Journal of Positive School Psychology http://journalppw.com
2022, Vol. 6, No. 3, 1179–1188

Nurturing the Scientific Temper and Vision of Ancient Indian Physicists through NCERT Science Textbooks: An Analysis

Manjushree Chaudhuri
Corresponding author
Research Scholar, Amity Institute of Education, AUUP
ORCID No.-0000-0001-8930-7532

Dr.Seema Agnihotri
Assistant Professor III, Amity Institute of Education, AUUP

Abstract

Scientific temper, according to Jawaharlal Nehru is a journey towards the search for truth, divinity of everything living, their cooperative development, leading to greater freedom and higher stages of human growth (1946, p.515). This spirit is visible in our Ancient Indian Physicists, documented in the surviving literature, dealing with the new frontiers of physics. As part of textbook review, undertaken bythe National Council of Educational Research and Training (NCERT) in 2017, Ancient Indian Knowledge had been incorporated.The objectives of the study were **t**o analyze the content of the revised NCERT Science Textbooks from the point of view of integrating the scientific knowledge and spirit of ancient Indian Physicists,to identify the gaps,and to make recommendations for the effective integration of the above-mentioned components in the Science Textbooks.This was a descriptive study undertaken through content analysis. It was found that the content on Ancient Indian Physics Knowledge in the revised edition of NCERT Science Textbooks is concentrated only in Science Textbook of class VIII,in the chapter"Stars and Solar System".There is a scope to incorporate the original investigations and discoveries of Ancient Indian Physicists. The Union Cabinet of Government of India incorporated the vision and wisdom of the ancient Indian knowledge system while launching the New Education Policy in July 2020, designed to transmit and incorporate United Nation's SDG4. The Indian Government has taken a policy decision to once again incorporate the ancient Indian knowledge related with science and other disciplines in the forthcoming revision of NCERT Textbooks.

Keywords: Scientific Temper, Ancient Indian Physicists,Vision, Textbooks, New Education Policy 2020

1.Introduction

The 42nd Constitutional Amendment Act of the Indian Constitution in 1976 laid the foundation of incorporating Scientific Temper, Humanism, Spirit of inquiry and Reform as a fundamental duty, first time in any constitution, under article 51(A) (h)(The Constitution of India,1976, Art. 51(A) (h)).

Scientific Temper is a disposition or frame of mind of employing the principle of logic to the act of doing, thinking, viewing or simply existing. Pandit Jawaharlal Nehru, erstwhile prime minister of India, introduced and defined the phrase "Scientific Temper" in his book "Discovery of India" (1946) where he says, "The discipline of Science deals with the realm of reliable and constructive knowledge but the temper that it should generate goes beyond that realm. On visiting theplaces beyond the reach of the scientific method of objective investigation,like atop a mountain, where philosophy dwells and strongsensibilitiespermeates us,or at the moments of the wonder at the infinitude beyond, that outlook and temper are still pertinent. The west still needs to evolve the real scientific spirit and temper, though it has led the world by glorifying and adopting Scientific methods and theory. On the other hand,

the ancient Indian notion of dauntless seeking of truth, and divinity in all beings, together with the concept of harmonious existence and advancement ever to greater freedom and higher stages of human growth speaks volumes of the real scientific spirit and temper though it might be far behind in accordance with the present definition of scientificdevelopment" (pp.624-627).

