

The Five-step Revolution: Enhancing Scientific Temper Via Panchpadi Approach

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Abstract

The foundation of societal development is in logical thinking and data-driven judgments, which are contingent upon a scientific mindset. Still, progress in this subject faces challenges stemming from superstitions, ideological biases, and misinformation. Using the Panchpadi Approach, an experienced five-step learning model, this study looks at a methodical educational framework targeted at fostering scientific temper in classroom environments. This method guarantees alignment with the National Curriculum Framework (NCF) 2023 and National Education Policy (NEP) 2020 by including *Adhiti (Introduction & Observation)*, *Bodh (conceptual understanding & Exploration)*, *Abhyas (Expression & Practice)*, *Prayog (Experimentation & efforts)*, and *Prasar (Expansion & sharing)*. It emphasizes the need to encourage investigation, doubt, and logical thinking, as well as tying theoretical knowledge to useful application.

A comprehensive framework that combines inquiry-based learning, problem-solving exercises, multidisciplinary approaches, and technology-enhanced evaluations is provided. This study looks at how this approach combines scientific ideas into daily life and addresses pragmatic problems, including the battle against superstitions and false knowledge. This paper emphasizes the Panchpadi Approach as a useful teaching tool for encouraging a scientifically oriented attitude, therefore arming students with the required tools for a society based on evidence. The Panchpadi Approach's contribution to developing a scientific mindset.

This work integrates a literature review on scientific temper, experiential learning, and educational policy using a qualitative research methodology with an exploratory approach. We examine worldwide educational systems, including those in Finland and South Korea. The outcomes aim to present a novel educational framework that encourages an inquiry-based approach in students, therefore enabling them to make well-informed decisions and use scientific reasoning for solving problems in modern society.

Keywords: *Scientific Temper, Rationality, NCF 2023, Panchpadi Approach*

Introduction

Scientific temper is an outlook that respects reason, evidence-based thinking, and skepticism. It challenges people to examine and challenge material instead of just absorbing ideas. The first Prime Minister of India, Jawaharlal Nehru, popularized the phrase in his book *The Discovery of India* (1946), stressing the part reason and science play in forming contemporary society. Notwithstanding its significance, scientific temper sometimes runs against societal norms, false information, and ideological forces.

It is not restricted to science but rather permeates daily life as well. It promotes evidence-based decision-making, rational thought, and research. Carl Sagan famous scientific communicator, said, "Extraordinary claims require extraordinary evidence" (Sagan, 1995). This idea emphasizes the importance of skepticism and logical investigation in separating truth from lies.

Real-Life Example: Getting Over Superstition with Scientific Temper

One prominent instance of scientific temper in action is the movement opposing witch-hunting in India. Women have been accused of being witches and subjected to violence depending on unfounded superstitions in places like Jharkhand and Odisha. Rationalist Narendra Dabholkar started *Andhashraddha Nirmoolan Samiti (ANIS)*, which has fought nonstop to refute such ideas using scientific education and legal actions. His campaigning resulted in the 2013 *Maharashtra Anti-Superstition and Black Magic Act*, therefore advancing scientific ideas in society. One of the main difficulties of scientific temper is the dissemination of false information, particularly in the digital age. One startling illustration is the *COVID-19* epidemic. Vaccine hesitation globally resulted from false information about alternative treatments, including avoiding vaccinations or drinking herbal beverages. Emphasizing the need for scientific moderation in public health, the *World Health Organization (WHO, 2020)* vigorously refuted.

Story: The Effort at Smallpox Eradication. Before the World Health Organization launched its smallpox eradication campaign (1967–1980), many groups opposed vaccination because of religious and cultural convictions. Mass immunization campaigns first drew mistrust in India. But a mix of evidence-based reasoning, grassroots lobbying, and scientific education persuaded people to embrace vaccinations, thereby eradicating smallpox in 1980 (Henderson, 2009).

Political and Religious Opposition to Scientific Temper

When scientific temper questions well-established beliefs, political and religious organizations typically object. Science education in the United States is still influenced by arguments on evolution vs creationism. Notwithstanding substantial scientific data backing Darwin's theory, some conservative organizations favor "intelligent design" as taught alongside evolution (National Center for Science Education, 2021). In climate change denial, some political leaders likewise reject the scientific agreement in favor of ideological and financial objectives. Notwithstanding unambiguous data from the Intergovernmental Panel on Climate Change (IPCC, 2021), some countries have postponed action, aggravating world environmental problems.

