Chapter I

INTRODUCTION

Background of the Study

Mathematics is considered as a social construction. The development of mathematics depends on the development of human civilizations. The different human civilizations have their different mathematical concepts for examples Babylonian, Greek, Roman, Egyptian, and Hindu civilizations etc. Similarly, the different ethic-groups have their different mathematical concepts. Mathematics solves the daily life problems of human civilization and fulfills the human needs. At the ancient period of human civilization the concept of mathematics was practiced or the mathematics employed at the time of human problem solving. Also the geometrical concepts and four basic operations of mathematics were included in human activities.

Mathematics is the branch of human enquiry involving the study of numbers, quantities, data, shape and space and their relationships, especially their generalizations and abstractions and their application to situations in the real world. As a broad generalization pure mathematics is the study of the relationships between abstract quantities according to a well-defined set of rules and applied mathematics is the application and use of mathematics in the context of the real world. Pure mathematics includes algebra, abstract algebra, calculus, geometry, number theory, topology and trigonometry. Applied mathematics includes mechanics, probability and statistics, quantum mechanics and relativity (Clapham & Nicholson, 2009).

The word mathematics comes from the Greek word “mathema”, which, in the ancient Greek language, means “what one learns”, “what one gets to know”, hence

also “study” and “science”, and in modern Greek just “lesson”. The word “mathema” is derived from “manthano”, while the Modern Greek equivalent is mathaino, both of which means “to learn”. In Greece, the word for “mathematics” came to have the narrower and more technical meaning “mathematical study”, even in classical time. Its adjective is “mathematikos”, meaning “related to learning” or “studious”, which likewise further came to mean “mathematical”.

Mathematics is a way of thinking, a way of organizing, analyzing and synthesizing a body of data. Also mathematics is an organized body of knowledge in which each proposition follows as a logical consequence of proved proposition or assumptions. Such mathematical structure is characterized by undefined terms, assumptions and rules of logic. So that the mathematics is a body of knowledge in the area of science, with its own symbolism, terminology, contents, theorems and techniques (Pandit & Bhattarai, 2011).

According to the history of mathematics the main sources about origins of mathematics are cultural value, social practice, animal psychology, language, child psychology, anthropology, archaeology and philosophical speculation. So, that the mathematics is created by the human activities or culture and used by human civilization. Mathematics is considered as a social creation. Mathematics plays an important role in the advancement of culture and civilization. Therefore, development of culture and mathematics contributes each other for their advancement. It helps people in transmitting and enriching the culture (Acharya, 2017). Pythagoras says that all things on universe are number, universe is a sphere and fire is a pyramid.

D’Ambrosio, (1990) defines ethno-mathematics as: the mathematics which is practiced among identifiable cultural groups, such as national-tribal societies, labor

groups, children of a certain age bracket, professional classes, and so on. Its identity depends largely on focuses of interest, on motivation, and on creation codes and jargons which do not belong to the realm of academic mathematics. We may even go further in this concept of ethno-mathematics to include much of the mathematics which is currently practiced by engineers, mainly calculus, which does not respond to the concept of rigor and formalism developed in academic courses of calculus (Hammond, Marakowitz & Kosoresow, 2000, p. 8 & 9).

There are no definitions of "ethno-mathematics" in any standard dictionary. This is to say that the definition of ethno-mathematics has not been standardized yet. Relating to etymology, "ethno-mathematics" is initialed by "ethno" and ends with "mathematics". Thus, literature that refers to two different fields' anthropology and mathematics can be used to survey "ethno-mathematics". We can speculate to a certain extent that ethno-mathematics should be discussed at the cross point of culture and mathematics with etymological evidence. We know that "ethno-mathematics" is a compound word if we look over the word itself and the definitions of its word initial "ethno" and the etyma "mathematics". The word initial "ethno" is part of the word "ethnology" which is defined as "the science that analyzes and compares human cultures" or "cultural anthropology" in the dictionary and the definition of "mathematics" is "a science dealing with 'quantitative relations' and 'spatial forms' in the real world" (Zhang & Zhang, 2010).

