SCIENTIFIC CULTURE
www.sci-cult.com

SCIENTIFIC CULTURE, Vol. 12, No. 4, (2026), pp. 3823-3830
Open Access. Online & Print

DOI: 10.5281/zenodo.12426437

FOSTERING A SCIENTIFIC TEMPER THROUGH EDUCATION: A THEORETICAL STUDY ON THE ROLE OF SCHOOLS IN PROMOTING CRITICAL THINKING AND RATIONAL INQUIRY

Dr. Man Singh[1]*, Bappaditya Adhikary[2], Paramjeet Kaur[3], Dr. Raja Pathak[4], John Vincent Aliazas[5], Prof. Pavan Kumar Yadavalli[6], Ar.Mahua Biswas[7]

[1]Department of Education Central University of Punjab, Bathinda, Punjab
[2]Sikkim University, Gangtok, Sikkim, India
[3]Chandigarh University, Mohali
[4]Humanities, Inter University Centre for Teacher Education, BHU, Varanasi
[5]Laguna State Polytechnic University, Philippines Department: Teacher Education Science Education
[6]Department of Teacher Education Manipur University (A Central University) Canchipur -795003, Imphal, Manipur
[7]Architecture Ajeenkya D Y Patil university Pune

Received: **27/12/2025**
Accepted: **18/02/2026**

Corresponding Author: Dr. Man Singh (man.singh@cup.edu.in)

ABSTRACT

This theoretical paper discusses how education contributes to development of scientific temper as a basis of critical thinking and rational questioning. It theorizes schools as rational ecosystems of interaction between institutional structures, teacher roles and learner dispositions, to develop epistemic and moral rationality. Based on the philosophical traditions and learning theories, this paper forms a new conceptual framework named School as Rational Ecosystem, which puts inquiry, reflection, and ethical reasoning as the key aspects of learning. The research claims that education should not be rote based because it should foster doubts, evidence-based thinking, and free discussion. It incorporates the perspectives of constructivism, critical pedagogy and epistemic cognition to provide an explanation on how schools can be turned into a place of reflective thinking and civic accountability. The discussion also shows the issues of examination-based practice and the necessity of the systemic change in the curriculum and teacher education. The paper finds that scientific temper can only be cultivated by educating the masses to create rational, ethical, and critical citizens of contemporary societies.

KEYWORDS: Scientific temper, critical thinking, rational inquiry, education, conceptual framework, reflective pedagogy, epistemic rationality, moral reasoning.

1. INTRODUCTION

In a world today, where the pace of scientific progress is accelerated, the world is more uncertain, and the information is more abundant than ever, it demands a scientifically moderated citizenry more than ever before. The 21st-century climate change, misinformation, health epidemics affecting the population, and the disruption of technology all require a population that is able to think rationally and critically and make evidence-based decisions. This is a specific necessity in democratic societies where the participation of the citizens depends not only on the opinion but also on a rational comprehension. It is on this background that the development of a scientific temper among the students is not only an academic objective but also a civic necessity (UNESCO, 2021).Education is the pillar of developing this capacity. Schools do not merely serve as a source of knowledge, but they are the initial conditions that can help one cultivate habits of mind like skepticism, logical thinking and reflective judgment. Following the Future of Education and Skills 2030 report, education systems should strive to prepare students to become future-ready individuals, i.e., be able to think critically and solve complex problems (OECD, 2018, p. 7). On the same note, the National Education Policy 2020 of India discusses the necessity to inculcate scientific temper as a constitutional obligation and educational objective and urges the adoption of pedagogy that supports questioning, creativity, and conceptual clarity (Ministry of Human Resource Development, 2020).

Three constructs that are interrelated are chosen as the core of this educational mission, namely scientific temper, critical thinking, and rational inquiry. Scientific temper is not restricted to the knowledge of scientific facts, but it is the attitude, a commitment to questioning, to find evidence and to change the beliefs based on new data (Bardapurkar, 2020). It is very similar to critical thinking, which can be seen as a skill of analyzing, evaluating and synthesizing information in a logically coherent manner. Rational inquiry, in its turn, is concerned with the procedural aspect: how individuals can be involved in systematic thought and hypothesis testing.