Though the aim of the life of ancestorsof Indian denizens has been the search of truth, and their prayer – *Tamasomājyotirgamaya*or "To be lead from darkness to light" (Bṛhadāraṇyaka Upaniṣad,1.3.28), the method to obtain it was scientific and portrayed the scientific temper of logic. Elaborating on the Nyāya system of philosophy, Vātsyāyana in his commentary (Nyāyabhāṣya)avers that the process of methodological investigation distinguishes the Nyāyasystem.Proof is an inference supported by observation and authority in this system(Ganeri,2001,p.11)Thus,Nyāya system is described as logical realism on account of its doctrine that the world exists independently of our perception and knowledge of it, and the contention that the independent existence of the world can be defended not by appeal to naïve belief,faith,intuition or scriptural testimony but by logical arguments and critical reflection on the nature of experience. According to Nyāyaphilosophy sixteen *Padārthas* or categories were identified to arrive at valid knowledge, which are-*Pramāṇa*(true knowledge through objectivity, *Prameya*(the knowable),*Saṁśsaya*(doubt) ,*Prayojana*(purpose or motive),*Dṛṣṭānta*(instances or examples of truth),*Siddhāṇta*(principle or doctrine held by someone),*Avayava*(premise or conclusion of syllogism),*Tarka(*hypothetical reasoning or reduction ad absurdum),*Nirṇaya*(decision or true knowledge arrived at through legitimate methods of knowledge),*Vāda*(an argument or discussion in which premises and conclusion as well as means and criteria of knowledge is used) etc. Vaiśeṣikaschool of Indian Philosophy founded by sageKaṇāda is also known as the "atomistic school"because of its elaborate atomic theory.The expository work of Praçastapāda'sPadārtha-Dharma-Sangraha mentions the categories(*padārthas*)which are capable of existence(*astitva*),those which are knowable(*jñeyavatva*),and those which are nameable(*abhideyatva*).Thus Vaisesikas possessed the Scientific temper to logically analyze the physical reality.The basis of ṚṣiKaṇāda's"Theory of matter" is the short sutra"*NityaṃParimaṇḍalam*"(*Vaiśeṣika-Sūtra*,7.1.20) i.e. Atoms areindestructible while he started with the hypothesis that the occurrence or non-occurrence of the perception of the minute atom or the extended object had been explained in the eternal or "*Aṇormahataścopalabdhyanupalabdhīnityevyākhyāte*" (*Vaiśeṣika-Sūtra*,7.1.8).He went further to assert that the atoms are imperceptible and aggregations thereof into masses are perceptible(Sirkar,1911).Kaṇāda had elaborated on different types of atoms(*paramāṇu*), and referred to an unknown force called *Adṛṣṭa*,due to which the atoms begin to vibrate*(pariṣpanda*), and can combine to form dyads or *dvyaṇuka*(2 atoms), or*tryaṇuka*(3atoms), thusdetailingatomic reactions,and classification of matter.The other concepts of Physics which have been elucidated by VaiśeṣikaPhysicist have been in Mechanics.They recognized massas a property of matter (Kumar,2019) and knew the linkage between force and work (*VaiśeṣikaSūtra*,5.1.2), and also about antimatter or *abhāvapadārtha*(*VaiśeṣikaSūtra*,5.2.18).Kaṇādaposits that in the beginning the impulse (nodanā) produced due to the force results in the production of initial kinetic energy(karma) in the arrow which results in the productionof its momentum. The gain in momentum results in the ascentof the arrow(projectile).

nodanādādyamiṣoḥ karma tatkarmakāritāccasaṁskāraduttaraṁtathottaramuttarañca

(Vaiśeṣika-*Sutra*,5.1.17)

As thearrow rises higher,its *samsakara* or *vega*(velocity)starts decreasing, and upon its absence, it starts falling down under theinfluence of the gravitational force.

saṁskārābhāve gurutvāt patanam (*Vaiśeṣika-Sutra*,5.1.18)

