

EXPLORING THE SCOPE OF INTEGRATION OF INDIGENOUS KNOWLEDGE OF TRIBAL COMMUNITIES OF JHARKHAND IN SCIENCE CURRICULUM AT ELEMENTARY STAGE

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It is widely known that local communities possess rich repositories of knowledge which are built upon their beliefs, practices and ways of living. National Education Policy 2020 suggests for school curricula which are deeply rooted in Indian contexts. In addition, sustainable ways of life offered by indigenous communities also justify the need for collecting and organising knowledge rooted in the profundity of indigenous societies. Considering science as a way of exploration of nature, it is imperative to appreciate vast knowledge of indigenous societies about nature. Attempt also has to be made to preserve and transmit them through school curricula and textbooks. In this context, this paper seeks to identify indigenous knowledge of tribal communities of Jharkhand by interviewing knowledge experts which would be deliberated for integrating into science curriculum at elementary stage. The study was also aimed at exploring the extent of integration of indigenous knowledge into the science curriculum and teachers' perception regarding the integration by conducting interviews with the teachers, Focus Group Discussion with students and science classroom observations. The study paved ways for collecting indigenous knowledge of tribal communities that can be related to the concepts of science in the existing curriculum at elementary stage. It is also found that the teachers have positive perception towards the idea of integrating indigenous knowledge as it is intended to make the science learning more contextual. However, limited integration could be found in the elementary science classes of Jharkhand. The scope for integration of indigenous knowledge of tribal communities at elementary stage science curriculum is found to be plenty. Positive perception of students regarding integration of indigenous knowledge in science curriculum is promising. This demands efforts from curriculum planners and textbook developers to integrate indigenous knowledge into science curriculum to strengthen the bridge between the realms of science and indigenous knowledge.

Keyword: Indigenous Knowledge, Tribal education, Science Curriculum, Indigenous practices, Cultural Specific Pedagogy

Introduction

Long interaction of societies with their natural surroundings leads to development of perspectives about their world, strongly rooted in their contexts. Consequently, specific knowledge structures with the accumulated understandings and accrued skills are created based on a strong philosophical basis. This is termed as indigenous knowledge. Indigenous knowledge is a unique information about people's beliefs, practices and ways of knowing passed down from generation to

generation in indigenous societies (Mekoa, 2018). Indigenous knowledge refers to the understandings, skills and philosophies developed by societies with long histories of interaction with their natural surroundings (UNESCO, 2017). It gives specific views about the world held by indigenous societies. They possess a worldview, which shapes a unique relationship between people, the living world around them and their territory. National Curriculum Framework for School Education (NCF-SE) 2023 defines indigenous knowledge as the knowledge that an indigenous (local) community accumulates over generations of living in a particular environment.

We need to preserve the essence of indigenous knowledge in this fast-moving world, where we are striving hard to keep up with the pace of scientific advancements and modernity. However, a large portion of the knowledge wealth possessed by indigenous communities are underrepresented and underutilised. It is imperative to consider the ways and means through which indigenous knowledge can be preserved and also transmitted over the generations. School curriculum being the strongest means of nurturing young minds with different world views, presenting indigenous knowledge elements at school level could be considered significant. Science as a discipline of exploring inter-relationships among natural, physical and social world, offers large scope for reconnoitering knowledge and practices of indigenous societies and contemplate on them to frame multiple perspectives and interpretations. Indigenous knowledge focus on how people, other living things and the environment are connected (Welden, Chausson and Melanidis, 2021). If we are to preserve global biodiversity and rewild key habitats, science and indigenous knowledge must work in partnerships (Ogar, Pecl and Mustonen, 2020). Integrating indigenous knowledge into the science curriculum is essential for enhancing awareness of local culture and identity. It is important to understand how culture impacts the development of scientific literacy and the technological skills necessary for individuals to fulfil their roles in a society influenced by science and technology (Pawilen, 2021). The environmental challenges we face today are complex and multifaceted, involving cultural and social factors as well as

scientific and technological ones. While science offers valuable tools for addressing these challenges, it's not enough; indigenous knowledge can also make important contributions (Sindhya, 2018). The importance of integration of indigenous knowledge into curriculum and pedagogy has been recognised by our country and has been reiterated in various policies and documents. NEP 2020 articulates that "all curriculum and pedagogy, from the foundational stage onwards, will be redesigned to be strongly rooted in the Indian and local context and ethos in terms of culture, traditions, heritage, customs, language, philosophy, geography, ancient and contemporary knowledge, societal and scientific needs, indigenous and traditional ways of learning, etc. — in order to ensure that education is maximally relatable, relevant, interesting and effective for the students. Ideas, abstractions and creativity will indeed best flourish when learning is thus rooted". This is reiterated in NCF-SE 2023 that in particular, Indian Knowledge Systems, including tribal knowledge and indigenous and traditional ways of learning, will be covered and included in school subjects. Indigenous knowledge contributes to understanding biodiversity management, various conservation issues, disaster management, organic farming, weather, crafts, value of life, etc., among many other things.

