Indigenous Number System and Geometrical Knowledge Inherent in Cultural Artifacts of Byansi Sauka Ethnic Group in Nepal

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Abstract

The purpose of this study is to explore ethno mathematical knowledge of Byansi Sauka ethnic group. This study is based on interpretative paradigm followed by qualitative research method and ethnographic design. A sample of two persons from Byansi Sauka Community has been taken by purposive sampling method. The result of the study showed that Byansi Sauka developed mathematical counting numbers and expressed them by different words. They used basic twensty words to count objects. The words are Tigai, Nishya, Sum, Pi, Nai, Tugu, Nishe, Jedai, Gui, Chee, Chethi, Cheni, Chesum, Chepi, Chebang, Chedhu, Chyonee, Chebjai, Chirgu, and Nassa, standing respectively for 1,2,3,4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, and 20 in the Hindu Arabic numeral system. All other numbers are formed by these twenty words. They developed a rule of addition, a word placed after another of small value adds its value; e.g., Nassa tigai = 20+1 = 21, Nasha nishya = 20+2 = 22, Nasha sum = 20+3 = 23, Nasha pi = 20 +4, Nasha nai = 20+5=25 and so on. Woolen garments like Chedar (Pankhi), Pye (Chutka), and Sab (Carpet). Lanbyaare associated with geometrical concept of parallel sides, vertices, right angles, rectangle, and square. With the help of sub, we can teach the concept of sides, vertex, right angle, and rectangle, square. From cultural ornaments like Bira, Baha, and Baldang, we can sketch the knowledge of circle. Cultural artifacts Jhamko and Dumbo are cylindrical in shape. We can give the concept of cylinder by using Jhamko and Dumbo as instructional material. To teach the rectangular prism we can sketch the knowledge from cultural artifact Phir, Bhakar, Jung Baksa and Almari.The cultural artifact Ghurra is associated with the concept of Cone. We can use the Ghurra as instructional

material for teaching the concept of cone. The musical instrument Damaha is in bowl shaped. When teaching the concept of half sphere, circle radius, diameter and circumference we can use Damaha as instructional material. The musical instrument Dhol is cylindrical double-headed drum and associated with geometrical concept of cylinder, circle, radius, dimeter and circumference.

Keywords: Byansi Sauka, indigenous, number system, cultural artifacts

Introduction

Byansi Sauka is indigenous ethnic group officially recognized by the Government of Nepal. The population of Byansi Sauka is estimated about 5718 (0.01%) in 2021 census (CBS, Nepal). Byansi Sauka are found in Himalaya range of Darchula district, near trilateral boarder (Nepal, China and India). According to S. Budathoki (Personal communication, Aug5, 2023), Byansi Sauka uses the term Rang, Ransya to represent their community. Rang represent male and Ransya represent female people. The Byansi Sauka has unique language which is called "Sauka" language. They made different varieties of food items from Kodo, Potato, Phapar, and Lathe. They made Chamma (Sattu) from Uwa (a kind of wheat) and Chyakpi (a kind of alcoholic made from grain and are considered as valuable items and used in special occasion, different ceremonies and worshiping god. Traditionally Byansi Sauka man wear clothes like Ranna, Benthlo, Jiujyan, and Chukti. Byansi Sauka women wear clothes like Chunbala, Jiujyan, Gagari, Chukti, and Vakcha. The uses golden ornaments like Bira (Phuli), Lakchayab (earring) and silver ornaments like Baha (hand ring), Nan (hand ring), Baldan (neck less), and Jhumkawali (used in forehead).

Sauka follow the Hindu religion, and their practices depend upon many typical Aryan practices. They are completely influenced by Hinduism and religious sentiment has an effect on thinking, living, and activities (Ray, 2005). They worship the god Sanshye, Dipchand, Shiddya. The main god is Sanshye. Epically they celebrate Kirjidama (Kangdali) Mela after every twelve years. The Bada (head) is the head of Sauka community. Bada makes policies, plans, rules and regulations for theSauka community. Lama is adviser, and Lewa is assistant of Bada in Sauka community. The tenure of Lewa is one year, so Sauka community Different casts are found in Sauka community like Budhathoki, Aitwal, Bohara, Tinkari, and Kallyal. However, cast based discrimination is found in Sauka community, also untoucability is not in practice during menstruation period of Sauka women and girl. Bhotia lives in both joint and nuclear families. The paternal property is inherited in their culture (Sharma, 2022). The eldest son succeeds the late

father as head of the family. Male Sauka are engages in farming and business, so they spent maximum time out from house. So Sauka community is maternal authoritarian.