The difference between scientific literacy and scientific temper is great. Although the former refers to the knowledge of content, awareness of scientific concepts and processes, the latter refers to dispositions and epistemological orientation. A student can study the laws of physics but be dogmatic in his or her personal or political opinion; a scientific temper is meant to fill this gap by changing the attitude of the learner towards knowledge.

The importance of inquiry in learning is not a recent topic for educational researchers and philosophers. Dewey was a supporter of education as a kind of persistent questioning and problem-solving. Popper maintained that knowledge is developed by critical rationalism, which is the systematic falsification of hypotheses. Freire stressed the liberatory power of education in conscientização or critical consciousness. Nehru regarded scientific temper as the crucial element of national building and democratic discussion. These philosophers have a point of convergence in their view of education as the art of liberty in inquiry.

The recent empirical research confirms these theoretical observations. According to Netto and Dominic (2023), students who had a more positive internal locus of control had a greater scientific temper, and cognitive dispositions were found to have a significant impact on educational performance. In a meta-analysis, Arifin et al. (2025) affirmed that inquiry-based learning has a strong positive impact on the development of critical thinking skills in students, which implies that the development of scientific temper has a solid pedagogical basis. On the same note, Boonsathirakul and Kerdsomboon (2023) summarized over ten years of studies to demonstrate significant gains in student reasoning on both ends of the basic education continuum when structured interventions of critical thinking are implemented.

In spite of these positive results, the educational discourse is still very divided. The current models tend to consider critical thinking and scientific knowledge as separate skills, and not components of an epistemic disposition. Rote education, exam-oriented education, and didactic education still prevail in most school systems, and there is little opportunity to inquire and discuss.

This research paper seeks to fill that gap by coming up with a theoretical framework that incorporates scientific temper, critical thinking, and rational inquiry in the school setting. It redefines schools on the basis of rational ecosystems environments in which inquiry, skepticism and evidence-based thinking are developed systematically.

Objectives of the Study:

1. To analyze the theoretical basis that explains the contribution of education towards a scientific temper
2. To theorize how schools can be intellectual spaces that are conducive to critical thinking and rational inquiry

2. THEORETICAL AND CONCEPTUAL FRAMEWORK

2.1 Philosophical Foundations

Scientific temper in education is based on three epistemological traditions, namely rationalism, empiricism and constructivism. Rationalism puts emphasis on reason as the major basis of knowledge, promoting organized investigation and logical reasoning. Contrarily, empiricism believes that one can gain knowledge through sense and observation, which is similar to scientific experimentation and inductive logic. Constructivism unites these sides by suggesting that learning is constructed by the experience, socializing, and internalization.

The epistemological underpinnings are also supplemented by Enlightenment principles, particularly the glorification of reason, secularism and cynicism towards authority. In the democratic models of education, it will be translated into the humanistic approach to education, in which open dialogue, autonomy, and rational civic engagement are valued. In this respect, education is not instrumental but a tool of building intellectual freedom and moral judgment (Ennis, 2018).

2.2 Educational Theories Supporting Scientific Temper

The three theoretical strands that support scientific temper as a combination of cognitive disposition and rational behavior are best supported in the field of education. To start with, the theory of constructivist learning, which is guided by the works of Piaget and Vygotsky, puts emphasis on the active participation of the learner in the material. It believes that meaning is never given but rather built, with the help of social conversation and scaffolding experiences. Dökmecioglu et al. (2022) prove that the perception of constructivist environments by students has a positive correlation with critical thinking dispositions, mediated by metacognitive strategies.

Second, critical pedagogy emphasizes the liberating importance of education. Ayuste González and Trilla Bernet (2024) state that critical pedagogy advocates dialogic interaction, hegemonic norms, and allows learners to be aware of their socio-political environment. These are key areas of inculcating a scientific temper that is based on critical awareness and ethical responsibility.