Rationale of the Study

Researchers have echoed the importance of identifying indigenous knowledge. It requires identification, decoding, proper documentation and classification, and only if there is a gradual historical background,

cultural profile can be further understood. Several medicinal and highly nutritious foods have been discovered in the midst of tribal dwellings (Ghosh et al., 2015). Indigenous knowledge is celebrated across the globe as accelerator of sustainability. Way of life of indigenous societies is based on strong sense of interconnection and interdependence. In the case of integration of indigenous knowledge, it is not only important to connect to these knowledge systems, rather the process of acquiring and validating this knowledge also could be incorporated in the curriculum. Tribal communities largely built their indigenous knowledge on intense, continuous observation of nature. Apparently, observation is widely accepted as tool for exploring nature in Western Science. Hence, indigenous knowledge is complementary to science rather than being a contradictory (Agrawal, 1995). There are studies pointing that tensions exist between formal science content, process traditional values and purpose. Science is often considered as universal, while indigenous knowledge is tied to specific cultures and has developed from people's experiences. Although Western science is often seen as the standard, it is important to recognise that indigenous knowledge provides a complete picture of the world, while science focuses on its individual parts. This is a promising way of revelation that how different systems can work in harmony with one another, not in isolation. Indigenous knowledge patterns resemble collective regional thinking based on natural occurrences that integrate both human and non-human thought, such as scientific information ingrained in the local culture.

Educational studies conducted across tribes in India have indicated that majority of the tribal students face difficulty in understanding subjects taught in the class. It is found that, it is mainly due to its irrelevance with respect to their day-to-day life. Such result from the learners of the particular section of the society has been explained on the basis of their poverty, inability to relate to the content and language adopted in the classroom (Manojan, 2018; Kumar, 2008). Parents and elders from the community are also of the impression that children are not sufficiently aware of the traditional knowledge of their community and they want to preserve it through their younger generation. They look up to the education system as a tool to transmit their traditional knowledge to the younger generations. Community leaders of indigenous groups have expressed concern about the schools' qualifications being of little practical use as it does little for the development of practical skills and traditional values (Keane, 2012; Manojan, 2018). These argumentations are sufficient to initiate discussion on how culturally rooted curriculum is more inclusive.

Though the studies of identifying indigenous knowledge of tribal communities are limited, the existing literature suggests some of the topics, wherein indigenous knowledge can be integrated—medicinal and edible plants, weather, river dynamics, seasons, food gathering and preservation, indigenous way of classifying plants and animals, making drinks from local fruits, navigation, animal behaviour and habitat, tides, erosion and relocation, tools and technology, snow

and ice, landforms, shelter and survival, anatomy, use of local materials, etc. (Monika & Lal, 2018; Pawilen, 2021). Understanding and appreciating the vast knowledge base of indigenous societies is the stepping stone. More researches are needed to identify age-appropriate indigenous knowledge and integrate them into the contemporary science curriculum by looking into local authentic sources of knowledge. Jharkhand is an eastern state of the country, which is known for contribution of diverse tribal communities, such as *Mundas, Oraons, Kharias, Hos* and *Santhals*. The current research has been taken up with the aim of exploring the idea of integrating their rich indigenous knowledge with formal school science curriculum at elementary stage. A comprehensive literature review revealed a limited number of studies directly addressing the integration of indigenous knowledge into school science, particularly in the context of Jharkhand. This scarcity of research highlights the need for further investigation in this area, especially considering the implementation of National Education Policy 2020.

Objectives

1. To identify indigenous knowledge of tribal communities for integrating in elementary stage science curriculum of Jharkhand.
2. To study the perception of teachers about integration of indigenous knowledge of tribal community

into the elementary stage science curriculum.

3. To examine the extent of integration of indigenous knowledge in the pedagogical processes at elementary stage science curriculum.

Research Questions

1. What kind of indigenous knowledge can be integrated in the elementary stage science curriculum?
2. What is the perception of teachers towards integration of indigenous knowledge into the elementary stage science curriculum at Jharkhand?
3. To what extent is indigenous knowledge of Jharkhand integrated in the science pedagogical processes at the elementary stage?

Method and Sample

An exploratory research approach has been adopted to study indigenous knowledge of tribal communities for integrating in elementary stage science curriculum of Jharkhand. Purposive sampling method was adopted as the study was focusing on the indigenous practices of specific tribal communities. Five knowledge experts were selected on the basis of their experience with the tribal culture and practices. A brief profile of these experts is given below, which served as the basis for selecting them for the study.