Education System and Scientific Temper

The scientific mindset is essential for society's advancement, well-being, and innovation. Misinformation, superstition, and ideological resistance provide hurdles; nonetheless, history demonstrates that rational thought and evidence-based policy result in beneficial transformation. By incorporating scientific inquiry into education, governance, and daily life, communities can progress toward a future guided by reason and knowledge instead of ignorance and blind faith. Scientific temper is fostered in great part by education. Finland and South Korea stress in their educational systems critical thinking and inquiry-based learning. They score highly in technical innovation and science literacy (OECD, 2019). The National Education Policy (NEP 2020) of India supports experiential learning and acknowledges the necessity of a scientific temper. Still, its application is difficult because of current social and political divisions.

Pedagogical Approach and Scientific Temper

Different teaching strategies stressing critical thinking, investigation, and evidence-based reasoning help to cultivate a scientific temper. The several pedagogies that help to shape scientific temper are compared in the table below.

Table-1*List of pedagogies*

Pedagogy	Key Features	Impact on Scientific Temper	Challenges & Limitations	Examples of Implementation
Inquiry-Based Learning	Encourages students to ask questions, investigate, and analyze evidence	Develops curiosity, problem-solving skills, and independent thinking	Requires well-trained teachers and resources	Finland's education model, NGSS (USA)
Problem-Based Learning (PBL)	Learning through real-world problems; students develop solutions through research and collaboration.	Enhances critical thinking, research skills, and application of knowledge	It can be time-consuming and requires active facilitation	Medical and engineering education, STEM programs
Project-Based Learning (PjBL)	Hands-on learning where students create projects based on scientific inquiry	Encourages creativity, experimentation, and teamwork	May require more classroom time and resources	Maker education, robotics, and environmental projects
Socratic Method	Uses questioning to stimulate critical thinking and discussion	Promotes logical reasoning and skepticism	It can be challenging in large classrooms or rigid curricula	Philosophy and science discussions in higher education
Constructivist Learning	Students build their understanding through experiences and reflection.	Enhances conceptual understanding and deeper learning	Needs active student participation and trained educators	Montessori schools, IB curriculum
Experiential Learning	Learning through direct experiences, experiments, and fieldwork	Encourages hands-on scientific exploration and real-world application	Logistical challenges in organizing field experiences	Science labs, outdoor environmental education
Collaborative Learning	Peer discussions, group work, and collective problem-solving	Enhances communication and diverse perspectives in scientific thinking	Requires structured facilitation to avoid dominance by some students	STEM classrooms, interdisciplinary research teams

