

INTEGRATION OF TRADITIONAL KNOWLEDGE IN SECONDARY SCHOOL CURRICULUM

***K. V. Sridevi and Pooja Tomar**

RMSA Project Cell, NCERT

***Email:** kvsridevi@gmail.com

Across the globe human civilisation has developed its unique set of knowledge through interaction with the environment that human beings live in. The ancient scientific knowledge developed through continuous efforts is still relevant today and is capable to sustain the modern society. The present paper analyses the secondary school textbooks to identify the scope for integrating relevant aspects of ancient Indian scientific knowledge in secondary school science curriculum. On the basis of analysis, suggestions are made on how to include Ancient Scientific Knowledge in secondary school science curriculum.

Keywords: Ancient scientific knowledge, Secondary school science curriculum, Integration

Introduction

Respecting nature and sustainable development have always been the main ethos of the Indian way of life. To compete in the race of global development and modernisation, we have veiled ourselves with an unnatural mask. We are running behind the torchbearers of western science and technology, unaware of our own glorious past. The ancient Indian civilisation had embodied the spirit of sustainable development with deep rooted values like respect for nature and conservation.

Climbing several stairs of civilisations, human beings have reached a stage from where even the universe seems smaller. To reach these heights, several civilisations contributed in many ways. The Indian civilisation being one of the oldest and with a

strong rich tradition of science and technology has laid a great impact on the modern world. The ancient Indian knowledge of science and technology has laid the foundation of the basic principles of modern science and technology. The ancient Indian scientist, Kanad, devised the atomic theory, centuries before John Dalton was born. Binary numbers, the basic language in which computer programs are written, were first described by the Vedic scholar Pingala, in his book *Chandahśāstra*, which is the earliest known Sanskrit treatise on prosody (the study of poetic metres and verse).

Scholars around the globe acknowledge and appreciate contributions made by the ancient Indian science and technology in the development of modern scientific knowledge, but the irony is that they are still unknown to most of us. Our students or present

generation are unaware of our rich scientific knowledge and thus, fail to integrate it in their daily lives. We somehow failed to pass this ancient knowledge to our present generation. The question arises as to how this knowledge could be transferred? “Education” provides the solution for this.

Characteristics of Traditional Knowledge

- Traditional knowledge is referred to as indigenous or local or cultural knowledge, has evolved over centuries, in specific ecological and linguistic contexts.
- This knowledge is transferred from elders to young people in practical working and life situations.
- This knowledge is dynamic in nature, it is transmitted orally through stories, rituals, songs and laws, which are preserved in artifacts handed from parents to children. As a result, it has constant improvement as new knowledge is integrated with the existing research.
- Hence, creation and improvement of knowledge is a group effort in this context.

The protection, preservation and promotion of this knowledge is the need of the hour. Education must not only aim at developing an ability among the students to appreciate indigenous perspectives on ways of living together and using resources sustainably; but it is also important to motivate and enable students to integrate indigenous knowledge in their daily life activities.

Education is a medium of preserving, protecting one's values, knowledge, language and tradition. Education facilitates the passing of information from one generation to another. Both formal as well as informal education play an equally important role in the transference of knowledge. This transference of knowledge is found to be more predominant in the secondary stage when students move beyond the limitations of concrete mental operations and develop the ability to think in a more abstract manner. Since logical thought, deductive reasoning and planning come alive at this stage, it is the appropriate stage to develop the understanding that the basis of modern scientific knowledge is derived from traditional knowledge. Indian traditional knowledge reflects deep-rooted values and aspirations of our Indian society. Including traditional knowledge and practices in formal education will enable students to appreciate their culture and heritage. Research also supports that including traditional knowledge in formal education enhances students' ability to apply education in their day-to-day activities. It helps students to understand the similarities, differences and combined possibilities of modern and ancient scientific knowledge. Indigenous knowledge (IK) can act as a powerful tool in a learning environment to teach students (Srikantaiah, 2005).

The need of the hour is to blend modern knowledge with the goodness of traditional knowledge. This will help in drawing upon the strengths of both Indigenous and scientific knowledge systems to help guide humanity through the 21st century. If formal education does not take appropriate account of the traditional knowledge, learners will not be able to connect their learning experiences with their social and cultural environment.