One gets a glimpse of the modern analytical way of studying physics, which did not exist in Europe before the 17thcentury. (Priyadarshi, 2012).Prasastapāda(6th century A.D.)introduced the concept of Elasticity,Buoyancy and the propagation of sound as progressive waves, while theMimāṁsakas following the Mimāṁsa school of Indian philosophy touched upon condensation and rarefaction of the medium during propagation of

sound (Chatterjee,1980, p.112).The science of acoustics and music is elaborated in the Sama Veda. Bhaskara II in SiddhantaShiromani, elaborated on the concept of Gravitation,around 500 years before Newton.Sutras in Agastya Samhita give the procedure of the construction of an electrolytic cell and its uses,while those in Vaisheshika refer to a magnetic compass, while the phenomenon of capillarity was identified in 15th century A.D. by SankaraMisra.ṚgVedic astronomical computations paved the way for enhancement in techniques in theSiddhanticEra (5th century A.D.) where computations of planetary positions were undertaken with thehelpof models using epicycles,and trigonometric methods. The astronomersĀryabhaṭa(b.476A.D.), Varahamira (b.505 A.D.), Brahmagupta(b598), BhaskaraI (b.600 A.D.), andBhaskaraII(b.1114 A.D.)calculated the mean and true positions of celestial bodies ,triple problem of time,epileptic and eccentric theories for the motion of planets together with theirconjunction,rising and setting , and produced innovations in astronomical techniques and astronomical instruments.This was taken to a greater level of precision by the astronomers of the Kerala School from the 14th to the 17th century.Computational analysis of the various astronomical treatises, and the compiled data led Roger Billard to corroborate the accuracy of the observations(Sen,1980, p.87)

This ancient scientific brilliance of the Indians can be ascertained from the literature that has survived the destruction caused by invading foreign troops, to the centres of learning. The quintessential characteristic that emerges from them is the scientific disposition of skepticism, egalitarianism, objectivity, modesty, logicality, analytical deliberations, perseverance and ubiquity. This wisdom and vision displayed by the ancient Indian Physicists was recognized by our intelligentsia and leaders to fit with the idea of scientific temper which later got incorporated in the Scientific Policy Resolutions, and the various National policies of Education, after Independence, and spells out the country's vision of spreading this scientific spirit and the ancient Indian culture.

Textbooks are societal artifacts which are prescribed to homogenize and disseminatea selective vision (Apple, 1990), and are systematized to be appropriate for a particular age group. Science textbooks play an imperative role to guide the teachers in adopting a didactic approach on one hand, but also facilitating a constructivist and a collaborative teaching methodology on the other. The process of digitalization of India, has still not made deep inroads to erode the concept of state textbook culture concretized by the National Council of Educational Research and Training(NCERT), the textbooks remaining sometimes the sole aids for curriculum transaction (Kumar,1986, p.1309). The constant review of the content and the quality of the science textbooks prescribed by the state has been a significant policy consideration in India (Kumar, 1988).The National Council of Educational Research and Training is an Indian Governmentorganizationwhich guides and assists the Government at the central and the state level on policies and programmesrelated with school education.

If we examine the National Curriculum frameworks (NCFs) of India from 1975 to 2005, we find an increasing importance given to the criteria of validity of the Science Curriculum, in which besides Cognitive, Content, Process and Environmental validity, the role played by Historical validity is of high significance. The ratification from the historic point of view, guides the curriculum to be infused with historic strands to facilitate the neophyte to appreciate the social determinants governing the advancement and blossoming of science, and also to be able to understand the development of the principles of science with time (NCF 2005, p48).

2.Significance of the Study

In a not very recent development, and as part of textbook review which was undertaken byNational Council of Educational Research and Training in 2017, ten years since the last one, Ancient Indian Knowledge and traditions was incorporated in the new NCERT textbooks for the academic year 2018-19.This was a positive step towards humanizing science curriculum, incorporating aspects of nature of science, and transmitting the value of scientific temper inherent in the thoughts and work of ancient Indian Physicists so as to motivate the students, and ignite a spirit of curiosity, creativity and national pride which is the need of the hour in the new generation of denizens of our country.