	Knowledge Expert 1	Knowledge Expert 2	Knowledge Expert 3	Knowledge Expert 4	Knowledge Expert 5
Age	56	73	82	56	85
Gender	Male	Male	Male	Female	Female
Basis of Selection as a Tribal Knowledge Expert	A social leader, writer in tribal magazines, composer of numerous songs based on folk and seasonal melodies and an expert player of tribal musical instruments.	Founder of first Anglo-Kurukh medium school, an institution that integrates traditional tribal knowledge with contemporary educational practices.	Conducts research on tribal culture, writes books and articles on tribal culture, customs and traditions, composer of numerous songs based on folk and seasonal melodies.	Interested in tribal culture and traditions, works to transfer it to school children.	Long experience with the tribal culture.

Ten schools in Gumla district were selected, where majority of students are from tribal communities. From each school, 10 tribal students of Class 8 were selected randomly. Two elementary science teachers from each school also participated in the study. Thus, total 5 knowledge experts, 100 students and 20 teachers became part of the study. Thematic analysis and content analysis techniques were employed for data analysis.

Tools

The following self-developed tools were used for collecting data for the study:

- Semi-structured interview schedule for local knowledge experts to identify indigenous knowledge of local tribal communities for integrating in the elementary stage science curriculum of Jharkhand.
- Semi-structured interview schedule with teachers about integration of indigenous knowledge of tribal community into the elementary stage science curriculum.
- Observation schedule to examine the extent of integration of indigenous knowledge in the elementary stage science curriculum. The items were included from various dimensions such as introduction, presentation, assessment, use of resources and pedagogical strategies used.
- Focus group discussion with students to elicit responses of students related to integration of indigenous knowledge in science pedagogical processes.

Analysis and Findings

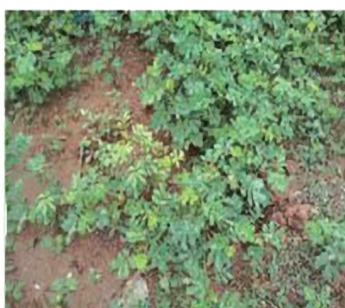
Identification of indigenous knowledge of tribal communities for integrating in elementary stage science curriculum of Jharkhand.

The responses of knowledge experts related to various themes related to school science are tabulated and classified. The richest area of indigenous knowledge identified was in the domain of food. The following table depicts the knowledge identified under the theme—Food and Nutrition.

Table 1: Concepts Identified under the Theme—Food and Nutrition

Major Concepts and Exemplars		Benefits (As suggested by the knowledge experts)
Grains	<i>Kulthi daal</i> (horse gram)	It is hot in nature; a protein-rich lentil beneficial for <i>pathri</i> (kidney stones)
	<i>Ragi</i> , maize, <i>gondli</i> (little millet)	Rich in fibre, powdered ragi, gondli and maize are eaten as halwa and chapati.
Root	<i>Taal Mooli</i>	Beaten to make medicine for clear stomach, helps increase appetite and is an energy booster.
Leaves	<i>Phutkal</i> (<i>Ficus geniculata</i>)	Beneficial for indigestion, it is dried and eaten as a substitute of daal.
	<i>Beng saag</i> (<i>Centella asiatica</i>)	Memory booster, eaten raw as chutney and curry
	<i>Chimti saag</i> (<i>Polygonum plebijum</i>)	Good for digestion, eaten as curry
	<i>Saru saag</i> (<i>Colocasia anti quorum</i>)	Good for digestion, eaten as curry
	<i>Sarla</i> (<i>Vangueria spinosa</i>)	Source of fibre, eaten as curry
	<i>Munga</i> (<i>Moringa oleifera</i>)	Leaves, flowers and fruit are consumed as immunity booster.
	Others: <i>Khapra saag</i> (<i>Trianthema monogynal</i>), <i>Siliyari saag</i> (<i>Celosia argentia</i>)	
Flowers	<i>Jhirhul</i> (<i>Indigophera pulchella</i>)	Eaten as chutney, gravy, etc.
	<i>Sanai</i> (Sunn hemp)	Eaten as chutney, gravy, etc.
	<i>Mahua</i> (<i>Medhuca longifolia</i>)	Fresh flower is boiled and consumed to cure sun stroke.
Fruits	<i>Chiraunji</i> (Charoli nut)	Rich in fat, has a high market value; it is used in sweets
	<i>Kendu</i> (<i>Diospyros melanoxylon</i>)	Rich in fibre


Exotic food	<i>Demta</i> (Red weaver ants)	Eaten fried or as chutney
	<i>Tumbil</i> (Wild bee larvae)	Eaten fried or as chutney
	<i>Gongha</i> (Snail)	Eaten fried or as chutney

*Beng saag* (*Centella asiatica*)*Chakod* (*Cassia lora*)*Phutkal*; fresh (*Ficus geniculata*)*Sarla saag* (*Vangueria spinosa*)*Gethi kanda* (*Dioscorea bulbifera*)*Ghongi* (*Helix pomatia*)*Jhirhul phool* (*Indigophera pulchella*)*Hirmichiya saag* (*Enhydra fluctuans*)*Mandua* (*Eleusine coracana*)**Fig. 1. Indigenous food of tribal communities of Jharkhand**

The next table enlists knowledge identified in various other fields related to topics from elementary stage science syllabus.