Ethnomathematics studies the relationship between mathematics and culture of ethnic groups. According to D' Ambrosia (1985) ethnomathematics is "the mathematics which is practiced among identifiable cultural group such as national-tribe societies, labor groups, children of certain age brackets and professional classes". Also, Gilmer (1995) notes that all different cultural groups have their own language and specific ways of obtaining their practical mathematics and ethnomathematics study their techniques. Likewise, Bishop (1998) defines mathematics itself as a cultural product, which has developed as a result of various activities.

Mathematics is an important part of school education. So, it is compulsory subject in school education. Mathematics knowledge is essential in daily life, and it is the base for science and technology. So, it must contain the cultural knowledge of the students. A culturally relevant mathematics curriculum should integrate student's cultural mathematical knowledge and daily life experience through ethnomathematics. This mathematics curriculum must be grounded in a constructivist approach (Rose & Oery, 2007).

Byansi Sauka are rich in ethnic knowledge including ethno-mathematical knowledge. Traditionally they were farmers; they kept horses, sheep, made wool from sheep and made woolen garments like. They also collect medicinal herbs like Yersagumba, Amala, Kurilo, Sugandhawal, Satuwa, Panchaunle, Keshar etc. from mountain areas. Farming and business are their main occupations. They have been engaged in the business of woolen garments, medicinal herbs and domestic animals like sheep, horse, goat etc. Their trade extended to the Himalayas, hills and Tarai. Generally, in winter seasons, to escape the snow, they migrate from the mountains to hills. Lacking mathematical numbers, they faced various problems of daily life. Necessity is the mother of invention, so they developed mathematical counting numbers and expressed them by various words. Numbers are words or symbols or figures used in counting objects and making calculations (English dictionary, UK).

According to S. Budhathoki (Personal communication, Aug. 5, 2023), Byansi Sauka traditionally make woolen garments like Chedar (Pankhi), Pye (Chutka), Sab (Carpet), Lanbya (Sheep skin). They make woolen garments of different geometrical shapes and sizes with full drop

repeat of horizontal and vertical patterns of different colors and lines. The Byansi Sauka are rich in culture and cultural artifacts. The various geometrical concepts are inherent in cultual artifacts of Byansi Sauka ethnic group. In this context, the paper tries to explore indigenous number system, and geometrical knowledge embedded in cultural artifacts of Byansi Sauka ethnic group. The paper seeks to answer the question, how do Sauka people inherit geometrical knowledge in cultural artifacts?

Methods and Materials

To address the research questions, I have chosen a qualitative research approach, particularly ethnography design. The ethnographic research obtains a holistic picture of the subject of study and emphasis on the everyday experiences of individuals (Fraenkel& Wallen, 1990). This design explored in-depth ethnomathematical knowledge and cultural phenomenon of Byansi Sauka ethnic group. To fulfill the purpose of study, the interview schedule and observation guideline were used as research instruments. So, the researcher observes the cultural artifacts and cultural practice of Byansi Sauka people by developing close relationships with participants. Research participants were selected purposively to meet the objective of the research. For the research purpose, two people were selected from the Byansi Sauka community. Moreover, the researcher visited the Museum, houses, school and social association for observing social phenomenon.

Data were analyzed by the qualitative data analysis process of ordering, categorizing, coding, interrelating themes (Description) and interpreting the meaning of themes (Creswell, 2014) to obtain answers to the research questions. The researcher mentioned field notes by observing the cultural artifacts, cultural phenomenon interview with participants. The data thus obtained are ordered and categorized all the visual materials. Further the researcher coded the data by involving textual data and pictures gathered in the actual language of the participant. Moreover, the researcher generated a small number of themes by specific evidence and interconnected themes

Result and Discussion

Development of number system

Traditionally they were farmers; they kept horses, sheep, made wool from sheep and made