In the present study a content analysis of the revised NCERT Science Textbooks for classes 6 to 10 has been

undertaken, to see the extent to which the knowledge of Ancient Indian Physicists hasbeen incorporated in the Science Textbooks across the mentioned grade levels. This study is of even greater significance with the launch of New Education policy in July 2020, by the Government of India to advance the concept of lifelong learning, an inclusive and unbiased educational system, a vibrant knowledge society imbibing the vision of United Nation's fourth goal of Sustainable Development.Promulgating the previous flagship schemes like *Sarva Shiksha Abhiyan* (2010) entailing Universalization of elementary education, *Rashtriya Madhyamik Shiksha Abhiyan*(2009) which aimed at enhancing the quality and access to secondary education, and the right to education act (2010), the New Education Policy aims at removing the impediments posed by the society based on social, economic, gender, and physical impairments to the universalization, and equity in education. The National Education Policy (2020, p.1) laying emphasis on the ancient knowledgeof India further averred that

> Ancient India was renowned for its famous residential, multidisciplinary internationalcentres of higher learning and research like Nalanda(in Magadha),Telhara (in District Nalanda in Bihar),Vikramshila(District Bhagalpur in Bihar), Nagarjuna Vidyapeeth(in Andhra Pradesh),Vallabhi(in Saurashtra of Gujrat)etc. Eminent ancient Indian intellectuals did pioneering research in the diverse fields of knowledge such as astronomy,physical sciences, surgery, medicine,engineering,biological sciences,agriculture,architecture, economic policies,yoga, grammar, ethics and many more.Some of these prominent scholars were Suśruta,Āryabhaṭa,Kautilya,Charaka, Panini, Nāgārjuna, Varahamira,BhāskaraI,Bhāskara II,Mādhava, Patañjali,Siddhārtha Gautama Buddha,Thiruvalluvar, Gargi, Maitreyi, and Lopamudra. The philosophical tradition of Ancient India has had a strong impact on the world. We must not only protectand nurturethese rich legacies of the world heritage for our future generations but also endeavour to put them to new usages and applications through our education system, and further investigation.

In continuation with this thought the Ministry of Human Resource Development, Government of India plans to once again revise the NCERT Textbooks in the coming year to incorporate the vision and knowledge of the great physicists amongst others.

3.Objectives of the study

The following objectives were identified for the study:

(i)To analyze the content of the revised NCERT Science Textbooks (December 2017) forthe classes VIto X, from the point of view of integrating the scientific knowledge and spirit of ancient Indian Physicists as compared to that of thefirst reprint edition of the various textbooks.

(ii)To identifythe gaps in the above-mentioned textbooks with reference to the above components.

(iii)To make recommendations for the effective integration of the above-mentioned components in the Science Textbooks developed by NCERT for classes VI to X.

4.Method and Procedure

This was a descriptive study undertaken through content analysis.Content Analysis is an archetypal systematized methodology of examining the written material quantitatively. The written text which is analyzed through this method could belong to a textbook, transcript of interviews,social media transactions,speeches,online material and the like.Human coded analysis has been utilized in this study.Popularized by Bernard Berelson particularly for communication research, content analysis was quantified by him as the objective description of the manifest content of communication (1952, p.18). In 2002, Kimberley Neuendorfdescribed content analysis as a summarization of the quantitative analysis of messages that relics on scientific methods. (p.10).Following the path laid down by Nachimas and Nachimas in 1976, the content of the text of all the Science textbooks formed the foundation for deducing conclusion related to the aim of the study.The research population consisted of the Science Textbooks issued by the government of India for the schools following the CBSE (Central

Board of Secondary Education-a popular National Board of education in India) curriculum.

The revised and the first reprint of the Science Textbooks published by the National Council of Educational Research and Training were taken as the samples. In particular the analyzed textbooks belonged to the Upper Primary Classes (VI to VIII), and the Secondary classes (Classes IX and X). The Units which were considered for analysis comprised of every text, image and exercise contained in all the pages of the NCERT textbooks.