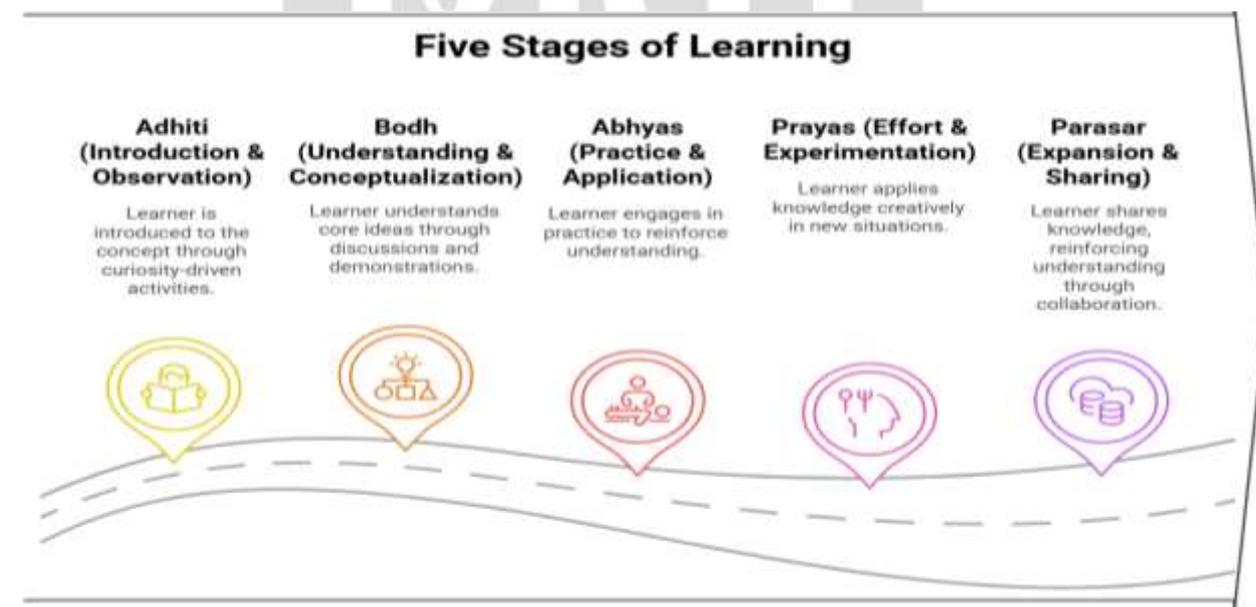
Gamification & Simulation-Based Learning	Uses interactive simulations, role-playing, and game-based approaches to explain scientific concepts	Engages learners through immersive experiences and experimentation	It can be expensive and requires technological access	Virtual labs, physics simulations, AI-driven learning tools
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By encouraging curiosity, analytical thinking, skepticism, and problem-solving abilities, every pedagogy helps the scientific temper to grow. Their success, nevertheless, depends on institutional backing, teacher preparation, and educational infrastructure. These strategies taken together provide a comprehensive strategy to help students in different learning situations develop a scientific temper.

The Panchpadi Approach is one such transforming strategy that the twenty-first century calls for creative ideas to assist in rebuilding classroom learning to encourage a scientific temper. The Panchpadi approach has five steps that promote critical thinking, originality, and active involvement in the classroom. It underlines child-centric education and fits very nicely with the ideas of the National Curriculum Framework (NCF) 2023, which supports experiential learning and holistic, competency-based education. This researcher tries to prepare the framework based on the Panchpadi approach of learning. It also addresses how the Panchpadi Approach fits the scientific temper that permeates classroom learning.

It is a Structured Learning Process

Figure- 1
The Panchpadi Approach's five steps



Adhiti (Introduction & observation), Bodh (understanding & conceptualization), Abhyas (practice & Application), Prayas (Efforts & Experimentation), and Prasar (expansion & share) create a disciplined yet adaptable learning path. By combining investigation, introspection, and practical application, that is, away from rote memorization, this approach promotes experiential learning.

NCF 2023 and the Panchpadi approach

NCF 2023 emphasizes, in line with the National Education Policy (NEP) 2020, the value of experiential, transdisciplinary, and skill-based learning. The Panchpadi Approach supports numerous important NCF 2023 principles:

- **Competency-Based Education:** Panchpadi develops analytical ability and problem-solving by pushing active participation.
- **Integration of Play-Based and Inquiry-Based Learning:** Particularly in basic education, the method fits NCF's focus on activity-driven, inquiry-based learning. The Panchpadi framework promotes cross-disciplinary thinking in line with NCF's aim for integrated learning, therefore supporting multidisciplinary and holistic education.
- **Experiential and Contextual Learning:** NCF's emphasis on contextualized knowledge speaks to real-life application (Anukaran).

Scientific Temperament and Panchpadi Approach

The scientific temper, a fundamental component of progressive education, fosters evidence-based understanding, inquiry, and logical thinking. The Indian Constitution, specifically Article 51A(h), underscores the necessity of cultivating a scientific mindset among its citizens. This objective is inherently aligned with the Panchpadi Approach, which promotes students' critical analysis, experimentation, exploration, and questioning of concepts, rather than their inert acceptance of information. The five-step process is crucial for the cultivation of a scientific perspective in students, as it fosters rational inquiry and complex problem-solving.

Table-2

(Some research papers & articles related to the Panchpadi approach and scientific temper are discussed in Table 2.)