In this context, it is very important to be reminded of the objectives of protection of traditional knowledge as per the intergovernmental committee of intellectual property and genetic resources, traditional knowledge and folklore which include the following:

- Recognise value of traditional knowledge — social, spiritual, intellectual, scientific, ecological, technological, commercial and educational value and acknowledge that traditional knowledge systems are frameworks of the ongoing innovation and distinctive intellectual and creative life that benefit all humanity.
- Promote respect for traditional knowledge systems for the dignity, cultural, intellectual and spiritual values of the traditional knowledge holders who conserve and maintain those systems; and for the contribution, which traditional knowledge holders have made to the conservation of environment, food security, sustainable agriculture and the progress of science and technology.
- Support traditional knowledge systems for their continuing customary use, development, exchange and transmission of traditional knowledge.
- Contribute to safeguarding traditional knowledge and the customary means of their development, preservation and transmission.

From the above discussion, it is very clear that traditional, indigenous or local knowledge needs to be recognised, valued and transmitted in order to conserve it for the future.

Transmission of Ancient Scientific Knowledge

The ancient scientific knowledge and its practice are the result of thousands of years of careful observation, scrutiny and in-depth study of the basic principles of biology, chemistry, physics and mathematics. They are very much relevant to modern science, particularly as they relate to areas such as botany, geology, hydrology, meteorology, astronomy, physiology, anatomy, pharmacology, technology, engineering, ecology, topography, ornithology, fisheries and other applied fields. In the era of globalisation, conserving the traditional knowledge is of utmost importance. It is essential to develop a positive attitude among students towards ancient Indian scientific knowledge and appreciate its relevance in the present time. Utilisation of traditional knowledge and its transmission from generation to generation is the prime need of the hour and it is the joint responsibility of parents, school and society to transmit this hard-earned knowledge to our future generations.

Transmission of traditional knowledge in a holistic manner will only be possible if both parents and school shared the responsibility. So, transmission has to be done through both formal and informal means.

Transmission of traditional knowledge in an informal set-up

Traditional knowledge in general is passed from generation to generation either through parents, other elders of family or Guru. In ancient times, it was transmitted informally through *gurukuls*. This knowledge is usually passed by word of mouth and cultural

rituals, from parent to offspring, from Guru to sishya. Traditional knowledge of music (folklore), arts, medicine, health, hygiene and aesthetic values, etc., was also preserved in families and transmitted from family members to the next generation. During the course of time, due to changes in family system (from joint to nuclear) and social structure, this string of transmission lost its rigour. Traditional knowledge was passed on (through indoctrination) and accepted by many generations as such without questioning its significance and relevance. With time, knowledge of scientific significance behind these practices was lost, as people could not provide the exact reason for performing these rituals and practices to their next generation. And over time, people stopped practising traditional rituals as it was mistakenly assumed that they are not relevant in present times. The present generation should be motivated to ask and explore reasons behind various rituals and practices that are being performed in our families and society. Parents can motivate their children to sit with them and explore their religious texts. Children can be taken to ancient religious places, where they can explore their history and science behind the architecture and rituals performed. Interacting with grandparents and other elders in family and society can also help children to enrich their knowledge about traditional practices. Following Ayurveda or locally prevalent traditional medical practices by parents for common ailments like cold and stomach-ache will help children to learn and respect our traditional medical practices.

Transmission of traditional knowledge in a formal set-up

The teaching-learning process provides immense opportunities to teachers to develop

character and knowledge among students. Through activities and by applying certain content delivery techniques, teachers can motivate students to explore and enhance their knowledge about ancient scientific processes and principles. In order to achieve the objectives of learning and understanding of ancient scientific knowledge, teachers need to explore the scope in content, context, comparison, illustration, delivery and activities in the present curriculum to build the scientific knowledge of their students.

Content: Content is the domain of knowledge and skill in an academic programme. Teachers can enhance the topic by blending the traditional knowledge with modern concept. Teacher can give examples from traditional practices based on present themes. Content could be enriched in a manner that it inculcates respect towards one's culture and knowledge. Information about facts and beliefs of the ancient science related to the concepts in curriculum can be added to enrich the contents. Blending traditional knowledge within the subject can improve scientific knowledge and skills of students. It will help to strengthen their value system and it will foster scientific attitudes of students.

Context: Traditional knowledge can be explained in the context of relevant topics in the curriculum like matter, atoms and molecules, sustainable management of resources, health and hygiene, chemical reactions, metallurgy, etc.

Delivery techniques: Teachers can introduce and integrate the traditional knowledge during the delivery of the content through various activities, demonstration and lectures.