Third, the theory of epistemic cognition examines how people use their thoughts to think about knowledge, sources of knowledge, justification and evaluation of knowledge. According to Barzilai and Chinn (2018), developing the appropriate epistemic performance requires educating students to be more critical about the credibility of claims, to listen to multiple arguments, and to update their knowledge based on evidence. On the same note, Muis et al. (2021) also note the importance of epistemic emotions like curiosity and doubt in encouraging learners to critically and persistently address complex socio-scientific problems.

By and large, these theories indicate that the development of scientific temper is not only based on the impartation of content, but also on the development of certain cognitive, emotional, and dialogical skills in students.

2.3 Conceptual Model Development

Based on these traditions, this paper will present a Three-Dimensional Model of Scientific Temper, which incorporates cognitive, affective, and ethical aspects. The cognitive dimension refers to the ability to reason, analyze logically and provide arguments based on evidence. The emotional component encompasses emotional dispositions like intellectual curiosity, an open mind to ambiguity and strength in dealing with cognitive conflict. The ethical aspect is associated with fairness, intellectual honesty, and adherence to truth-seeking rather than persuasion and self-interest.

This theory considers scientific temper as the dynamic interaction between internal learner dispositions and external learning arrangements. It underlines the importance of both teaching methods and training of individual attitudes and institutional beliefs that support inquiry, discussion, and critical thinking (Kivunja, 2018; Kuhn, 2018).

To explain the correlation between these variables, Figure 1 below demonstrates the interaction between school structures (curriculum, pedagogy, and leadership), teacher roles (facilitator, model, and mentor), and student dispositions (cognitive, affective, and ethical) in the process of developing scientific temper in a learning environment.

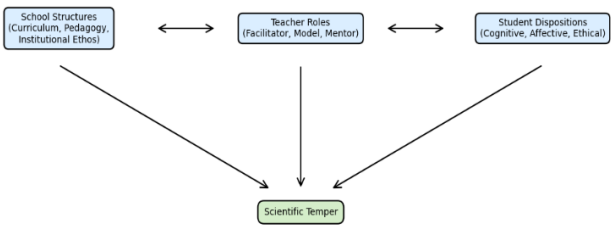

Figure 1: Conceptual Framework for Fostering Scientific Temper in Schools

The conceptual model presented in Figure 1 is dynamic, and at the school level, the inputs of the school, teaching practices, and student dispositions combine to create and maintain scientific temper as a long-term educational outcome.

This framework offers a theoretical perspective to comprehend how various forces in the educational ecosystem should be aligned to develop the culture of inquiry and rationality. It highlights the fact that scientific temper is not a single characteristic but an elaborate combination of intellectual capacity, emotional maturity and moral dedication that is developed under planned educational planning.

3. METHODOLOGY

3.1 Research Design

The theoretical and conceptual research design is adopted in this study and is suitable for examining abstract educational constructs like scientific temper, critical thinking and rational inquiry. According to Snyder (2019), theoretical research is based on the synthesis of the available literature to produce new interpretational frameworks instead of findings. In this line of thought, the paper has placed greater emphasis on conceptual integration rather than data collection, with specific emphasis on elaborating a consistent theoretical framework that explicates the manner in which schools can foster a scientific temper.

Jaakkola (2020) finds conceptual research to be an act of theory construction based on literature analysis, logical reasoning, and the creation of new connections between existing ideas. Subsequently, the current paper will combine philosophical, pedagogical and epistemological views into one conceptual framework.

3.2 Methodological Approach

The study is based on a qualitative interpretive research method which is the synthesis of concepts and theories. The process consists of three phases, which are different but related:

1. Investigation of theoretical backgrounds using literature review and defining applicable educational theories.
2. Comparison of the viewpoints on critical thinking, inquiry-based learning and epistemic cognition.
3. The development of the models in which the knowledge of various sources was rationally combined in the theoretical construct of how the educational systems contribute to developing the scientific temper (Evans, 2020; Chaudhary and Singh, 2022).
4. The methodology and philosophy fit the logic of theory-oriented inquiry characterized by Jaakkola (2020), and conceptual clarity and analytical rigor guarantee theoretical validity.

