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Indigenous Mathematical Knowledge and Oral Traditions in Jharkhand: An Explorative Study of Tribal Learning Practices

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ABSTRACT

The Oraon, Munda, Kharia, Santhal, and Ho, among others, reside in Jharkhand. Each tribe has its own unique customs and diverse systems of knowledge. Schooling in the tribes was predominantly oral, done through stories, songs, and folklore. It encompasses useful skills such as agriculture, hunting, medicine, community leadership, spiritual practices, and a compassion for nature. Tribal elders were the primary educators as they shared knowledge accumulated from life experiences through storytelling. Through these indigenous systems of knowledge, mathematics was part of life and culture in holistic ways. Activities like farming, construction, trade, and craftwork already had an element of estimating, measuring, and counting. For instance, tribal societies used sticks, marbles, and other local materials for counting and basic arithmetic-methods that were contextually relevant and easy for children to understand. Such mathematical practices were rooted in the community, focusing on true and relevant issues that would benefit the people. The tribal people of Jharkhand have taught and understood mathematics with culture in mind, which makes it relevant to their lives. For example, recent educational projects have aimed to convert mathematics textbooks into tribal languages such as Ho, Santhali, Mundari, Kudukh, and Kharia, using local contexts to enhance teaching efficacy for primary school learners. By employing traditional teaching tools and methods, tribal people protect lost forms of mathematical knowledge and ensure they are taught and learned. Knowledge in tribal societies is often acquired and taught communally, such that it is disseminated and enjoyed in groups, which strengthens social relations and cooperative solutions. The Objective of the study is to identify the role of the tribes of Jharkhand in understanding of mathematics. Data sources include the review of related literature. The study explores the ways in which traditional mathematics-based on oral tradition, interactive engagement with nature, and group learning-traditionally have determined mathematical ideas such as number, measurement, and spatial thinking. Through a reading of modern schooling programs, such as mother-tongue math textbooks using indigenous illustrations (sticks, marbles, and seeds) and biliterate curricula.

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INTRODUCTION

The Jharkhand state is home to a rich tapestry of indigenous peoples, the Santhal, Munda, and Ho being among the most significant and historically powerful. Not only did these groups create the cultural and social fabric of the area but also enriched its intellectual and educational heritage. These groups traditionally acquired knowledge through oral transmission, the passing of information through stories, songs, folk tales, and rituals, emphasizing practical knowledge such as agriculture, resource management, and communal living (*The Educational Contributions of Jharkhand*, 2025). Mathematical understanding, in fact, was an integral part of daily life-expressing itself in the measurement of land, the estimation of crops,

building, and trade-rather than formal education(*The Educational Contributions of Jharkhand*, 2025).

In spite of experiencing setbacks like low literacy rates and restricted access to formal education relative to state levels, these tribes have shown rich, context-specific mathematical engagement. Recent trends, such as the incorporation of mathematics education into tribal languages like Ho and Santali, reflect continued attempts to integrate indigenous knowledge systems with formal education. This research aims to determine and examine the contribution of the Santhal, Munda, and Ho tribes of Jharkhand to the knowledge of mathematics, examining how their traditional practices, cultural context, and changing educational experiences contribute to mathematical cognition and learning in these societies. Through traditional knowledge, identity creation, and cultural integration, indigenous learning in South Asian tribal communities-like the Santals-can be incorporated into contemporary educational institutions. With about 6.5 million members, the Santhals are India's third-largest tribal group. In the Chhota Nagpur area, they are by far the largest tribal group. Nevertheless, three state borders split them apart, shattering their motherland even though they live in a contiguous geographical area (Dutta & Sinha, 2022).

Objective of the Study

The aim of this research is to investigate and account for the contribution of the Santhal, Munda, and Ho tribes of Jharkhand towards the shaping and positioning of the construction of mathematics. Through their indigenous knowledge systems and the integration of native mathematical concepts into daily life, the research aims to highlight the manner in which these tribal communities enrich mathematical knowledge and education in the region

Methodology of the Study

This literature review was systematic in its approach to identification, selection, and analysis of scholarly research and allied sources on the Santhal, Munda, and Ho tribes of Jharkhand's contribution to understanding mathematics. The research began with the formulation of clear objectives and research questions, with emphasis on how indigenous knowledge, cultural practice, and traditional education among the tribes shape mathematical cognition and learning.