Table 2: Concepts Identified under Other Themes Related to Elementary Stage Science Curriculum

Major Concepts	Benefits <i>(as suggested by knowledge experts)</i>
Rainwater harvesting	Tribal communities of Jharkhand mostly have slanting terrace, it helps in easy flow of rainwater down the slope. The rainwater is used for immediate needs such as washing dishes. In agricultural fields, small holes known as dobha are dug to collect rainwater. The wastewater generated after performing chores is collected in a pit just beside the place that facilitates the rejuvenation of groundwater level.
Roots	<i>Gethi kanda (Dioscorea bulbifera)</i> , <i>Taal mooli</i> , (beaten to make medicine for clear stomach, increase appetite and is an energy booster.
Leaves	<i>Hirmichiya (Enhydra fluctuans)</i> supports immunity and digestion; <i>Saru saag (Colocasia anti quorum)</i> supports digestion; <i>Chimti saag (Polygonum plebijum)</i> regulates blood sugar level and <i>Siliyari saag (Celosia argentic)</i> low in calorie, good for heart health.
Flowers	Karanj (Pongame oiltree) flower is decomposed to make manure. Moringa and banana flowers are consumed as food.
Vegetative reproduction	Potato, ginger, sugarcane, banana, rose, garlic, <i>phutkal</i> , <i>Moringa</i> , <i>Bryophyllum</i>
Sexual reproduction in plants	Papaya trees are planted in pairs to facilitate artificial pollination.
Excretion in living beings	Excreta of hen, pig, goat and cow is decomposed to make manure.
Adaptation in plants and animals	<i>Saal</i> , a temperate tree, imbibes water during monsoon and sheds leaves during summer.
Separation of materials	<i>Ragi</i> , pigeon pea and urad (black gram) are beaten to separate the grains from the stalk.
Measurements	Use of <i>paila</i> (a measuring utensil)
Plant fibre	<i>Sanai</i> (Sunn Hemp) and <i>Kudrum (Hibiscus cannabinus)</i> sticks are sources of fibre; plant is dipped in water for 3–4 months and fibre is extracted.

Weaving	<p>A thick cotton cloth called <i>padia</i> is woven with the help of <i>charkha</i>. The clothes are dyed using beaten barks of <i>chaili</i> tree.</p> <ul style="list-style-type: none"> Traditional hand-woven mats made with palm leaves.
Musical instruments	<i>Mandar, nagara bansuri, ghunghru, thechka</i>
Lightening safety	At the time of heavy thundering, iron or copper ware is thrown out of the house, perhaps with a thought that it will direct the lightning strike out of the house.
Constellation	Two main constellations were mentioned <i>khatipaaon</i> and <i>harjuaat</i> . Their position in a particular season were used to estimate time.
Measures to reduce friction	<i>Karanj</i> (Pongame oil tree) oil is used to grease the movable parts in doors, dheki, etc.
Sonorosity	 <p>As an alternative to sonorous material, bells for cattle are made out of wood.</p>
Fermentation	Rice is fermented to get alcoholic drink called <i>hadia</i> .
Preservation of food	<ul style="list-style-type: none"> Cooked rice can be prevented from decay by soaking it in water; however, water should be changed every day for it to be edible for up to 3–4 days. Mango, <i>kendu</i>, etc., are dried and stored. Leaves like <i>brahmi</i>, <i>Moringa</i>, <i>phutkal</i> (<i>Ficus geniculata</i>) are dried and stored for future. Meat is salted and boiled to extend its edibility. Many food items are dried on the hot surface behind the burners, made of mud.

Gravitation and beating involved in various agricultural practices are based on the principle of gravity.

- *Okhal*



- *Dheki*



Menstrual hygiene

Cotton clothes were boiled in ash mixed water to sterilise.

Adolescent health practices

Mixture of jaggery and *beng saag* (*brahmi* leaves) is given to adolescent girls for menstrual health.

Agricultural practices

Onion cultivation aided by pig excreta as manure remains fresh for longer days. (Cold storage isn't required)

Irrigation





Rahat system of irrigation was used in the area.

Protection from weeds

To prevent the growth of weeds, *pechki* and turmeric is covered with dry leaves.

Manure and fertiliser

Ash along with excreta of hen, pig, goat and cow is decomposed to get manure. Compost of *Karanj* flower has antiseptic property.

Storage	<ul style="list-style-type: none"> • <i>Morah</i>: Grains are stored in <i>morah</i> made by weaving rice straw tightly into a basket-like structure. It was lined with mud to make it airtight. Seeds stored in such arrangement have better germination power. • <i>Chhatka</i>: Big compartments made by weaving bamboo. 
Agricultural tools	<ul style="list-style-type: none"> • Plough • <i>Paata</i>  • <i>Juwat</i>  • <i>Dhelpasa</i>
Crop rotation	<i>Urad</i> cultivation is followed by paddy or <i>ragi</i> .
Packing of food	<ul style="list-style-type: none"> • Bowls made of leaves are used to pack food. • A bottle guard is scraped out of its pulp to get a container. It is used to carry around food and water. 