3.3 Data Sources and Selection

The research relies solely on the secondary data provided by the scholarly sources, such as peer-reviewed articles, educational policy documents, and theoretical essays that were published between the year 2018 and 2025. The sources have been chosen according to:

- **Relevance** to critical thinking, rational inquiry, and pedagogy;
- **Recency**, ensuring theoretical alignment with contemporary educational discourse;
- **Scholarly credibility**, emphasizing Q1/Q2 indexed journals and established academic publishers.

To ensure methodological transparency, the stages of theoretical synthesis are outlined in Table 1 below.

Table 1. Phases of Theoretical Methodology

Phase	Purpose	Key Activities	Reference Base
Phase I: Analytical Review	To examine and categorize literature related to scientific temper and critical inquiry	Reviewing conceptual and policy literature, identifying theoretical constructs	Snyder (2019), Evans (2020)
Phase II: Comparative Integration	To identify overlaps among educational theories and rational inquiry frameworks	Synthesizing pedagogical and epistemological insights	Jaakkola (2020), Chen & Chen (2024)
Phase III: Model Development	To construct the theoretical model linking schools, teachers, and learners in fostering scientific temper	Logical deduction, framework articulation, and conceptual validation	Butler (2024), Chaudhary & Singh (2022)

Table 1 presents the methodological sequence guiding this theoretical inquiry, illustrating how literature-based reasoning and conceptual integration lead to framework development.

3.4 Analytical Procedures

The research uses deduction in order to come up with conceptual relationships between the constructs of education and rational inquiry. It is done through critical reading, thematic grouping of ideas, and the synthesis of common educational principles. In accordance with the suggestions of Snyder (2019) and Jaakkola (2020), theoretical transparency and argument coherence were the focus areas to provide analytical credibility.

Comparative reflection was used to test the theoretical propositions, with particular attention paid to the internal consistency of the constructs, including constructivist learning, critical pedagogy, and epistemic cognition (Chen and Chen, 2024).

3.5 Ensuring Theoretical Rigor

The indicators of rigor in the absence of empirical validation are conceptual validity and argumentative consistency. According to Butler (2024), the soundness of the theory relies on the defined clarity, reasoning, and logical combination of evidence. Hence, triangulation was not done by data but by cross-verification of arguments with many theoretical paradigms.

The methodological credibility of the research is due to the systematic approach to synthesis, logical clarity, and reliance on authoritative sources in developing a consistent model of explaining the contribution of schools to developing the critical, rational inquiry and scientific temper.

4. ANALYSIS AND DISCUSSION

4.1 Schools as Sites of Rational Inquiry

Schools are a dynamic cultural environment where rationality, skepticism and dialogue are developed as educational virtues and not by-products. Being institutions of social learning, they provide systematic settings in which learners are exposed to ideas critically and collectively. UNESCO (2020) states that, in addition to transferring knowledge, education should be able to develop the attitude of inquiry, ambiguity tolerance, and opinion revision willingness.

In this perspective, the school becomes a place of reason, a place where argumentation, questioning and evaluation of evidence become part of the learning process. OECD (2019) underlines that these institutions develop creativity and critical thinking with classroom practices that are based on problem-solving, open-ended inquiry, and reflective communication. This is in line with the idea of developing a scientific temper, where rational inquiry is the epistemic and ethical pedagogical centre.

4.2 Pedagogical Dimensions

Pedagogy is the core aspect of developing a scientific temper, since it works out rational inquiry in the daily classroom context. Studies show that both inquiry-based and project-based learning have a great contribution to higher-order thinking and critical reasoning (Antonio & Prudente, 2023). These strategies make learners develop hypotheses, assumptions, and collaboratively engage in evidence-based thinking.

Bansal (2021) discovered that pre-service teachers are already aware of the importance of inquiry-oriented instruction in the development of conceptual knowledge and intellectual independence, but its application is still unequal. Moreover, Cornejo et al. (2022) have shown that the scientific reasoning and reflective judgment of the students can be improved significantly by means of organized programs that work on critical thinking.

It is possible to make the humanities and sciences interconnected in such pedagogical designs to make rationality balanced between empirical analysis and moral and civic reasoning. This synthesizing strategy will see to it that scientific temper building does not lead to cognitive stagnation but moral and socially accountable inquiry.