Exhaustive searches were conducted on academic databases such as JSTOR, Google Scholar, Wikipedia, consensus, paper panda , as well as through regional literature, government reports, and ethnographic reports. Search terms such as "Santhal mathematics," "Munda tribe measurement," "Ho ethnomathematics," and "tribal education Jharkhand" were employed to guide the literature search.

Santhal tribe

The Santal, or Santhal, are an ethnic group found in South Asia, originally hailing from Bangladesh and India. The Santal tribe is also found in the Indian states of Assam, Bihar, Odisha, and West Bengal. The Santal tribe is the largest by population within the state of Jharkhand. They are the largest ethnic population in Rajshahi, north Bangladesh division and Rangpur division. Nepal and Bhutan are inhabited by a considerable number of them. Santali is spoken by most of the Santals, and it is the most widespread of the Munda languages. The origin of the term "Santal" can be found in the terms "Santa," meaning "peaceful and calm," and "ala," meaning "man." The Santals once had a nomadic way of life. They later settled on the Chotanagpur plateau(Sinha,2020).

Munda Tribe

Though much of what is documented about the "Munda system" refers to their social and political structure (the Manki-Munda system), rather than a codified set of physical measurement units, their traditional systems of measurement, like those of many Indian tribal groups, were deeply entwined with daily life, agriculture, and local governance. The Munda and Ho are indigenous communities primarily found in the Kolhan region of the former Singhbhum district (now in Jharkhand, India).

Result and Discussion

Measurement System of Santhal tribe :-

The Santhals' rich oral tradition and their own alphabet, Ol Chiki, enable the production and transmission of indigenous knowledge, such as mathematical ideas. Mathematics lived and embodied, not formally learned, is expressed in their language and story, often encoding practical knowledge concerning measurement, counting, and spatial relationships.

As indicated by university coursework in calculus, differential equations, vector calculus, and special functions, modern educational efforts have begun to introduce formal mathematical concepts in Santali dialect. But in contrast to being rooted in abstract theory, the conventional Santhal method of mathematics remains rooted in practical use and community needs.

Tribal communities use different number systems, algorithms, heuristics, and problem-solving strategies adapted to their environments. Despite this, school mathematics is primarily linked to Eurocentric, formal mathematics-focused on abstract symbols, formulas,

and symbolic notation-which often does not reflect or incorporate the tribal knowledge.

Indigenous Santhal wisdom includes sustainable practices that require mathematical thinking, such as: Resource management (e.g., sharing water and dividing land) Construction and crafts (e.g., geometric patterns in building and art) Orientation and navigation on the landscape

The Summary table of Santhal tribe understanding of mathematics aspect wise:-

Aspect	Description
Everyday Practice	Measurement, estimation, counting in agriculture, trade, and craft
Language and Script	Ol Chiki script supports indigenous knowledge sharing
Oral Tradition	Storytelling encodes mathematical and spatial concepts
Formal Education (Modern)	Introduction of advanced mathematics in Santali vernacular
Indigenous Knowledge	Resource management, sustainable practices, geometry in art

Source:- *Variations of body physique in Santhals: an Indian tribe*. (2010, June 1). PubMed. https://pubmed.ncbi.nlm.nih.gov/20698118/

The Summary table of Santhal measurement :-

Context	Description
Anthropometric Measurement	Height, weight, circumferences, skinfolds, BMI (used in health studies)
Land/Administrative Measures	Santhal Parganas created by British, legal land transfer restrictions
Traditional Units	No direct evidence of unique Santhal units for length, area, or volume

Source :- Carrin, M. (2022). Santal indigenous knowledge, cultural heritage, and the politics of representation. *Modern Asian Studies*, *56*(5), 1438–1463. https://doi.org/10.1017/s0026749x2100024x

Measurement system of Munda and Ho tribe

1. Anthropometric and Traditional Units:

Prior to the metric system, Indian societies-including the Munda and Ho-employed anthropometric units derived from the human body and local objects. These were:

Anguli (width of a finger)

Haath (from elbow to tip of finger, approximately 18 inches)

Gaz (yard, but locally variable-36 inches in Bengal, 27 in Bombay, 33 in Madras). Bigha (area of land, regionally variable)

These were not standardized and varied widely from village to village.

2. Commodity and Land Measurement

Weights tended to be seed-based (such as wheat or barley) and measures of length on the body. For land, the bigha and katha were the usual ones, but their size differed locally.