Comparison: Wherever possible, teachers could provide scope to compare and contrast the ancient scientific knowledge and modern science. Students could be provided with the opportunity where they can relate and analyse pros and cons of the ancient practices and current practices. For example, students can be asked to compare pros and cons of using modern day air conditioner and traditional method of hanging wet *khas-khas* on doors and window in earlier times.

Illustrations: Illustrations play an important role in instruction. Teachers can use illustrations to establish a context with ancient scientific knowledge. Since students generally do not find traditional knowledge interesting, illustrations can help to grab students attention, and will improve retention of knowledge. This will ultimately improve students understanding of ancient scientific concepts.

Activities: In order to achieve objectives of developing an understanding of the ancient scientific knowledge and to provide the means of exploration of traditional knowledge to students independently, the following activities can be planned by teachers:

- Interviewing elders on traditional or indigenous knowledge practised by them.
- Surveys related to the topics dealt in the school subjects.
- Literature reviews on various indigenous practices related to the topics learnt.
- Projects on identifying the origin of present day practices and their linkages with traditional knowledge.

- Debates and discussions on the evolution of various practices.
- Album making.

Through these activities, the science discipline, being exploratory in nature, would allow students to explore, contemplate and reason the ancient scientific knowledge.

Objectives of the Study

1. To analyse secondary school textbooks to identify the scope for integrating relevant aspects of the ancient Indian scientific knowledge in secondary school science curriculum.
2. To suggest ways to include ancient scientific knowledge in secondary school science curriculum.

Methodology

The secondary school science text books were analysed to identify the scope for integrating relevant aspects of ancient Indian scientific knowledge in secondary school science curriculum on five criteria, namely— context, delivery of content, illustrations, comparison and deduction. The suggestions were made on how to integrate indigenous or traditional knowledge in the school curriculum.

Analysis and Interpretation

Researchers analysed science text books of secondary stage to see if they help in acquisition and understanding of ancient scientific knowledge and whether there is any scope at instructional level to integrate traditional knowledge in formal education. Content is analysed on five criteria— in what

context, how it is brought (delivery of content), illustrations, comparison and deduction.

Context

- Concepts of matter, atoms and molecules, metals, environment and sustainable management of natural resources. For example, the chapter “Matter in our Surroundings” (Class-9) introduces the chapter with a mention of classification according to Indian philosophers, i.e., “Panch Tatva”. Similarly, in the chapter, “Atoms and Molecules” (Class-9), Indian philosophers are given the credit of devising the atomic theory centuries long ago in 500 BC.
- In the chapter “Acids, Bases and Salts” (Class-10), traditional remedies are suggested wherever possible. Historic references are made regarding common salt and its significance in Independence movement is illustrated.
- In chapter “Metals and Non-metals” (Class-10), information about “the wonder of ancient Indian metallurgy”, presentation is done in a way that it glorifies our past. A few other examples in the Indian context are made, like purity of gold, etc. But the chapter fails to include extraction and prevention of corrosion practices followed by Indians in ancient times.
- Chapter “Sustainable Management of Natural Resource” starts with the Indian belief and philosophy ‘Vasudhaiv Kutumbakam’. A reference of the ancient Indian text *Atharva Veda* is also given. The chapter highlights the uses and management of forest by ancient Indians.

The Sanskrit text with English translation by Devi Chand is incorporated to highlight sustainability and management of natural resources in Vedic times.

- Concepts in biology like life processes, why do we fall ill, etc., fail to make any reference to ancient scientific knowledge of Ayurveda and *Charaka Samhita*.

Delivery of content

- Mainly reference to ancient Indian knowledge is made in the introductory parts of the chapters. The content signifies that roots of modern scientific knowledge lies in our ancient knowledge of science and technology. A few activities are also dedicated to build awareness about our traditional practices. For example— students are asked to observe various traditional practices for conservation of nature in day-to-day life.
- In general, we could say, the content is delivered in a manner that it appreciates our ancient scientific knowledge, acknowledges contributions of our ancient scientists, builds a linkage between modern and ancient knowledge, gives due respect to our traditional methods for being sustainable and protective towards the environment.
- At instructional level a few chapters have the scope to build and enhance students’ knowledge regarding ancient Indian practices. For example, in the Chapter “Why do we Fall Ill” (Class 9) and “Life Processes” (Class 10) teachers can give references from the ancient Indian medical practices,

while demonstrating or explaining the chapter.