4.3 Role of Teachers

The role of the teachers is that of the reasoning facilitator and the intellectual independence model. They are key in creating the classroom atmosphere required in dialogic learning and rational discourse. Butcher et al. (2023) noted that when teachers explicitly consider and promote critical inquiry, they establish classrooms in which students engage in more serious investigating and solve problems.

In the case of teachers, professional development should therefore focus on reflective and dialogic skills, which will enable a teacher to shift his/her role as a transmitter of information to a reasoning mentor. This is supported by Latorre-Cosculluela et al. (2021), who state that the development of critical thinking dispositions is directly supported by inclusive teaching practices that are based on empathy and open-mindedness.

Table 2 below presents the main teacher competencies that should be used in fostering scientific temper in schools.

Table 2: Teacher Competencies for Fostering Scientific Temper

Competency Area	Description	Supporting Evidence
Dialogic Pedagogy	Ability to guide reflective discussions and Socratic dialogue to promote reasoning.	Butcher et al. (2023)
Reflective Skepticism	Encouraging students to question assumptions and evaluate evidence critically.	Cornejo et al. (2022)
Ethical Facilitation	Modelling integrity, fairness, and tolerance during inquiry-based learning.	Latorre-Cosculluela et al. (2021)

Table 2 outlines the foundational competencies educators require to function as facilitators of reasoning rather than information providers, demonstrating that fostering scientific temper depends largely on teacher agency.

4.4 Curriculum and Institutional Structures

Curriculum and institutional ethos are decisive in the

process of instilling rational inquiry in the education process. Curricula should be changed to go beyond memorization and add processes of metacognitive reflection, logic, and philosophy of science, as OECD (2019) recommends. The inclusion of such elements would push the students to conceptualize the process of knowledge creation, as opposed to the meaning of knowledge.

Structurally, the schools are to achieve institutional norms that instil reward for questioning, experimentation, and academic honesty. According to Jose and Wilson (2020), even though the National Education Policy 2020 in India provides inquiry-based and multidisciplinary learning, there is a limitation in its implementation because of the examination-driven practice and lack of teacher autonomy. Thus, the fact that institutional policies should be consistent with rational pedagogical goals is the key to maintaining the environment in which the development of a scientific temper is possible.

4.5 Challenges and Constraints

Although this has a pedagogical and theoretical potential, there are a number of obstacles that prevent the implementation of rational inquiry in schools. Systems based on examination give too much emphasis on rote memorization, and there is little room to explore and engage in dialogic thinking. Barta et al. (2022) also discovered that concept-mapping and analytical learning approaches facilitate the development of critical thinking but are usually constrained by systemic pressures.

Besides, the sociocultural context can dishearten open questioning or criticism, especially in hierarchical or culture-bound environments. According to Jose and Wilson (2020), the disconnect between policy and classroom reality related to the reform policy is maintained by resistance to change and poor teacher preparation. To curb these challenges, there is a need to restructure institutions, train teachers and reforms assessments that put more emphasis on thinking than on testing.

4.6 Presentation of the Theoretical Model: The School as a Rational Ecosystem

The discussion ends with the model of School as Rational Ecosystem, which is a theoretical synthesis of the interaction between the educational system, the role of teachers, and student dispositions to foster the scientific temper (see Figure 1 in the previous section). The model posits that:

- **School Structures** (curriculum, pedagogy, and institutional ethos) provide the organizational foundation for inquiry.
- **Teacher Roles** function as mediators of reasoning, exemplifying reflective skepticism and intellectual integrity.
- **Student Dispositions** represent the affective and cognitive outcomes of this ecosystem, encompassing curiosity, open-mindedness, and ethical reasoning.

Golden (2025) uses the notion of such integration as global citizenry critical thinking, in which the inquiry is used not only intellectually but also civically. Likewise, UNESCO (2020) and OECD (2019) also point out that an education that balances cognitive and ethical growth creates citizens who can actively engage in the life of the community reasonably.

Accordingly, the intended framework aims to redesign the school as a dynamic system of rationality with the institutional norms of the school, pedagogical plans, and dispositions of learners converging to produce the lasting habits of scientific disposition toward and rational research.