Conservation of forests	Tribals worship trees, hence they plant more and more trees. Even if the trees are cut for some use many more plants are planted.
Prevention of soil erosion	<ul style="list-style-type: none">• Step farming• Planting shrubs, trees, grass on the ridges of the field.
Products from forests	<ul style="list-style-type: none">• Tribals consume <i>Gethi (Dioscorea bulbifera)</i>, <i>Kusum (Schleichera oleosa)</i>, <i>Karanj</i> (Pongame oiltree), <i>Pithaur</i>, <i>Chaar</i>, <i>Meda (Litsea glutinosa)</i>, mushroom, <i>putu</i>, spices, etc., directly from forests.• <i>Sarai</i> (fruit of <i>Saal</i>) is used in snacks, resin is used for making incense.• <i>Mahua (Madhuca longifolia)</i>: fresh flower is boiled and consumed to cure sun stroke; fermented to make alcohol; fruit is used to make medicinal oil.• <i>Chaar</i>: exchanged for salt, high valued.• Resin of <i>Dumbar (Ficus racemosa)</i> and <i>Chaar (Buchnanian lanzan)</i> is used as gum.

Perception of Teachers on Integration of Indigenous Knowledge of Tribal Community

A total of 20 science teachers of elementary stage were interviewed using a semi-structured interview schedule. The interview schedule was split into various dimensions and the dimension-wise analysis has been presented below.

Perception on integration of indigenous knowledge of tribal community

Out of 20, 19 teachers agreed that indigenous knowledge of tribal communities should be integrated in the science curriculum at elementary stage. The basic knowledge of children is based on the experiences centered around tribal communities. They opined that integrating indigenous knowledge in science curriculum would make concepts

of science more relatable to the learners from tribal background and hence, make the understanding of the concepts easier and joyful. They added that integration of indigenous knowledge of tribal community would help tribals to know their survival techniques, understand their culture, identity and rights. Integration would be beneficial for both the tribals and non-tribals. On one hand, it would make learning more contextual and comprehensive and on the other, it will serve to preserve and transmit the indigenous knowledge of tribal communities from one generation to another and from one community to the other.

Most of the teachers negated the idea of possible increase in burden on the teachers and learners as a result of integration. A few were of the idea that science syllabus of the state is not so vast as compared to other boards of education, hence newer

topics from the indigenous knowledge of tribal communities can definitely be included. According to a few, science curriculum should be more utilitarian and practical, therefore, a few topics could be omitted from the syllabus and those from the tribal knowledge can be included in the curriculum. If the judicious use of time is made to transact the textbook content and simultaneously integrate the indigenous knowledge by means of relevant examples, storytelling, etc., there will not be a problem as suggested by teachers. Moreover, effective integration of the indigenous knowledge would improve interest and attention level, making learning active.

One of the teachers opined that, “Today, tribal knowledge is not restricted to the tribals only, they have travelled across communities. I’m from a non-tribal background but *Maad-jhor* and *sukti*, which are said to be the food of tribals are my favourites”.

Existing integration of indigenous knowledge of tribal community in the curriculum

Most of the teachers said that they do not find integration of tribal knowledge in the textbooks however they integrate examples from tribal context wherever possible.

Teachers were mostly unsatisfied with the integration level of tribal knowledge in the science textbook of the state. They opined that there is much scope and need to integrate the indigenous knowledge of tribal communities into the elementary stage science curriculum.

Training received on integration of indigenous knowledge of tribal community

None of the teachers had received any training on integration of tribal knowledge

into the science curriculum at elementary stage. However, a few mentioned that during the teacher-education programme they were given inputs to make the teaching-learning more contextual according to the background of learners.

Ways to integrate indigenous knowledge of tribal communities

most of the teachers think giving relevant example as a primary and effective way of integrating indigenous knowledge of tribal communities in the science classes. Few suggested to connect the topics of science to the tribal contexts through demonstration method. A few suggested to arrange awareness programmes on tribal food, health and other topics. Various competitions, such as drawing competition and speech competition on themes of tribal culture and knowledge can be conducted to foster the integration at inter-class and inter-school levels.

Suggested topics for integration of indigenous knowledge of tribal community

The interviewees suggested a number of topics where tribal perspective can be integrated. Various suggestions have been sorted under content, process and value.

At content level: Tribal perspective to food, medicine, natural resources, sustainable use of resources, sources of fibre, local tool and techniques of measurement, techniques of preserving food, organic farming, separation of materials, metals and non-metals.

At process level: Observation and exploration.

At value level: Hard work, perseverance, cooperation, celebrating work, celebrating life, honesty and coexistence.

