 2020

The National Education Policy (NEP) 2020 aims at shifting away from rote-based education in Indian schools toward a more experiential, inquiry-driven and competency-based approach. One of the key ways it encourages is the experiential learning where students are provided first-hand experiences and concepts to help them gain better comprehension. Students are gathering information not only from books but also from activities such as experiments, project work, group discussions, role-plays and real-life problem-solving situations. The method encourages scientific interest by cultivating observation, curiosity and a pragmatic attitude to learning. These techniques of experiential learning assist students to build their scientific temper and problem-solving skills in tangible realisation of abstract concepts and in developing meaningful correlation with practical applications. Another fundamental pedagogical principle of NEP 2020 is to promote inquiry-based learning and critical thinking. Inquiry Based Learning reduces the emphasis on teacher-led instruction and increases the emphasis on student-led discovery through inquiry, discovery of answers and constructing their own understanding. This is in accord with the scientific process. It is vital to develop the inquisitive mind and introspective attitude of scientific inquiry. Critical thinking was also regarded as one of the important 21st century talents, enabling children to independently assess, evaluate and synthesise knowledge. NEP 2020 promotes teaching methods that stimulate students to question assumptions, engage in discourse and arrive at logical conclusions. This encourages children to acquire cognitive flexibility and learn how to systematically tackle new challenges, which is important for both academic achievement and real-world problem solving. Implementing these new

pedagogies requires a fundamental re-structuring of curriculum design, teacher preparation and teacher education. Teachers must also be able to support student-centered learning in addition to their subject-matter skills. The NEP 2020 highlights the need of teachers' engagement in seminars, peer learning and exposure to novel pedagogic techniques regularly as part of their Continuous Professional Development (CPD). This transition also leads to a revision of curriculum, with textbooks, tests and classroom activities being revised to promote active learning and holistic growth instead of memorisation.

Also, assessment methods should not be confined to traditional examinations but may incorporate projects, portfolios and performance-based assessments to reflect critical and creative thinking. Without adequate teacher training programs and curricular consistency, the vision of NEP 2020 is a theoretical one. Therefore, the integration of many instructional modalities is important for the development of a scientific attitude and problem-solving abilities in secondary school.

Challenges of Implementing NEP 2020 Goals

The educational goals of NEP 2020 including development of experiential learning, inquiry-based pedagogy and critical thinking in secondary school are ambitious and creative yet, there are a lot of realistic challenges to be dealt with (Singh et al., 2023; Kaur, 2024). First of all, the qualifications and training of the instructors have much to be desired. Most of the instructors in secondary schools, particularly in the public and rural schools, were educated by the usual technique of education by lecture. They often do not have the self-confidence and the pedagogical skills to move toward more student-centred and activity-based kinds of teaching. In addition, there is minimal possibility for future professional growth or it is not uniformly spread across the sites. Thus, there is a lack of ability to assure uniform quality of teaching methods in line to NEP 2020. Second, there are significant issues with lack of resources and infrastructure. Technology is an essential to make the classrooms vibrant and equipped labs. Digital resources and immersive inquiry-based learning. Many secondary schools in poor regions lack basic resources like as science labs, internet connectivity and good teaching materials (Nagamani et al., 2024). These are the necessary things that without which the most carefully prepared instructional methods cannot be effectively achieved. Finally, development is hindered by institutional constraints (set curricula, stress on examination in evaluation procedures, and administrative inertia). Our present school system continues to emphasise high stakes testing. It encourages creativity and critical thinking. Often there is a lot of pressure on teachers and schools to get through the curriculum quickly and achieve high test results, and little room for alternate techniques of teaching. Furthermore, policies are sometimes implemented only on the basis of top-down instructions with minimal adaptability to the reality, resulting in a gap between objectives and execution. To achieve the goals of NEP 2020, institutional reforms and continued investments in infrastructure, teacher development, innovative curriculum and a culture shift from rote learning to inquiry and lifelong learning are needed (Bohra et al. 2024).

Educational Implications

1. **Pedagogical transformation:** It emphasises the need to transition the secondary school system from rote learning and lectures to a more active, question-based, and critical thinking approach (National school Policy 2020, 2020).
2. **Changing the Curriculum:** The effort intends to align the high school curriculum with NEP 2020 (Balakonda 2024). The curriculum would have problem solving exercises that foster scientific research, relevance to the actual world and cross field issues.
3. **Development of Teacher Skills:** It concentrates on the continuous professional development (CPD) of the teachers to cope with the NEP and to present the lessons such that the student may understand the scientific views and problem-solving skills (Neelofar and Bai 2024).
4. **Recommendations for Policy Makers:** In this section, we offer policy makers the theoretical knowledge that could aid them in decision making for school level interventions, educational reforms and teaching methodologies (Singh et al. 2023).

5. Changes in the approach of assessing pupils: students will be graded on the basis of their performance, projects and the way they think about their work instead of memorisation (National Education Policy 2020 2020).

6. Encourages Equitable Education: Assists in developing situation-specific pedagogies to bridge the disparities in teachers' quality and access to resources arising from differences in socioeconomic and geographical conditions (Kaur 2024).

7. Study Insights: It provides a theoretical platform for subsequent empirical study to assess the implementation of the goal of NEP 2020 in different contexts of Indian education.

8. Whole Child Development: It stimulates higher order thinking, creativity and scientific reasoning through secondary school thereby achieving the purpose of NEP 2020 to generate well-rounded persons (National Education Policy 2020 2020).

Conclusion

The present study is an introspective amalgamation of the pedagogical vision of NEP 2020 with the greater educational purposes of inspiring children to think scientifically and sharpening their problem-solving skills at the secondary stage. It is crucial to point out that education should be expanded beyond the traditional limits and include learner-centric, inquiry-based and experiential approaches to serve the needs of a knowledge-based innovation-driven society. It highlights that the scientific mentality with its curiosity, reason, impartiality and openness to evidence is as much an important part of human growth and country progress as cognitive problem-solving skills are. These conclusions have a number of relevant policy implications. The first step is to rejig teacher training programs to include entire modules on inquiry-driven learning, experiential learning and critical thinking facilitation. Second, curriculum and assessment techniques need to be updated to include project-based assessments, interdisciplinary learning and real-world application of concepts as per NEP 2020. Third, educational policies have to be implemented according to the context and with specific provisions for low resource schools to ensure fair access to high-quality learning settings. Finally, these changes must be complemented by continual evaluation and reflective research to determine their success and to make required adjustments.

Author Contributions Statement

Ms. Debalina Majumdar contributed to the conceptualization, literature review, analysis, interpretation, writing of the original draft, and final preparation of the manuscript. Dr. Biswajit Chakraborty supervised the study and provided academic guidance throughout the research process.

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