woolen garments like that. They also collect medicinal herbs from mountain areas. Farming and business are their main occupations. They have been engaged in the business of woolen garments, medicinal herbs and domestic animals like sheep, horse, goat etc. Their trade extended to the Himalayas, hills and Terai. Generally, in winter seasons, to escape the snow, they migrate from the mountains to hills.   Lacking mathematical numbers, they faced various problems of daily life. First, they faced the problem of counting family members and domestic animals. Knowledge is constructed by social interaction and social interactions are critical. In this line Vygotsky's constructivism theory stresses the fundamental role of social interaction, interpersonal interaction is the development of cognition, and the community plays central role in the process of making meaning (Vygotsky, 1978). Necessity is the mother of invention, so the interpersonal interaction in Sauka community developed mathematical counting numbers and expressed them by various words. Sauka were engaged in the business of garments and medicinal herbs, so they faced problems of addition and subtraction. In this line Vygotsky stated that interactions with people in the environment (e.g. apprenticeships, collaboration) stimulate cognitive growth, language and symbols are the key factors in cultural transformation (Vygotsky, 1978). Gradually they developed the rules of addition in these numbers. Byansi Sauka expresses numbers by words. They use basic twenty words to count objects. The words are Tigai, Nishya, Sum, Pi, Nai, Tugu, Nishe, Jedai, Gui, Chee, Chethi, Cheni, Chesum, Chepi, ChebangChedhu, Chyonee, Chebjai, Chirgu, and Nassa, standing respectively for 1,2,3,4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, and 20 in the Hindu Arabic numeral system. All other numbers are formed by these twenty words.

A word placed after another of small value adds its value; e.g., Nassa tigai = 20+1 = 21, Nassa nishya = 20+2 = 22, Nassa sum = 20+3 = 23, Nassa pi = 20 +4, Nassa nai = 20+5=25, Nasha tugu = 20+6 = 26, Nasha nishe = 20+7 = 27, Nasha jedai = 20+8= 28, Nasha gui = 20+9 = 29. They use the word "Sumsaa" standing for 30 in the Hindu Arabic numeral system. They use "Saa" after 29 as 0 is used after 9 in Hindu Arabic numeral system. After 30 they use the same rule of addition; e.g., Sumsaatigai = 30 + 1 = 31, Sumsaanishya = 30 + 2 and so on up to Sumsaagui = 30+9 = 39. Similarly, they use the word "Pisha" standing for 40 in Hindu Arabic numeral system. After 40 they use the same rule of addition; e.g. Peesaatigai = 40+1 = 41, Pisa nishya = 40 +2 = 42, and so on up to Pisha gui = 40+ 9 = 49. Same ways they use the word "Naasaa" standing for 50 in Hindu Arabic numeral system. After Nasha they use same rule of addition; e. g. Naasaatigai = 50 + 1 = 51, Nasha nishya = 50 + 2 = 52, so on up to Nasha gui = 50 + 9 = 59.

They use the word "Tukchha" standing for 60 in Hindu Arabic numeral system. After Tukchha they use the same rule of addition; e. g. Tukshhatigai = 60 + 1 = 61, Tukchhanishya = 60 + 2 = 62 and so on up to Tukchhagui = 60 + 9 = 69. Sameways they use the word "Tukchhachee" standing for 70 in Hindu Arabic numeral system. After Tukchhachee they use the same rule of addition; e. g. Tukchhatigai= 70 + 1 = 71, Tukchhanishya = 70 + 2 = 72, Tukchha sum = 70 + 3 +73 and so on up to Tukchhagui = 79. Like ways they use the word "Jecchha" standing for 80 in Hindu Arabic numeral system. After Jecchha they use the same rule of addition; e.g. Jecchhatigai = 80+1 = 81, Jecchhanishya = 80 + 2= 82 and so on up to Jecchhagui = 80 + 9 = 89. They use the word "Jecchhachee" standing for 90 in Hindu Arabic numeral system. After Jesha chee they follow the same rule of addition; e.g. Jecchhacheetigai = 90 + 1= 91, Jecchhacheenishya = 90 + 2 = 92 and son up to Jecchhacheegui = 90 +9. However, after Jesha cheegui, they use the words that are similar to Devnagari number numeral system; e.g. Sai stand for Shaya (hundred), Nishyasai standing for dui shya (two hundred) and so on up to "Hajare" stand for hajar (thousand), Nishyahajare standing for dui hajar (two thousand), Sum hajare standing for tin hajar (three thousand) and so on. Byansi Sauka developed words for fraction. They use the word Faye standing for half, "Sum Kuwtigai" standing for one third, "Faye gefaye" standing for one fourth, and "Pi Kuw sum" standing for three fourths. They have been using these numbers in daily life as well as in business to count objects and measure time, weight, length, volume etc.

They use the words "Mathe" and "Chithe" to compare the numbers as less than and more than respectively. In Hindu Arabic numeral system, ten digits (symbol) 0 to 9 are used and number system is based on them. However, in ByaniSauka number system, twenty words are used, and number system is based on them. So numeral system used by Byansi Sauka is different from Hindu Arabic numeral system.