Extent of integration of indigenous knowledge in the pedagogical processes at elementary stage science curriculum

To examine the extent of integration, data obtained from two tools, namely classroom observation schedule and focus group discussion (FGD) with students were analysed and presented below.

Integration through language

On analysing the classroom observation reports and FGD with students, it was found that there is limited integration of indigenous knowledge through integration of indigenous language.

Integration of indigenous knowledge through integration of tribal language was seen during classroom observation in very few instances. Out of 20 classroom observations, only in 4 observations did the teachers present the alternative local terms for different concepts. In lesson 'Living and their Habitat', '*bhasam patta*' for bryophyllum and '*ropa*' for 'plantation' were used. '*Bakla*' for 'bark' in lesson 'Cell' was used. Students in an occasion came up with local examples in their tribal language. *Sukti*, *Maad jhor* and *Putu* were brought by children which are tribal food items.

Integration of indigenous knowledge through integration of indigenous language was supported by the students in FGD. All the 10 groups were of the opinion that they speak their respective tribal languages that are *Kurukh*, *Munda*, *Kharia*, *Asur*, etc., 6 out of 10 groups agreed that teachers use tribal/local language (mostly *Sadri* and *Kurukh* as it is understood and spoken by the majority in the area) to make concepts clear.

Integration of indigenous knowledge was seen in limited instance in the form of examples. 4 out of 20 classroom observations show integration of tribal knowledge in form of examples. At an instance, students mentioned *sukti* that is a dried leafy vegetable chutney, and *rugda* (a type of mould) as examples of food. In another instance, in the context of uses of metals, students mentioned *paila* (a measuring bowl) used among tribals.

All the FGD groups agreed that teachers cite local examples during the teaching-learning to make teaching points easy and simple.

Integration through traditional activities

In one out of 20 observations, integration of indigenous knowledge in the form of integration of tribal culture was seen. In lesson 'Water', a tribal culture was mentioned, where a guest is always welcomed by washing their feet with cold water. Integration in the form of tribal art and folk tales were not observed in any of the classes.

In FGD, 4 out of 10 groups said that their culture and traditions are brought into science classes. 7 out of 10 groups said that cultural dance and music is promoted through tribal cultural dance competitions held at intra and inter-school levels. Teachers are involved in teaching and training them the tribal music and dance skills.

Integration through TLMs, role play, physical activities and blackboard work

Integration through role play, physical activities and blackboard work was not seen in any of the classroom observations.

Major Findings of the Study

- Teachers hold a favourable view on incorporating the indigenous knowledge of tribal communities into the science curriculum at the elementary level.
- Students show eagerness towards integration of indigenous knowledge in their classroom.
- There is limited integration of indigenous knowledge of tribal communities in science textbooks and in classroom transaction at the elementary stage. There is a scope for the integration of indigenous knowledge of tribal communities into the elementary stage science curriculum.
- Teachers from tribal communities showed higher extent of integration of the indigenous knowledge in their classroom teaching-learning practices.
- Teachers receive no training on the subject of integration of indigenous knowledge in science teaching-learning at the elementary stage.
- Integration of indigenous knowledge in the elementary stage science curriculum finds possibility at the level of content, process and values.
- **At content level:** Tribal perspective to food, food and nutrition, its packing and preservation, life processes of plants, agriculture practices and management, resources from forest, medicine, natural resources, products from forest, sustainable use resources,

coexisting sources of fibre, local tools and techniques of measurement, techniques of preserving food, organic farming, separation of materials, metals and non-metal.

- **At process level:** Observation and exploration.
- **At value level:** Honesty, hard work, perseverance, cooperation, celebrating work, celebrating life and coexistence

Discussion

The present study attempted to explore the possibility of integrating indigenous knowledge of tribal communities of Jharkhand. The study was conducted through consultations with the knowledge experts in order to identify indigenous knowledge and practices of tribal communities. Classroom observations and FGD with students were conducted to see integration of indigenous knowledge with reference to the identified knowledge. The teachers were interviewed regarding their perceptions on the subject of integration of the indigenous knowledge of tribal communities into the elementary stage science curriculum.

The study shows that there is a scope for the integration of indigenous knowledge. The experts have assented to the integration of indigenous knowledge as an important step to make science learning better. Learning becomes concrete and easy when contextualised. Integration of tribal knowledge in any curriculum must be at the level of language, cultural traditions and identity. As per the expert, the first level of integration is the integration of mother tongue that instils confidence among the learners. Hence,

contextualising learning is the priority. For integration of the indigenous knowledge, an attitudinal change towards tribal knowledge is required. A shift from disregarding the tribal knowledge to appreciating it is needed. Integration of indigenous knowledge of tribal communities can be done effectively by conducting teaching-learning in a natural setting. School can be reimagined as a house of exploration rather than a domination of imitation.