3. Volume and Weight:

In grains, hour-glass containers were used for volume, not weight.The usual units were ser (roughly a liter) and maund (roughly 37 kg in British times later on).

Traditional Unit	Type	Description/Context
Anguli	Length	Smallest unit, width of 3 fingers = 1 Girah
Girah	Length	8 Girah = 1 Haath
Haath	Length	Elbow to tip of middle finger; 2 Haath = 1 Gaz
Gaz	Length	Varied by region; used for measuring cloth, land, etc.
Kathi	Length	5 5/6 Haath = 1 Kathi
Bigha/Begah	Area	Traditional land area unit, size varied regionally
Nilve/Kolve/Chipte/Mapte/Ser	Volume (grain)	Grain measured by volume, not weight; 2 Mapte = 1 Ser
Chhataank/Pav/Seer/Maund	Volume/Weight	Used for liquids and bulk goods; 40 Seer = 1 Maund
Ratta«/Masha/Tola	Weight	Used for precious metals, jewelry
Ser	Weight	80 Tola = 1 Ser
Maund (Maan/Man)	Weight	40 Ser = 1 Maund; traditional load for porters or pack animals

Munda and Ho measurement systems were based on traditional, anthropometric units found throughout most of pre-modern India. They were useful but non-standard, resulting in considerable local variation. These indigenous systems were replaced by the British colonial government and then the Indian government with standardized,

metric units, but remnants of the old measures continue to be found in rural life and in oral tradition. There is no indication of a special, codified system of measurement specific to the Munda or Ho; instead, their systems conformed to regional traditions, adapted to local requirement.

Counting system used by Munda , Ho and the Santhal communities

Both the santhal and munda communities have their own system of counting and it was based on the language they used. they tend to learn to use the numbers they learn at home.

The counting system of Ho are as follows:-

1-Mied, 2-Baariye , 3-Aapiye , 4 -Upuniye, 5- Mayan, 6- Turuye , 7- Aaye, 8- Irliaa, 9-Aareyaa, 10- Geleyaa. Numbers from 11 to 19 are called with suffix of the number in unit place and with the a prefix 10. for example 13 is called Gel Aapiye which means 10 and 3 and this continues till 19. after that 20 has a new word splet as "Hisi" and 30 means twenty and ten " Hisi geleyaa" , 31 is called "Hisi geleyaa meid" , similarly 40 means two twenties i.e "Baar hisi" and 50 is "Baar hisi geleyaa". these 20 based system continues till 100 where for 100 there is word used "Mi sa".

In santhal community the number name from 1 to 10 is as follows :-

1- Mid , 2- Baar , 3- Pe , 4 Pun , 5- Mane , 6- Turui , 7- Eyaae , 8- Irel , 9- Are, 10-Gel. Number from 11 to 19 are called with suffix of the number at unit place and with a prefix 10. For example 12 is called as "Ge Baar" Which literal means 10 and 3. This system continues till 19. While 20 doesn't have independent name but is called "Baagel"(Baar-2 and Gel-10) , it is also called "Ishi". 50 is called "Magel", which means five tens.

Comparitive table of Ho and Santhal number names

	Munda (Ho)	Santhal
0	Gole	Yetahab
1	Mied	Mid
2	Baariye	Baar
3	Aapiye	Pe
4	Upuniye	Pun
5	Mayan	Mane
6	Turuye	Turui
7	Aaye	Eyaac
8	Irliaa	Irel
9	Aareyaa	Are
10	Geleyaa	Gel
11	Gel Mied	Ge-mid
12	Gel baariye	Ge-bar
13	Gel Aapiye	Ge-pe
14	Gel upuniye	Ge-pun
15	Gel manya	Ge-mane
20	Hisi	Baagel / Ishi
30	Hisi geleyaa	Pegel / Ishigel
40	Baar hisi	Pungel/Baar ishi
50	Baar hisi geleyaa	Magel / Bar ishi gel
100	Mi sa	Mid saye

A. Rice and Grain Volume Measures:- Nilve, Kolve, Chipte, Mapte, Ser: Smallest to largest, with 2 of each smaller unit combining to make the next larger; 2 Mapte = 1 Ser (approximately 1 litre). Grains were measured in volume by hourglass-shaped vessels, not weight.

B. Liquid Volume Measures:-Chhataank, Pav, Seer, Maund: 4 Chhataank = 1 Pav, 4 Pav = 1 Seer, 40 Seer = 1 Maund. Used for milk, ghee, and oils, with special containers for easy pouring.