5. IMPLICATIONS AND RECOMMENDATIONS

This paper has provided the significance of redefining education as a practice of cultivating both epistemic and moral rationality. It does not view learning as a form of imparting knowledge but rather as a form of transformation that determines intellectual autonomy, form of critical thinking and moral responsibility. The proposed theoretical framework leads to the assumption that not only science education but a general approach of producing thoughtful and evidence-based citizens is to teach individuals science and advance the notion of scientific temper. It re-conceptualizes schools as sensible ecologies in which inquiry and moral thinking co-exist to produce the power of thinking and the power of developing individuals.

At the policy level, the concept of scientific temper has to be introduced in the system of national curricula. The rational inquiry, creativity and reflective thinking must be clearly advocated as the learning outcomes and learning guidelines as the standards of student growth. Institutional behaviours that value questioning, innovation and interdisciplinary exploration should be encouraged by the policies. This systemic convergence would be gradually transforming the area of education more into a rote learning into a dialogic and an inquiry based orientation.

Teacher education becomes one of the primary sources of change. The teachers should also be given the reflective, dialogic and inquiry based skills in the training programs that will see them become

facilitators of the thinking process rather than be providers of facts. Teachers can create classrooms that are characterized by rational and ethical interactions through professional dispositions which are founded on curiosity and critical reflection.

In future research, the proposed conceptual framework is to be empirically tested both in cultural and institutional settings. Cross-national research would come in handy in the exposure of how different education systems operationalize rational inquiry that would be applied to construct and enhance the theoretical framework.

6. CONCLUSION

This study has examined how education can be used in developing scientific temper that theoretically support the fact that schools play a crucial role in developing rational enquiry, reflective scepticism and ethical reasoning. It combined the philosophical and pedagogical traditions and proposed the model of the School as a Rational Ecosystem which conceptualizes the relationships between school organization, teacher and student roles, and student dispositions as the ways of developing critical and evidence-based thinking. The model reinvents education as a whole process that is not only able to guarantee intellectual aptitude but also moral sanity and civil responsibility. The discussion proves the transformative character of the education which is also defined by the power to change the way of thinking and not to simply instill information only. Coming up with a scientific temper will enable individuals to think of the intricacies of life in an inquisitive, rational, and modest manner, which will not only enable individuals to mature personally, but also enable them to co-exist in a democracy. Through fostering the cultures of questioning, dialogue and reflection within schools, learners would be prepared to make sense of a world that is more complex and information saturated with judgement and integrity. The value of the work to the educational philosophy and critical pedagogy is the ability to construct a detailed theoretical foundation of rational education. It combines philosophical rationality and classroom realities and offers a conceptual framework to guide future curricular and pedagogical redesign. The combination of epistemic rationality and ethical consciousness gives the framework a greater value to the contemporary discussions on the moral and intellectual ends of education. The research is a theoretical study and this has been identified as one of its weaknesses as far as empirical validation is concerned. In future, testing and improvement of this conceptual model should be done through carrying out qualitative and quantitative research under various cultural and institutional settings. These extensions would contain not only the solidification of the theoretical propositions but also their implementation as strategies that can be implemented by educators and policymakers who will be resolved to raise a scientifically tempered and rationally engaged society.

REFERENCES

Antonio, R. P., & Prudente, M. S. (2023). Effects of inquiry-based approaches on students' higher-order thinking skills in science: A meta-analysis. *International Journal of Education in Mathematics, Science and Technology, 12*(1), 251–281.

Arifin, Z., Sukarmin, S., Saputro, S., & Kamari, A. (2025). The effect of inquiry-based learning on students' critical thinking skills in science education: A systematic review and meta-analysis. *Eurasia Journal of Mathematics, Science and Technology Education, 21*(3), Article em2592.

Ayuste González, A., & Trilla Bernet, J. (2024). Critical thinking and critical pedagogy: Concurrences and complementarities. *Revista de Educación, 406*, 319–339.

Bansal, G. (2021). Indian pre-service teachers' conceptualisations and enactment of inquiry-based science education. *Education 3-13, 49*(3), 275–287.