Table-1: Research Population

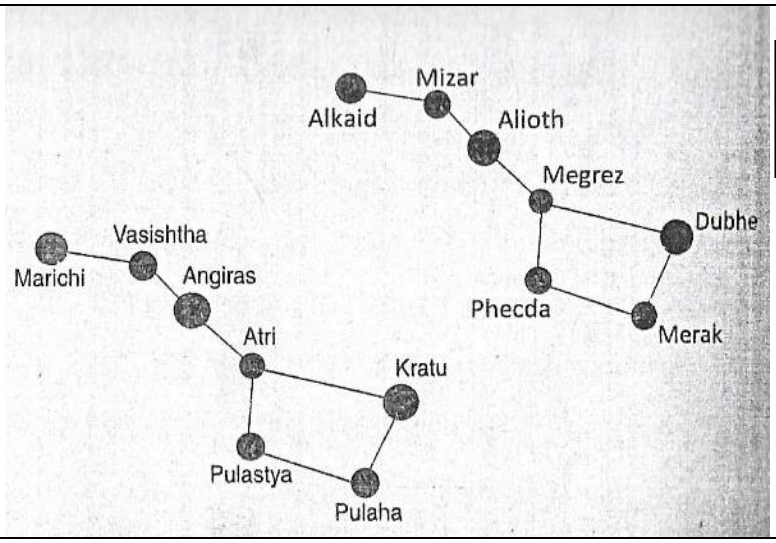
Class/Stage	Textbook	No. of Chapters (Old)	No. of Chapters (Revised)	No. of pages of thechapters (Old)	No. of pages of thechapters (Revised)	No. of analyzed pages(Old)	No. of analyzed pages (Revised)
6/UpperPrimary	Science	16	16	165	165	165	165
7/UpperPrimary	Science	18	18	230	230	230	230
8/UpperPrimary	Science	18	18	252	252	252	252
9/Secondary	Science	15	15	218	215	218	215
10/Secondary	Science	16	16	281	280	281	280

Table-2: Integration of Ancient Indian Physics Knowledge in the revised edition of NCERT Science Textbooks

Subject,Title of the book Year of Publication	Class	Title,Name oftheleson&PageNo.	Ancient Indian Physics Content with Page Number	Pages/Para/lines
Science, December 2017	VIII	Lesson 17 Stars and Solar System (Pages 215-238)	The study of celestial objects and associated phenomena is called astronomy. In ancient India our ancestors per formed methodical observations of sky. Their knowledge of astronomy was highly advanced for their time. Passage of the Sun, stars, moon and planets in the sky helped them to devise calenders and almanacs. These were often used by people in their day-to-day conduct and a better understandingof climate and rainfall patterns for timely sowing and choice of crops, fixing the dates of seasons and festivals**.(Page No.216)**	**1 Para**
Science, December 2017	VIII	Lesson 17 Stars and Solar System (Pages215-238)	Phases of the moon play an important role in our social life. Almost all festivals in India are celebrated according to the phases of the moon. For example, Diwali is celebrated on the new moon day; Budh Poornima and Guru Nanak's birthday are celebrated on full moon day; MahaShivratri is celebrated on thirteenth night of waning moon; Eidul-Fitr is observed on the day following the sighting of crescent moon (P**age No.216)**	**1 Para** **3lines**
Science, December 2017	VIII	Lesson 17 Stars and Solar System (Pages 215-238)	In all ancient cultures, very interesting mythological stories have been associated with the various constellations. Ursa Major (Saptarshi) :Saptarshi has been associated with seven well known ancient Indian sages, or rishis, as shown in the figure below. According to ancient mythology, the seven sages who form the Saptarshi, preserve the eternal knowledge of Vedas and explain it to people in every new age.**(Page No.222)**	1Para **Yellow Box**