Science includes human activities such as research, procedures, attitudes and opinions. Science does not only consist of the content but also circles around certain processes and values. While interacting with the local knowledge experts, knowledge and practices which could be integrated in the elementary stage science curriculum were identified. At content level, tribal perspective to food and nutrition, life processes of plants, agricultural practices and management, resources from forest, medicine, natural resources, products from forest, sustainable use of resources, coexisting, sources of fibre, local tool and techniques of measurement, techniques of preserving food, organic farming, separation of materials, metals and non-metals, etc., were identified. The processes mainly adopted by the tribes are observation, exploration and investigation, which were found to be in line with science processes and hence, were categorised as indigenous knowledge to be integrated at the process level of science. Attributes, such as honesty, hard work, perseverance, cooperation, celebrating work, celebrating life, etc., were identified as indigenous knowledge to be integrated as value in science. Similar findings were also observed in the study conducted by Sindhya (2018).

This study has found that teachers have a positive perception towards the idea of integration of indigenous knowledge of tribal communities. Teachers have suggested that integration would help in better understanding of the science content. It will also benefit both tribal and non-tribal students as it presents rich authentic knowledge of their locality. Students had shown positive responses about including their cultural practices into pedagogical processes of science. The study has found that students enjoy the learning process when concepts are related with tribal context. This is in alignment with the findings of Manojan (2018) as he pointed out the importance of relating the tribal context into school curriculum and thus, dropout rate among them could be regulated.

Limited integration of indigenous knowledge of tribal communities was seen in classes at schools. This can be owed to the lack of awareness among teachers regarding indigenised teaching-learning. Most of the teachers are not aware of the indigenous knowledge and practices of tribal communities that could be integrated with their classroom practices. Most probably, since teachers are not oriented on culturally sensitive pedagogies, they might be focusing on the pedagogy based on the universal nature of science. Another reason could be that the textbooks also present limited extent of integration of indigenous knowledge of the tribal communities. Therefore, there is a need to reorient the curriculum development that gives clear guidelines to teachers to incorporate indigenous knowledge at various points of pedagogical processes. At the same time, textbook writers need to include more content and provide better opportunities for exploration of the indigenous knowledge by students in their own tribal surrounding.

There is also a need of in-service and pre-service training for teachers on the subject to empower them to execute the expected development in the curriculum and textbooks effectively.

Educational Implications

Findings of the study have some significant suggestions for policy makers, curriculum developers, textbook writers and teachers.

- Policy makers should make integration of indigenous knowledge an important consideration during policy making.
- Curriculum planners should give proper guidelines for effective integration of indigenous knowledge.
- Textbook writers should consciously explore the possibilities of integrating indigenous knowledge in books.
- Teachers should be trained to integrate indigenous knowledge in the pedagogical processes.
- Pre-service and in-service teacher training should be conducted for better execution of indigenous knowledge base into the classroom practices.

Conclusion

In modern times, as people adjust to the changes brought about by technology and science, it is imperative that they preserve their cultural legacy and the sense of self. In order for people to fulfil their duties and perform social functions in a society that is formed by science and technology, it is essential to recognise the importance of culture in the development of scientific literacy and technological abilities. Guided by the similar thought, this study has attempted to explore the knowledge rooted deep into the tribal setting and to find ways to integrate it into the science curriculum at elementary stage. It is seen that teachers and students both have positive perception regarding the integration of indigenous knowledge but its integration into the classroom poses significant challenges. Thus, there is a pressing need for reforms in order to effectively incorporate indigenous knowledge into the curriculum and calls for in-service and pre-service training of teachers on the subject to empower them to execute the expected development in the curriculum and textbooks effectively.

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Appendix 1

Tools Used

TOOL-1

Integration of Indigenous Knowledge of Tribal Communities in Science Curriculum at Elementary Stage of Jharkhand

Semi-structured interview schedule for local knowledge experts

1. What is your name?
2. How have you been?
3. Do you think that indigenous knowledge of tribal communities should be integrated in science curriculum at elementary stage?

I have a few points from science syllabus of elementary stage. I would like you to kindly share your knowledge from your tribe on them.

S. No.	Major concepts	Tribal Knowledge
1.	Tribal food items	
2.	Nutrients	
3.	Balanced diet	
4.	Deficiency diseases	
5.	Medicinal practices	
6.	Water cycle	
7.	Rainwater harvesting	
8.	Herb, shrub and tree	
9.	Roots	
10.	Leaves	
11.	Flowers	
12.	Photosynthesis	
13.	Synthesis of plant food other than carbohydrate	
14.	Vegetative reproduction	