Geometrical Knowledge inherent in cultural artifacts

Geometry In woolen garments

Byansi Sauka traditionally make woolen garments like Chedar (Pankhi), Pye (Chutka), Sab (Carpet), Lanbya (Sheep skin). They make rectangular Cheder of different sizes, full drop repeat of horizontal and vertical patterns of different colors and lines are plotted. It is associated with geometrical concept of parallel sides, vertices, right angles, and rectangle, square.

Likewise, they make rectangular shaped pay with repeated full drops of horizontal and vertical patterns of lines and colors, circular pattern of lines and colors.

Same ways they make triangular, circular and rectangular Sab. Sab issued Full drop repeat and half drop repeat of horizontal and vertical patterns of lines and colors are used in the Sab. Triangular, rectangular, circular and polygonal patterns of different points, colors and lines are also found in Sab.

With the help of sub, we can teach the concept of sides, vertex, right angle, and rectangle, square.

Lanbyais is a famous artifact in Byansi Sauka community. It is made from skin (with wool) of sheep. It is used to sit in special festivals. Lanbya is in irregular shape. By using Lanbya We can give the concept of irregular shape.
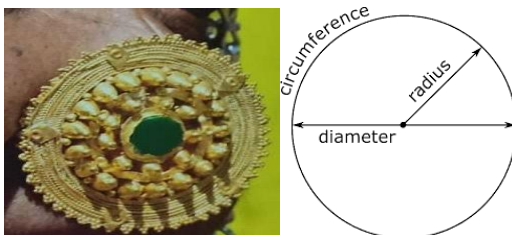
Geometry in Cultural Ornaments

Bira (Phuli) is famous cultural ornament wear by women in Byansi Sauka Community. It is made up of metal like silver or gold. They wear this ornament in their cultural festivals. Bira is in circular shaped. Different shapes of beautiful circular patterns are designed.

Circumference of the circle 2 r or d

Area of the circle

Diameter 2 r

Where radius of the circle

Baha (hand ring) is also famous cultural ornament wear by women in Byansi Sauka community. It is made up of Silver. The Baha is circular in shape. In Baha we can also see different beautiful circular pattern. By using Bira and Baha we can give the concept of circle.

Baldang is a famous ornament in Byansi Sauka community. It is worn by women as necklace and made up of Silver. They wear this beautiful ornament in their festivals. The shape of Baldang is rectangular. We can see circular patterns of different shapes in Baldang. While teaching rectangle and circle, we can use Baldang as instructional material

Geometry in cultural artifacts

Geometry in Jhamko and Dumbo: Jhamko is the most popular cultural artifact in Byansi Sauka community. It is made of wood, and the outside is tied with a circular wooden strip. It is used to keep grain and raw materials for alcohol. Jhamko is cylindrical shaped.
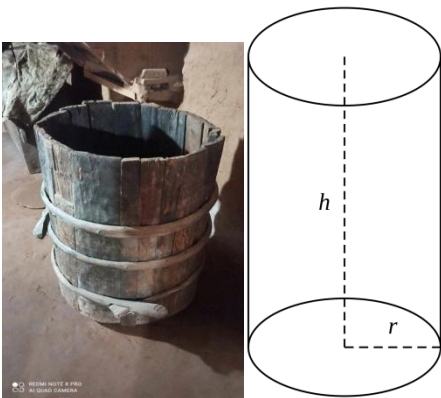
Curved Surface area $= 2\pi rh$ square unit

Total Surface Area of Cylinder = Curved Surface Area+Area of Circular Bases

$$= 2\pi rh + 2\pi r^2$$

$= 2\pi r(r + h)$Square units

Volume of the Cylinder $= \pi r^2 h$ Cubic unit

Dumbo is the most popular cultural artifact in Byansi Sauka community. It is made of wood, and the outside is covered with a circular metal strip. It is used to make curd and salty tea. Dumbo is cylindrical shape.

We can give the concept of cylinder by using Jhamko and Dumbo as instructional material.