Science, December 2017	VIII	Lesson 17 Stars and Solar System (Pages 215-238)	**Astronomy in Ancient India-** The practice of astronomy in ancient India is mentioned in Rig Veda which was composed about 4000 years ago. Many Indian scholars have contributed to astronomy. One of the most well-known astronomers is Aryabhata. The work of Aryabhata on astronomy can be found in his writing 'Aryabhatiya'. He wrote it in 499 CE at the age of 23 years. The diameter of the Earth as stated by Aryabhata is close to its presently known value. Disregarding the popular view that Earth is 'achala' (immovable), Aryabhata stated that Earth is sphere and rotates on its own axis. His estimate about the sidereal period of Earth was 23 hours, 56 minutes and 4.1 seconds, which is very close to the presently known value. He also correctly stated that the moon and the planets shine due to reflected sunlight. He also gave a scientific explanation for solar and lunar eclipses. When the shadow of the Earth falls on the moon, it causes lunar eclipse. When the shadow of the moon falls on the Earth, it causes solar eclipse. Aryabhata also found the distance between the Earth and the moon, which is very close to the known value today.**(Page No. 227)**	**3lines (1 Para Yellow Box)**

Table-3: Inclusion of Images related toAncient Indian Physics Knowledge in revised edition of NCERTT extbooks

Subject of thebook,Year of Publication	**Class**	**Title,Nameof the lesson and Page Number**	**Images related to Ancient Indian Physics Content with Page Number**
Science, December 2017 Science,	VIII	Lesson 17 Stars and Solar System(Pages 215-238)	 **Page no. 222**

December 2017	VIII	Lesson 17 Stars and Solar System(Pages 215-238)	 **Page No. 227**

Table-4: Inclusion of Exercises/Extended Learning Questions related toAncient Indian Physics Knowledge in revised edition of NCERT Textbooks

Subject of thebook, Yearof Publication	Class	Title,Name of the lesson and pageNo.	Questions/Activities/Projects	Life Skill
Science, December 2017	VIII	Lesson 17 Stars and Solar System (Pages 215-238)	5. Position of the rising Sun – Uttarayan and Dakshinayan: This activity may last for several weeks. Choose a place from where eastern horizon is clearly visible. Choose also a marker, such as a tree or an electric pole, to mark the position of the rising Sun. It will be sufficient if you take the observation once every week. On any day, note down the direction of the rising Sun. Repeat this observation every week. What do you find? You would have noted that the point of sunrise changes continuously. From summer solstice (around 21 June), the point of sunrise gradually shifts towards the south. The Sun is then said to be in dakshinayan (moving south). It keeps doing so till winter solstice (around 22 December). Thereafter, the point of sunrise changes direction and starts moving towards north. The Sun is now said to be in uttarayan (moving north). From the equator, only on two days, on the days of the equinoxes (around 21 March and 23 September) the Sun rises in the east. On all other days, it rises either north of east or south of east. So, the direction of the rising Sun is not a good guide to determine directions. The Pole Star, which defines North, is a much better indicator of directions. **(P.237)**	**Scientific Temper**

5. Results and Discussions

The Content on Ancient Indian Physics Knowledge in revised edition of NCERT Science Textbooks is concentrated only in Science Textbook of class VIII,in the chapter "Stars and Solar System. Two new imageshave also been added. The first shows Ursa Major (Saptarshi) to be associated with seven well known ancient Indian sages,who preserve the eternal knowledge.The second image is of Āryabhaṭa,the famous Ancient Indian Astronomer.An extended activity has been included in the same chapter to nurture the scientific spirit. The concept of *paramāṇu*

and*padārthas* ofVaiśeṣikaphilosopher Rishi Kanad, and the idea of atomic combination elaborated by PakhudaKatyayama is already incorporated in Chapter 3 of class IX Science Textbook namely Atoms and Molecules.