15.	Spore formation	
16.	Sexual reproduction in plants	
17.	Rumination	
18.	Gut health	
19.	Movement in living beings	
20.	Reproduction in living beings	
21.	Respiration in living beings	
22.	Excretion in living beings	
23.	Habitat (terrestrial, aquatic, aerial)	
24.	Adaptation in plants and animals	
25.	Underwater plants	
26.	Migrant birds and animals	
27.	Separation of materials	
28.	Winnowing	
29.	Sieving	
30.	Sedimentation	
31.	Filtration	
32.	Vapourisation	
33.	Any other technique of separation	
34.	Neutralisation (treating ant, bee stings)	
35.	Sources of light	
36.	Propagation of light (application)	
37.	Measurements: (i) Length (ii) Time (iii) Speed	
38.	Plant fibre	
39.	Animal fibre	

40.	Weaving	
41.	Electricity	
42.	Magnet	
43.	Ductility	
44.	Malleability	
45.	Sonorosity	
46.	Thermal conductivity	
47.	Electric conductivity	
48.	Alternative colour-based indicators	
49.	Fermentation	
50.	Vaccination	
51.	Microorganisms for agriculture	
52.	Preservation of food	
53.	Electroplating	
54.	Force	
55.	Gravitation	
56.	Atmospheric pressure	
57.	Adolescence education	
58.	Menstrual hygiene	
59.	Adolescence health practices	
60.	Metamorphosis	
61.	Reflection of light	
62.	Refraction of light	
63.	Measures for eye care	
64.	Type of soil in the area	
65.	Rabi crops	
66.	Kharif crops	

67.	Carbohydrate-rich crops	
68.	Protein-rich crops	
69.	Fodder crops	
70.	Fibre crops	
71.	Agricultural practices	
72.	Preparing of soil (tools, techniques)	
73.	Sowing	
74.	Irrigation	
75.	Protection from weeds	
76.	Manure and fertiliser	
77.	Harvesting and processing	
78.	Storage	
79.	Agricultural tools	
80.	Crop rotation	
81.	Solar system	
82.	Constellations	
83.	Comets	
84.	Friction	
85.	Measures to reduce friction	
86.	Packing of food	
87.	Musical instruments	
88.	Music	
89.	Controlling noise pollution	
90.	Transfer of charge	
91.	Lightening safety	
92.	Earthquake	
93.	Safety measures for storms	

94.	Air pollution	
95.	Water pollution	
96.	Sources of potable water	
97.	Greenhouse effect	
98.	Conservation of forests	
99.	Conservation of water	
100.	Prevention of soil erosion	
101.	Products from forests	
102.	Folk songs and tales that speak about above concepts	
103.	Other practices/knowledge	

Appendix 2

TOOL-2

Integration of Indigenous Knowledge of Tribal Communities in Science Curriculum at Elementary Stage of Jharkhand

Interview schedule for teachers

1. Do you think that indigenous knowledge of tribal communities should be integrated in the science curriculum at elementary stage?
2. Do you find integration of indigenous knowledge of tribal communities in the science curriculum?
3. Are you satisfied with the extent of integration of tribal knowledge in the science curriculum?
4. Have you received any training on integration of tribal knowledge into the science curriculum at elementary stage?
5. What measures do you take to integrate indigenous knowledge of tribal communities in the science curriculum?
6. What topics (from indigenous knowledge) would you suggest to add into the science curriculum to make it more relatable to the students?
7. What is your thought on the integration of newer topics (indigenous knowledge of tribal communities) in the already vast science syllabus at elementary level?

Appendix 3

TOOL-3

Integration of Indigenous Knowledge of Tribal Communities in Science Curriculum at Elementary Stage of Jharkhand

Focus Group Discussion (FGD) with Students

Points for Discussions

Introductory Discussion

1. Which place do you belong to?
2. Which class do you study in?
3. Which tribe do you belong to?

Main Discussion

4. What language do you speak at home?
5. Is your language spoken in the classroom (when needed)?
6. Do you relate to all the examples given in the textbooks?
7. If not, do teachers give your local examples (such as local technique of filtration, local food and medicine, local simple machines and tools, etc.) to explain the topics?
8. Are you aware of the traditional activities unique to your tribe? (Tribal art, music, storytelling, 'akhaada', etc.)
9. Do your teachers mention those activities during teaching-learning?
10. Would you prefer if such activities were included more frequently in teaching-learning?
11. What festivals do you celebrate in your communities? How these festivals are celebrated in your school?

Concluding Question

12. Can you suggest some examples from your culture to add in the curriculum?

Appendix 4

TOOL-4

Integration of Indigenous Knowledge of Tribal Communities in Science Curriculum at Elementary Stage of Jharkhand

Observation schedule to examine extent of integration of indigenous knowledge

Classroom Activities		Observation
1.	Introduction of the topic (Relevance to students' life)	
2.	Explanation of concepts related to daily-life experiences	
3.	Contextual examples used/elicited	
4.	Improvised TLMs/local resources	
5.	Involvement of students	
6.	Use of tribal art	
7.	Use of folktales	
8.	Opportunities for students to express their experiences in relation to the concepts such as role play	
9.	Physical activities—Integration of traditional or local games	
10.	Languages used in the class	
11.	Assessment (Continuous, reflective questions and alternative modes used)	