Geometry in Phir, Bhakar Jung Baksa and Almari

Phir is an ancient most popular cultural artifact of Byansi Sauka community. It is made up bamboo and covered by animal skin. Phir is used to keep clothes. The shape of Phir is associated with rectangular prism.
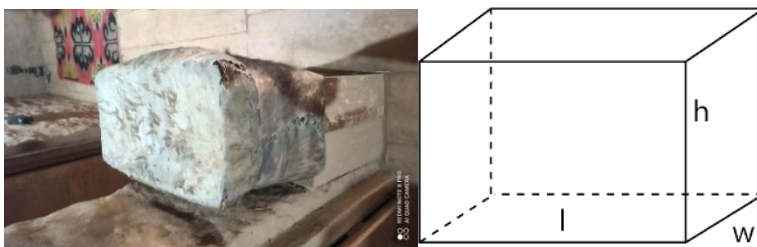
Volume of a rectangular Prism Length Width Height cubic units

 Volume l wh

Total surface area of a LSA 2 (Base area) [Square units]

LSA Lateral surface area

LSA   ph [Square units]

Were, p perimeter of a base

   hheight of the prism

p 2 (lw)

Therefore, the lateral surface area of a rectangular prism 2 (l w) Hence,

TSA LSA 2 (Base Area)

 2 (l) h 2 (lw)

 2 l h 2 w h 2 l w [Square Unit]

Bhakar is one of the famous cultural artifacts in Byansi Sauka community. It is made of wood and used to store grain. It is associated with the geometrical shape of rectangular prism.

Jung Baksa is one of the popular cultural artifacts in Byansi Sauka community. It is made of wood. it is used to store valuable clothes, ornaments and money. Jung Baksa represents unique geometrical shape in Byansi Sauka culture. It is associated with the geometrical shape of rectangular prism.
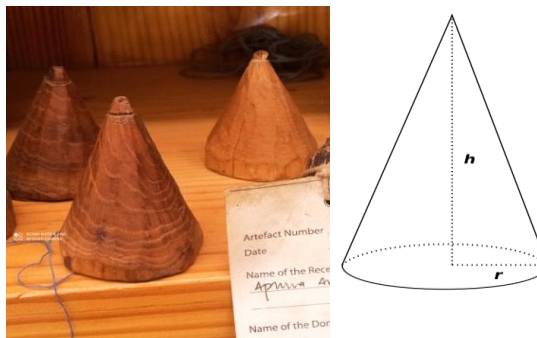

Almari is one of the common cultural artifacts in Byansi Sauka Community. It is made of wood and divided in various small boxes. It is used to store different types of herbal medicine. Almari is connected with unique geometrical shape. The shape of Almari is associated with rectangular prism.

When teaching the concept of rectangular prism we can use   Phir , Bhakar, Jung Baksa and Almari as instructional materials.

Geometry in Ghurra

Ghurra is one of the popular cultural artifacts in Byansi Sauka community. It is made of wood and famousgame stuff. Ghurra is connected with unique geometrical shape. it is ia a cone shape. From the figure, we can seeclearly, vertex, silent height, height, circle, and radius.

We can use the Ghurra as instructional material for teaching the concept of cone including vertex, silent height, height, circle, and radius.

Geometry in musical artifacts (Damaha and Dhol)

        Damaha is one of the famous cultural artifacts in Byansi Sauka community. it is made by leather and brass. It is bowl shaped. It is played in festivals and cultural ceremonies. This instrument is very easy to play and associated with geometrical concept of half sphere, circle, radius, diameter and circumference. When teaching the concept of half sphere, circle radius, diameter and circumference we can use Damaha as instructional material.

Dhol is a popular musical instrument in Byansi Sauka community. It is cylindrical double-headed drum and made by animal skin and wood. It is widely used in wedding ceremonies. It is easy to play and associated with geometrical concepts of cylinder, circle, radius, dimeter and circumference. When teaching the concept of cylinder, circle, radius, dimeter and circumference we can use Dhol as instructional material

Conclusion and implication

Byansi Sauka are rich in ethnic knowledge. They have unique language, culture and ethnomathematical knowledge. Byansi Sauka developed a mathematical counting numbers system and expressed them by various words. They developed basic twenty words to count objects. Byansi Sauka developed different patterns of points, lines and colors, and triangular, circular and rectangular and polygonal geometrical shapes in woolen garments. The concepts of plane geometry and space geometry are embedded in cultural artifacts of Byansi Sauka community. Teaching mathematics can be made easy and more effective by using cultural artifacts as instructional material in the classroom. Incorporating Byansi Sauka cultural practice and artifacts in teaching learning process of geometry can encourage students to learn mathematics meaningfully. So, it is needed to   incorporate indigenous (ethnic) knowledge, values, skill and technology in school mathematics curriculum. It will be helpful to develop a local need–based curriculum, diversity–based curriculum, inclusive curriculum and eastern philosophical value–based curriculum.

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