6.Gaps and Suggestions: There is a need to extend this trend of incorporating the thoughts and ideas of Ancient Indian Physicists through the various other chapters too. Prashastapada's idea of the concept of Buoyancy and Sound can be introduced in the Floatation part of the chapter of Gravitation and the chapter of "Sound "in class IX respectively, while the students of the same class, canbe introduced to Bhaskara II, who had elaborated on the concept of Gravitation ,through the chapter of "Gravitation" .Sutras of Agastya Samhita giving the procedure of the construction of a cell can be incorporated in the chapter on "Chemical Effects of Electric Current"of class VIII,while the magneticcompass of Vaisheshika can be introduced in Chapter 13 of class VI Science Textbook i.e.in " Fun with Magnets" . Though some details of the astronomerAryabhatya has been included, the names of Varahamira,Brahmagupta,BhaskaraI, BhaskaraII,and the Kerala school astronomers can be mentioned together with elucidating onthe advancements in astronomical techniques and astronomical instruments undertaken by them.There is a need to familiarize the students of class IX with the extensive work undertaken by sageKaṇāda, the famous physicist in the field of mechanics, in sixth century B.C., and alsoincorporate the latter investigation undertaken by Prasastapādain the 6th century A.D. related with Buoyancy.The Mimāṁsakas of the Mimāṁsa school of Indian philosophy, and their unveiling of the concept of longitudinal sound waves propagating in the form of condensation and rarefaction can be included in the Sound chapter of class nine.

7.Conclusion: Nurturing the scientific temper,in its true meaning, as portrayed in the vision and treatises of Ancient Indian Physicists is of paramount importance, and has been spelled out as the country's vision through its various policies and curriculum frameworks. It is worth noting that the latest revised Science Textbooks of December2017 had incorporated some of the vision and the discoveries of the ancient Indian Physicists, which will inspire and ignite the minds of the students of our country, and imbibe in them the value of scientific temper. To fully integrate this temper through our science textbooks, there is a need to incorporate it at various grade levels. There is a scope to incorporate concepts like Gravitation, Buoyancy, Electric cell,laws ofMechanics, advances in astronomy, magnetism etc.which were first discovered by the Ancient Indian Physicists.

The National Education Policy (2020) has opened up new vistas in the field of policy decisions concerning educational curriculum in India,particularly during the time the entire nation, and the world was combatting the initial attack of the Covid 19 pandemic.The emergence of this new ray of light tried to dispel the gloom surrounding the nation, and the country now has begun implementing the various facets of this new National Education policy. With the third wave behind us,the process of the development of the new national curriculum framework has just begun in India.The National Council of Educational Research and Trainingunder the directive of the Ministry of Education, Government of India has initiated the process of revising the school NCERT Textbooks in order to incorporate the Ancient Indian knowledge in general, and the discoveries, inventions and wisdom of the ancient Indian physicistsin particular,so as to not only preserve this rich heritage but also to promote further research and experimentation.

REFERENCES

1. Apple, M. W. (1990). The Text and Cultural Politics. *The Journal of Educational Thought (JET) / Revue de La Pensée Éducative*, *24*(3A), 17–33. http://www.jstor.org/stable/23768190
2. Berelson, B. (1952). Content analysis in communication research. New York,USA: The Free Press.
3. Chatterjee, S.D. (1986). Physics and Mechanics in Ancient and Medieval India. In P. Ray & S.N. Sen (Eds.), *The Cultural Heritage of India: Volume VI, Science and Technology* (pp. 101-114). Calcutta, India: The Ramakrishna Mission Institute of Culture.