Topic	Authors name	Summary	Key finding
<i>The Panchpadi Pedagogical Framework: A Scientific Approach to Rational Thinking</i>	<i>P. Chatterjee & V. Mehta (2020)</i>	This review discusses how the Panchpadi framework aligns with scientific inquiry and helps learners develop a systematic, evidence-based perspective . The study examines how each step builds on the previous one, reinforcing a logical approach to learning.	The sequential learning process fosters a deeper understanding of scientific concepts. Encourages students to challenge myths and rely on empirical evidence. The structured five-step approach nurtures rational and analytical skills.
<i>Enhancing Scientific Temper Through the Panchpadi Learning Model</i>	<i>S. Raghavan (2021)</i>	This study explores how the Panchpadi approach (five-step learning) fosters scientific temper by promoting inquiry, experimentation, and reasoning. The research highlights the effectiveness of Preparation, Presentation, Association, Generalization, and Application in structuring learning experiences that develop a rational mindset.	The preparation stage stimulates curiosity and questioning. The presentation helps in structured knowledge acquisition. The Association encourages logical connections between concepts. Generalization aids in forming scientific principles.

			The application enables real-world problem-solving and critical thinking.
<i>Scientific Temper in Classrooms: The Panchpadi Way to Inquiry-Based Learning</i>	<i>R. Sharma & D. Patel (2019)</i>	This paper investigates the effectiveness of the Panchpadi method in promoting an inquiry-based learning environment . It emphasizes how active questioning, experimentation, and application help learners develop a scientific temper.	The Panchpadi approach supports exploratory learning and hypothesis testing . Discussion and reflection enhance critical thinking. Encourages evidence-based reasoning and problem-solving.
<i>Fostering Scientific Temper Through Panchpadi and Constructivist Pedagogy</i>	<i>M. Srinivas & L. Banerjee (2022)</i>	This review explores the integration of Panchpadi with constructivist learning to enhance scientific reasoning and skepticism among students. It examines how the five-step model helps students construct their knowledge rather than relying on memorization.	Student-led learning enhances reasoning and scientific understanding. Encourages hands-on experimentation for real-world application. Peer discussions strengthen analytical thinking and logical reasoning.
<i>The Role of Panchpadi in Bridging Theory and Practice for Scientific Mindset Development</i>	<i>K. Pillai (2018)</i>	This study emphasizes the practical application of the Panchpadi approach in science education . It argues that the model helps students move beyond theoretical knowledge by enabling them to apply scientific methods in real-life situations.	Application-based learning reinforces a scientific temper. Promotes rational problem-solving and skepticism towards unscientific beliefs. Stepwise progression ensures a structured understanding of scientific concepts.

Broadening the Panchpadi approach toward a Holistic one

Integration of further pedagogical strategies and multidisciplinary approaches is necessary to effectively foster a scientific temper. This enlarged framework combines many techniques consistent with the Panchpadi method:

❖ Learning based on Inquiry

Students engaged in inquiry-based learning are urged to probe, pose questions, and use evidence-based conclusions.

- For instance, students can be asked: Why does a lamp turn on when it is linked to a battery? When learning about electricity
- Ask students to evaluate conductivity using many materials, metal, plastic, rubber, then methodically document observations (Bybee et al., 2006).

❖ Practical Trials and Demonstrations

Experimentally driven active learning promotes involvement and inquiry.

- In chemistry, students could look at acid-base interactions using household items (vinegar, baking soda) and litmus paper.
- Affects data-driven conclusions and hypothesis testing (Bransford et al., 2000).

❖ Logic and Critical Thinking

Scientific temper is collecting evidence, challenging presumptions, and assessing assertions.

- For instance, during a conversation about climate change, find out from scientific data which supports global warming.
- Activity: Give students access to several temperature change datasets so they may analyze trends. (*This corresponds with constructivist ideas of learning*) (Piaget, 1972).

❖ Integration across Disciplines

Scientific temper should draw on ideas from mathematics, social sciences, and ethics in addition to science.

- In a geography class on natural catastrophes, for instance, students examine earthquake trends and link them to seismic wave records.
- Impact: promotes a whole awareness of scientific events.

❖ The Role of Discussion and Argument

Classroom discussions on contentious scientific topics help students evaluate data, consider ethical consequences, and create critical viewpoints.