Illustrations

- Few concepts are illustrated to strengthen the students' knowledge about traditional practices, like local system of canal irrigation '*kulhs*' practised 400 years ago in Himachal Pradesh.
- Hymns from *Atharva Veda* are illustrated to reveal the utilisation and regeneration principles practised by ancient Indians to preserve natural resources.

Comparison

- Classification of matter and description of atoms are two topics where comparison seems to be drawn, though not so explicitly. Largely comparison between ancient Indian scientific knowledge and practices and modern knowledge is found to be missing in text books.

Deduction

- No where deduction of modern knowledge from ancient scientific knowledge could be located by researchers in text books.

Suggestions as to how to integrate traditional knowledge in the secondary school curriculum

In the light of analysis of secondary school textbooks, the following suggestions are made:

- A short paragraph can be added, wherever possible, to highlight

contributions of ancient Indian scientists to modern scientific knowledge.

- Traditional methods can be given as examples. For example, for purification of water, ancient Indians utilised the knowledge that certain metals disrupt bacteria cycles, including copper. So, in ancient India, brass, an alloy of copper and zinc and sometimes with other metals, was used to store water, which purifies water without using any machinery or chemicals.
- Life sketch and other contributions of Indian philosophers can be included, wherever relevant.
- Terminology used by ancient Indians in describing chemicals can be added as additional information.
- Chapters related to life sciences are framed in the context of modern biology. Framing chapters in accordance with international standards is a good approach. But a few more activities can be included to increase awareness regarding the contribution of Ayurveda and the Indian biologists like Birbal Sahni.
- Since there is no scope to incorporate ancient Indian knowledge with respect to motion, measurement, force and gravitation within the current framework of chapters, some relevant information can be given separately in a box.
- For themes related to health and hygiene, information regarding how people used to protect themselves

from epidemics in ancient times can be added in a box. Or an activity can be given, in which students are asked to collect information about preventive measures taken in their family to protect themselves from infectious and communicable diseases.

- For themes related to sustainable management of natural resources, activities can be included in chapters. Water conservation practices of ancient Indians, irrigation techniques, food grains preservation techniques, etc., can be taken as activity or project work. For example, students can be asked to collect information about preventive and control measures taken in their families before grains are stored for future use.
- To make students aware of our rich traditional knowledge of chemicals, they can be asked to collect information regarding traditional practices followed in their family to neutralise the effect of acids and bases like bee sting, ant sting and what traditional practices are carried out in their homes to prevent oxidation of food products.
- Our ancestors had made a great mark in the field of metallurgy. Crucible steel, Damascus steel, Rasayana, Wootz steel, Dhār iron pillar, early Indian epigraphy, Indian coinage, Iron pillar of Delhi are all proof our rich metallurgical knowledge. Chapters on metal and non-metals can include these topics as additional information to enrich students' knowledge about history of metallurgy in India.

In addition to that activities can be planned by teachers for the same. For example, trips can be planned to historic sites like Dhar pillar in Madhya Pradesh. Students can carry out a project work on the extraction of metals in ancient times or traditional ways of preventing corrosion.

- Names of commonly used metals in Hindi can be provided in a separate box.
- Ayurveda is considered to be one of the oldest known systems of medicine. Regarding two sets of texts form the foundation of Ayurvedic medicine, the *Susruta Samhita* and the *Charaka Samhita*, more information can be added in the text in the context of health and hygiene.
- It is known only to a few that ancient Indians have made a mark in the field of 'electricity' also. Ancient Indian Text "*Agastya Samshita*" dates back to the first millennium BC. It contains a detailed description not only of how to construct an electric battery or cell, but also, how to utilise the battery to 'split' water into its constituent gases.

Modern battery cell resembles Agastya's method of generating electricity. For generating electricity, Sage Agastya had used the following material: One earthen pot, copper plate, copper sulphate, wet saw dust, zinc amalgam. The text says:

संस्थाप्य मृण्मये पात्रे ताम्रपत्रं सुसंस्कृतम्।
छादयेच्छिखिग्रीवेन चार्दाभिः काष्ठापांसुभिः॥
दस्तालोष्टो निधात्वयः पारदाच्छादितस्ततः।
संयोगाज्जायते तेजो मित्रावरुणसंज्ञितम्॥

“Place a well-cleaned copper plate in an earthenware vessel. Cover it first by copper sulfate and then moist sawdust. After that put a mercury-amalgamated-zinc sheet on top of an energy known by the twin name of Mitra-Varuna. Water will be split by this current into Pranavayu and Udanavayu. A chain of one hundred jars is said to give a very active and effective force.”