4. Ganeri,J. (2001). *Philosophy in Classical India: The Proper Work of Reason*.London,U.K.:Routledge.
5. Government of India. (1950). *The Constitution of India*. Retrieved from https:// archive. org/ details/ coi_ part_ full/mode/2up
6. Government of India. (1976). *The Constitution of India.* Retrieved from https:/ / www. indiacode. nic. in/ bitstream/123456789/15240/1/constitution_ of_india.pdf
7. Government of India. (1968). *National Policy on Education, 1968*. Retrieved from https:// www. education.gov.in/sites/upload_files/mhrd/files/document-reports/NPE-1968.pdf
8. Government of India, Ministry of Human Resource Development. (1986). *National Policy on Education- 1986*. Retrieved from https://ncert.nic.in/pdf/nep/Policy_1986_eng .pdf
9. Government of India, Ministry of Human Resource Development. (2020). *National Education Policy 2020*. Retrieved from https:// www. education.gov.in/ sites/upload_files/ mhrd/files/ NEP_Final_ English_ 0.pdf\
10. Khan, A. (2018). Science, Scientific Literacy and Scientific Temper. *Voices of Teachers and Teacher Educators, VI (II)*,38-49. Retrieved from https:// ncert.nic.in/ pdf/ publication/ journalsandperiodicals/ vtte/ Voices_Feb_18.pdf
11. Kumar, K. (1986). Textbooks and Educational Culture. *Economic and Political Weekly, 21*(30), 1309–1311.Retrieved from http://www.jstor.org/stable/4375939
12. Kumar, K. (1988). Origins of India's 'textbook culture'. *Comparative Education Review*, *32*(4), 452–464.
13. Krippendorff, K. (1980). Content analysis: An introduction to its methodology. London,U.K.: Sage.
14. Mahanti, Subodh (2013).A Perspective on Scientific Temper in India.Journal of Scientific Temper,

1 (1):46–62.

15.Nachmias, D. &Nachmias, C. (1976). Content analysis. In Research methods in the social sciences (pp.132-139), UK: Edward Arnold.

16.NCERT.(2005). *National Curriculum Framework2005*.New Delhi: NCERT

17.NCERT (2000). National Curriculum Framework for School Education, 2000, NCERT, New Delhi.

18.NCERT (1988). National Curriculum for Elementary and Secondary Education: A Framework, 1988,

National Council of Educational Research and Training, NewDelhi.

19.NCERT (2005). Position Paper of the National Focus Group on Teaching of Science, NCF- 2005, National Council of Educational Research and Training, New Delhi.

20.NCERT (1975). The Curriculum for Ten Year School: A Framework, 1975, National Council of Educational Research and Training, New Delhi.

21.NCERT (2017). *Science Textbook for class X*. New Delhi, India: NCERT.

22.NCERT (2007). *Science Textbook for class X*. New Delhi, India: NCERT.

23.NCERT (2017). *Science Textbook for class IX*. New Delhi, India: NCERT.

24.NCERT (2006). *Science Textbook for class IX*. New Delhi, India: NCERT.

25.NCERT (2017). *Science Textbook for class VIII*. New Delhi, India: NCERT.

26.NCERT (2008). *Science Textbook for class VIII*. New Delhi, India: NCERT.

27.NCERT (2017). *Science Textbook for class VII*. New Delhi, India: NCERT.

28.NCERT (2007). *Science Textbook for class VII*. New Delhi, India: NCERT.

29.NCERT (2017). *Science Textbook for class VI*. New Delhi, India: NCERT.

30.NCERT (2006). *Science Textbook for class VI*. New Delhi, India: NCERT.

31.Nehru, J. (1946). The Discovery of India. Calcutta, India: Signet Press.

32.Priyadarshi, P. (2012). Mechanics in Hindu literature. In B.R.Singh et al (Eds.),*Science and Technology in Ancient Indian Texts* (1st ed., pp.88-104). New Delhi, India: D. K. World.

33.Radhakrishnan, S. (2014). The Principal Upaniṣads: Edited with Introduction, Text, Translation and Notes. Noida, India: Harper Collins Publishers.

34.Scientific Policy Resolution (1958). Reprinted for the Department of Science and Technology, Government of India, New Delhi.
35.Sen, S.N. (1986). Astronomy in Medieval India. In P. Ray & S.N. Sen (Eds.), The Cultural Heritage of India: Volume VI, Science and Technology (pp. 83-100). Calcutta, India: The Ramakrishna Mission Institute of Culture.
36.Sirkar, K.L. (1911). An Introduction to the Hindu System of Physics being an Exposition of Kanada-Sutras relating to the subject. Calcutta, India: Sree Press.
37.Swami Sivananda. (1985). The Brihadaranyaka Upanishad: Sanskrit text, English translation, and commentary. Uttar Pradesh, India: Divine Life Society.