C. Length and Area:- Anguli, Girah, Haath, Gaz, Kathi, Pand, Beesa, Begah: Used for land, building, and cloth.Gaz: Differed by region (Bengal: 36", Bombay: 27", Madras: 33", Gov. avg.: 33")Bigha/Begah: Standard area of land, but size varied locally.

D. Weight:- Rattī, Māshā, Tolā, Ser, Maund: Used for valuable metals, cereals, and bulk commodities.8 Rattī = 1 Māshā; 12 Māshā = 1 Tolā; 80 Tolā = 1 Ser; 40 Ser = 1 Maund.

Key Feature of Mathematical Understanding among the Munda and Ho Tribes

1. **Integrated into Daily Life and Work** :-Mathematical concepts are applied to agriculture, hunting, building, and commerce. For instance, the Ho and Munda societies apply estimation, measurement, and counting in planting seeds, sharing land, managing cooperative hunting, and sharing resources (TRI document)
2. **Oral and Experiential Learning :-**Mathematical understanding is transmitted by experience and oral tradition, rather than formal schooling. Adults and children acquire it through daily experience, watching older people, and problem-solving by experience.
3. **Application of Traditional Systems of Measurement** :-The conventional method of measurement employs anthropometric and conventional units like finger-widths, hand-spans, and locally available containers in place of standardized metric units. They are intuitive and are adapted to the community's needs (Dighe, 2020).
4. **Linguistic and Cultural Integration** :-The Ho and Munda languages have indigenous terms for measurement, navigation, and tools, which suggest the integration of mathematical ideas into their vocabulary and thinking process. Certain Indo-Aryan measurement words have been found to be Munda-based by linguistics (Dighe, 2020).
5. **Contextual and Practical Reasoning**:- Mathematical thought is context-dependent and problem-centered. The tribes are good at practical reasoning, including spatial reasoning in the construction of houses, management of resources, and collective decision-making. Adaptation to Modern Education There have been efforts to extend mathematics education to the Ho language, with books and materials used to bridge local and official mathematical knowledge. This translation enables literacy and numeracy learning while paying attention to cultural context (Deb,2018)

The Summary table of mathematical understanding of Munda and Ho tribe :-

Feature	Description
Embedded in Daily Life	Applied in agriculture, hunting, trade, construction
Oral/Experiential Learning	Passed down through participation and observation
Indigenous Measurement Systems	Use of body-based and local units
Linguistic Integration	Indigenous terms for measurement and tools in language
Contextual Reasoning	Practical, problem-oriented approach
Modern Adaptation	Introduction of mathematics in native language education

Mathematical processes used in daily lives of Munda and the Santhal communities

The santhals use Ishi for their daily life calculation. Ishi and Bagel both represent the number twenty (Kar,2020). The Santhal language (Santali) has a well-established phonology and structure6, but the sources cited do not specifically mention a special Santhal method for calculating length, area, or volume that is different from that of nearby villages or the larger Indian context. The Santhal people's daily life, indigenous knowledge, and cultural practices all have a deep impact on how they understand mathematics. Their mathematical reasoning, which emerges from activities such as agriculture, fishing, hunting, craft, and commerce, is contextual and pragmatic instead of abstract and formal. These processes involve: Estimating quantities (e.g., seeds to plant, harvest yields),Measuring land and produce using traditional units, Time and season calculation for crop cycles, Management and taking part in local markets, involving elementary arithmetic and bargaining skills.

Conclusion

tribal children possess extensive and rich mathematical knowledge rooted in their cultural practices and everyday activities. However, this indigenous knowledge system remains largely unrecognized and underutilized within formal education settings. integrating tribal mathematical knowledge into the curriculum, recognizing it as valid and valuable, and adapting teaching methods to bridge the gap between community practices and formal mathematics. This approach is essential for protecting tribal children's self-esteem, making mathematics education more meaningful, and improving their learning outcomes. Munda and Ho measurement systems were based on traditional, anthropometric units found throughout most of pre-modern India. They were useful but non-standard, resulting in considerable local variation. These indigenous systems were replaced by the British colonial government and then the Indian government with standardized, metric units, but remnants of the old measures continue to be found in rural life and in oral tradition. There is no indication of a special, codified system of measurement specific to the Munda or Ho; instead, their systems conformed to regional traditions, adapted to local requirement.

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