When a cell was prepared according to Agastya Samhita and measured, it gives open circuit voltage as 1.138 volts, and short circuit current as 23 mA.

Such descriptions should be illustrated in text books, so that students can appreciate our ancestors’ contribution. This will motivate them to relook themselves and revisit the information present in the original text.

- A very important agent of transmission is teacher and the teaching-learning process. To promote respect towards indigenous knowledge, the strategies need to be interactive, exploratory and inquiry oriented in nature. The teacher has to encourage the students to explore the origin, basis, linkages of modern knowledge with the traditional knowledge.
- Research says that the absence of materials and teachers, reluctance or reservations about including it in the classroom are important factors, which affected the transmission of traditional knowledge. Directions or suggested activities may be given at the end of the book; teachers, manual may be developed, which could modify their attitudes and understanding of traditional knowledge.

- As most of the traditional knowledge is transmitted orally, these practices can be recorded and made available to schools, teachers and students.
- The schools need to have support structures, like good books, audio-video resources and freedom to use them as and when they are required.
- The learning environment should be learning-centred where in debates and discussions are encouraged and valued. Community involvement in the context of transmission of traditional knowledge is of paramount importance and hence, it should find place in the school activities.

Conclusion

In the present era, when the world is dealing with several environment issues, it is high time that we seek guidance from our past, which has the treasure of scientific knowledge that was based on the principles of sustainable development. Both formal and informal platform of education should be utilised to transmit our indigenous scientific knowledge to our coming generations. Since textbooks are one of the easily accessible resources, books must be improved in the light of integration of traditional knowledge within the existing school curriculum. Upgrading textbooks will provide an easy route to students to imbibe goodness of our past. It will equip teachers and will promote its smooth transition. Knowing our indigenous scientific knowledge will help students to appreciate their culture for its wisdom and ethics and will further motivate them for future endeavour in the field of science and technology.

References

- Ancient and Modern Science Biology. retrieved from <http://www.wisdomworld.org/setting/biology.html> <http://www.themysteriousindia.net/electricity-in-ancient-india/>
- BERGIN, D. A. AND C. C. BERGIN. 2012. Child and Adolescent Development In Your Classroom (2nd ed.). IEMA Publisher, Cengage Learning, Stamford, Connecticut.
- GRENIER, L. 1998. Working with Indigenous Knowledge: A Guide for Researchers. IDRC. Canada.
- HATCHER, A., C. BARTLETT, A. MARSHALL AND M. MARSHALL. 2009. Two-Eyed Seeing in the Classroom Environment: Concepts, Approaches, and Challenges. *Canadian Journal of Science, Mathematics and Technology Education*. Vol. 9. pp. 141–153.
- INTERNATIONAL FUND FOR AGRICULTURAL DEVELOPMENT. 2003. *Indigenous Peoples and Sustainable Development*, Roundtable Discussion Paper for the Twenty-Fifth Anniversary Session of IFAD's Governing Council.
- LE GRANGE, L. 2007. 'Integrating Western and Indigenous Knowledge Systems: The Basis for Effective Science Education in South Africa?' *International Review of Education*. Vol. 53, Nos. 5–6, pp. 577–591.
- LOUKAS, M. A. LANTERI, I. J. FERRAUIOLA, I. R. S. TUBBS, G. MAHARAJA, I. MOHAMMADALI M. SHOJA, A. YADAV, AND V. C. RAO. 2010. Anatomy in ancient India: A focus on the Susruta Samhita. *Journal of Anatomy*. Vol. 217, No. 6. pp. 646–650.
- PARTHASARATHY, R. 2000. Paths of Innovators in Science' Engineering and Technology. East West Books (Madras) Pvt. Ltd.
- SRIKANTIAH, D. 2005. Education: Building on Indigenous Knowledge. Indigenous Knowledge (IK) Notes; No. 87. World Bank, Washington, DC. World Bank. <https://openknowledge.worldbank.org/handle/10986/10747> License: CC BY 3.0 IGO."
- ZOBOLO, A. M. AND Q. N. MKABELA. 2009. Traditional Knowledge Transfer of Activities Practised by Zulu Women to Manage Medicinal and Food Plant Gardens. *African Journal of Range and Forage Science*. Vol. 23, No. 1. pp. 77–80. <https://doi.org/10.2989/10220110609485889>