- For instance, students investigate reasons both for and against genetically modified organisms (GMOs) and then offer their own opinions.
- The result improves evidence-based thinking and persuasive ability. Strategies for assessing scientific temper should test logical thinking, conceptual knowledge, and inquiry techniques.

❖ Assessment

Concept maps, reflective diaries, and class discussions constitute formative assessment. Project-based assignments and open-ended problem-solving questions comprise a summative assessment.

- For instance, have students develop a hypothesis-driven inquiry and report results instead of conventional tests (Black & Wiliam, 1998).

Suggestive framework based on the Panchpadi approach

Scientific temper is the attitude of inquiry, reason, and curious learning motivated by science. It encourages a way of thinking based more on evidence-based knowledge than on superstitions, prejudices, or mythology. The Panchpadi Approach is, all things considered, a five-step instructional tool that improves learning efficacy. This approach combines Panchpadi with important teaching strategies, classroom exercises, and a suitable learning atmosphere to encourage a scientific temper.

Framework Objective:

- This teaching approach seeks to inspire pupils' interest and questions.
- Advanced hands-on experiments and inquiry-based learning.

- Grow in logical thinking and problem-solving ability.
- Encourage in daily life an evidence-based approach.
- Apply scientific ideas to practical issues.

Table 3 Suggestive Framework

<i>First step: Adhiti (Introduction and Observation) preparation and motivation</i>	
Objective	To generate curiosity and provide practical tests of critical thinking.
Teaching method	Brainstorming, narrative, interrogation, and multimedia presentations. Inquiry-based learning.
Learning environment	Interactive classroom with visual aids available. Promotion of open-ended conversation. Inquiry-based interrogation.
Classroom Activities	"Why does the moon change shape?" provocative question. Showing basic events (such as a glass candle displaying oxygen consumption). Demonstrating scientific ideas in action via movies or simulations.
Probable outcomes	Students start showing interest and a questioning attitude, guiding their learning objectives. They relate fresh information to experience.

<i>Second Step: Bodh (Conceptual Understanding) Thinking & Exploration</i>	
Objective	Raises independent investigations, hypothesis development, and logical reasoning.
Teaching method	PBL, interactive learning sessions, and the Experiential method. and demonstrations,
Learning Environment	Possession of ICT tools, models, and lab equipment. An environment free of which lets pupils investigate and experiment.
Classroom Activities	Teacher-led demonstrations, such as demonstrating diffusion with water and ink. Group talks on practical uses (e.g., how Newton's rules fit daily life). Interactive simulations and practical projects.
Learning Outcome	Students understand basic scientific ideas. They start to separate scientific facts from stories.

<i>Third step: Abhyas (Practice & Application) expression & correlation</i>	
Objective	Students should be able to clearly explain their ideas, accurately assess outcomes, and effectively apply concepts.
Teaching method	Case studies, role-playing, and STEM-based learning are among the techniques.
Learning Environment	A multidisciplinary approach, real-world examples, and hands-on activities.

Classroom Activities	"How can we purify water at home?" is a regular scientific question. Running studies or questionnaires (such as gauging air pollution levels near the university). Group efforts include the creation of environmentally friendly models or basic machinery.
Learning outcome	Students connect real-life events with scientific concepts, therefore guiding their learning objectives. They improve their critical thinking and creativity abilities.

***Fourth step - Prayog
(Effort & experimentation)
Concept Synthesis and Critical Thinking***

Objective	Links theoretical knowledge with practical experience to facilitate experiential learning.
Technique	Debates, panel discussions, research-based learning, heuristic, methodical learning, Collaborative, and discussion-based education.
Learning environment	Open-minded, inquisitive culture. Possibility of resources for data analysis and study.
Classroom Activities	Arguing on divisive scientific subjects (like "Is AI a boon or a threat?"). Inviting kids to create their tests. Examining study papers or scientific news items.
Learning outcomes	Students get knowledge on vital information evaluation. They approach problem-solving logically and based on evidence.