Bardapurkar, A. (2020). Teaching scientific temper. *Resonance: Journal of Science Education, 25*(10), 1399–1405.

Barta, A., Fodor, L. A., Tamás, B., & Szamosközi, I. (2022). The development of students' critical thinking abilities and dispositions through the concept mapping learning method – A meta-analysis. *Educational Research Review, 37*, Article 100481.

Barzilai, S., & Chinn, C. A. (2018). On the goals of epistemic education: Promoting apt epistemic performance. *Journal of the Learning Sciences, 27*(3), 353–389.

Boonsathirakul, J., & Kerdsomboon, C. (2023). Synthesis of critical thinking research of basic education level students using meta-analysis in Thailand (2010–2021). *Educational Research and Reviews, 18*(1), 1–8.

Butcher, K. R., Hudson, M., Lane, M., & Larson, M. (2023). Critical thinking during science investigations: What do practicing teachers value and observe? *Teachers and Teaching, 29*(6), 594–614.

Butler, H. A. (2024). Predicting everyday critical thinking: A review of critical thinking assessments. *Journal of Intelligence, 12*(2), Article 16.

Chaudhary, P., & Singh, R. K. (2022). A meta-analysis of factors affecting teaching and student learning in higher education. *Frontiers in Education, 6*, Article 824504.

Chen, F., & Chen, G. (2024). Technology-enhanced collaborative inquiry in K–12 classrooms: A systematic review of empirical studies. *Science & Education*. Advance online publication.

Cornejo, C. O., Luengo, M. P., Mujica, A. D., & Rovira, D. P. (2022). Promoting pedagogy students' scientific skills through a critical thinking program. *Electronic Journal of Research in Educational Psychology, 20*(57), 267–290.

Dökmecioglu, B., Taş, Y., & Yerdelen, S. (2022). Predicting students' critical thinking dispositions in science through their perceptions of constructivist learning environments and metacognitive self-regulation strategies: A mediation analysis. *Educational Studies, 48*(6), 809–826.

Ennis, R. H. (2018). Critical thinking across the curriculum: A vision. *Topoi, 37*(1), 165–184.

Evans, C. (2020). *Measuring student success skills: A review of the literature on critical thinking* (21st Century Success Skills Report). National Center for the Improvement of Educational Assessment.

Golden, B. (2025). *Critical thinking for global citizenship education: A conceptual framework*. Palgrave Macmillan.

Jaakkola, E. (2020). Designing conceptual articles: Four approaches. *AMS Review, 10*(1–2), 18–26.

Jose, A., & Wilson, D. D. (2020). National Education Policy 2020: Introspecting implementation challenges. *Economic & Political Weekly, 55*(34).

Kivunja, C. (2018). Distinguishing between theory, theoretical framework, and conceptual framework: A systematic review of lessons from the field. *International Journal of Higher Education, 7*(6), 44–53.

Kuhn, D. (2018). A role for reasoning in a dialogic approach to critical thinking. *Topoi, 37*(1), 121–128.

Latorre-Cosculluela, C., Sierra-Sánchez, V., Vázquez-Toledo, S., & Royo-Ardid, J. (2021). Critical thinking and inclusive practice: A qualitative study of Spanish primary school teachers' perceptions. *Issues in Educational Research, 31*(3), 803–823.

Ministry of Human Resource Development (MHRD), Government of India. (2020). *National Education Policy 2020*. Government of India, New Delhi.

Muis, K. R., Chevrier, M., Denton, C. A., & Losenno, K. M. (2021). Epistemic emotions and epistemic cognition predict critical thinking about socio-scientific issues. *Frontiers in Education, 6*, Article 669908.

Netto, S. G., & Dominic, P. (2023). Locus of control and scientific temper of student teachers at the secondary level. *International Journal of Educational Reform*. Advance online publication.

OECD. (2019). *Teaching, learning and assessing creativity and critical thinking*. OECD Educational Research and Innovation report.

Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. *Journal of Business Research, 104*, 333–339.

UNESCO. (2020). *Education for Sustainable Development: A roadmap*. UNESCO Publishing.

UNESCO. (2021). *Reimagining our futures together: A new social contract for education*. UNESCO Publishing.