***Fifth step: Prasar
(sharing & Expansion)
Evaluation & implementation***

Objectives	The aim is to encourage long-term retention and application of scientific knowledge in pragmatic settings.
Techniques	Peer teaching, project exhibits, and practical problem-solving.
Learning Environment	Student-centric, supporting originality and self-expression. Chance for pupils to defend and share their opinions.
Classroom activities	Classroom Exhibits or Hackathons for Science Encouragement of students to create podcasts, films, or science blogs. Doing field trips to businesses, museums, or research facilities.
Learning outcomes	Students start to be autonomous learners and future inventors. They grow to have a scientific attitude and a method of approaching problems.

Additional Elements for an Effective Framework

The Role of Instructors

- Approach your role as a facilitator instead of as a knowledge supplier.
- Promote open-ended debates and questions.
- Share mentoring and helpful criticism.

The role of technology

- Virtual experiments using AR/VR.
- AI-based learning applications for individualized instruction.
- Online tools for worldwide scientific research cooperation.

Assessment

- Formative evaluation via peer remarks, presentations, and tests.
- Using project reports, useful tools, reflective journals, and summative evaluation.
- Learning diaries or metacognitive reflections are self-assessment tools or rubrics.

Role of community

- Encouraging parental engagement in scientific initiatives.
- Planning community-based science fairs.
- Working with nearby universities or scientists.

Critical Viewpoint on NCF 2023 and Panchpadi

Although the Panchpadi Approach and NCF 2023 have commonalities, several issues and restrictions need thought.

Execution Drawbacks: Teacher training and pedagogical flexibility, which remain issues of concern in the Indian educational system, define the effectiveness of the Panchpadi Approach.

Assessment: NCF 2023 advances a change from summative to formative assessment. However, using qualitative assessment inside a Panchpadi system calls for fresh evaluation techniques beyond conventional testing forms.

HR &PR: Panchpadi and NCF's recommended experiential and play-based learning calls for enough resources, qualified teachers, and a suitable learning environment, all of which are not consistently present across India.

Structure with Flexibility: While Panchpadi offers a disciplined learning route, over-reliance on set procedures may stifle creative divergence and natural learning.

Cultural and Regional Adaptation: The Panchpadi framework has to be customized to fit regional educational demands, given India's varied linguistic and cultural environment, guaranteeing inclusion and efficacy.

Conclusion

Scientific temper, as advocated by Jawaharlal Nehru (1946), is a crucial aspect of progressive education and societal advancement. It encourages inquiry, critical thinking, and evidence-based decision-making, which are essential in combating superstitions, misinformation, and ideological biases (Sagan, 1995). The integration of scientific temper into education, particularly through structured pedagogical frameworks

such as the Panchpadi Approach, offers a transformative method of fostering rational inquiry, experiential learning, and problem-solving skills among students.

The Panchpadi Approach aligns with the objectives of the National Curriculum Framework (NCF) 2023 and National Education Policy (NEP) 2020, emphasizing competency-based education, inquiry-driven learning, and multidisciplinary integration. By incorporating five distinct stages: Adhiti (Introduction), Bodh (understanding & Exploration), Abh (Expression), Prayog (Effort & experimentation), and Prasar (sharing & expansion). This framework nurtures students' cognitive abilities, creativity, and application of scientific principles in real-world scenarios (NCF, 2023). The approach is instrumental in shifting educational paradigms from rote memorization to inquiry-based and problem-solving learning (Bybee et al., 2006).

Despite its strengths, implementing the Panchpadi Approach faces challenges such as inadequate teacher training, limited infrastructural resources, and resistance to pedagogical shifts (Black & Wiliam, 1998). Addressing these challenges requires professional development programs for educators, increased funding for educational infrastructure, and policy reforms that prioritize experiential and inquiry-driven learning. Furthermore, adapting the framework to India's diverse cultural and linguistic landscape is essential to ensure its effectiveness across different regions.

Scientific temper is not merely a pedagogical goal but a societal necessity, fostering an informed and rational citizenry capable of addressing global challenges such as climate change, public health crises, and technological advancements (IPCC, 2021). The Panchpadi Approach serves as a structured yet adaptable model for embedding scientific inquiry into education, empowering students to become critical thinkers, innovators, and contributors to a knowledge-driven society. By continuously refining educational practices and embracing scientific temper, India can progress towards an enlightened and rational future.

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