In mathematics education, ethno-mathematics is the study of the relationship between mathematics and culture or "the mathematics which is practiced among identifiable cultural groups". Thus, ethno-mathematics is the study of mathematical concepts practiced by identifiable cultural groups in solving, understanding and explaining their daily life problems.

Ethno-mathematics is the process of studying mathematical concepts from multicultural perspectives. Nepal is a multicultural country and the different cultural groups have their different types of mathematical concepts. As different cultural groups their mathematical concepts, geometrical concept, number system and symbols are different. In that context ethno-mathematics plays a vital role in development of mathematical knowledge. The goal of ethno-mathematics is to contribute both to the understanding of culture and the understanding of mathematics, and mainly to lead to an appreciation of the connections between the two.

Ethno-mathematics and mathematics education addresses first, how cultural values can affect teaching, learning and curriculum, and second how mathematics education can then affect the political and social dynamics of a culture. One of the stances taken by many educators is that it is crucial to acknowledge the cultural context of mathematics students by teaching culturally based mathematics that students can relate to. Can teaching math through cultural relevance and personal experiences help the learners know more about reality, culture, society and themselves (Robert, 2006)?

The word geometry comes from the ancient Greek word ‘geo’ means earth, and ‘metron’ means measurement is a branch of mathematics concerned with questions of shape, size, relative position of figures, and the properties of space. A mathematician who works in the field of geometry is called geometer. Geometry arose independently in a number of early cultures as a practical way for dealing with length, shape, size, areas and volumes. There are some general concepts that are more or less fundamental to geometry which are practiced by different ethic-groups. These include the concepts of points, lines, plane, surfaces, angles and curves, as well as the more advanced notions of manifolds and topology or metric.

In Nepal, there are several ethnic groups with their own typical traditions and practices. The different ethnic groups have their own geometrical concepts. The Majhi people of Nepal are also one of ethnic group in which they used their own geometrical knowledge, concept and processes in their daily life knowingly or unknowingly. All members of Majhi community like older, younger and children use different geometrical concepts in their own perception. Majhi people always use geometrical concepts for making domestic goods, fishing materials and in playing games. But the geometrical concepts of Majhi community has not expanded, explored and linked with formal geometry. So, that I am interested to identify the basic geometrical concepts practiced by Majhi community embedded in their culture.

Majhi Community

Nepal is multi-cultural, multi-religious and multi-lingual country having different castes like Brahamin, Chhetri, Kami, Damai, Sarki, Rai, Limbu, Tamang, Magar, Gurung, Newar, Majhi, Danuwar, Tharu and so on. They have different language, cultures and religious so that the country Nepal is rich in cast, language, cultures, and religious.

Majhi are an ancient and major indigenous people of Nepal. They have their own language, cultures, religious, rituals, belief, dress, festivals and god. Their major occupations are fishing, boating, traditional agriculture, making “Marcha”, husbandry and handicraft. They are found in Nepal and India. Majhi people are those who have been forced to fall backward politically, economically, educationally and socially. Majhis are rich in language, culture and religious.

Majhis are mainly found in the district of Sindhuli, Ramechhap, Makawanpur, Sindhupalchok, Kavre, Sarlahi, Udayapur, Sunsari, Jhapa, Dolakha, Okhaldhunga,

Khotang and so on and normally in riverfront. Their population according to national census 2068 is 83,727 which is 0.32% of national population in which 24,422 or 0.09% speaks Majhi language, whereas the literacy percentage is 52.25 which is average. There are 10,279 Majhi people in Sindhuli district, which is the highest population than other district, in which 4,840 speak Majhi language (National Census 2068). Majhis have their own language. Their language belongs to the Endo-European family but their script has been disappeared. The language of Majhi community has been going to revocation day by day. But Majhi speaks their own language in the district of Kavre, Dolakha, Ramechhap, Okhaldhunga and Khotang still now.

Main area of Majhi in Nepal

The main foods of Majhi are rice, fish, ale, alcohol and meat. Physical appearance of Majhi people are as ancient Mangolian. They have medium hight, wheat-white skin and forceful physical format. There are many sub-castes in Majhi community which are listed as follows: Danuwar Majhi, Kusuwar Majhi, Kumale Majhi, Bantar Majhi, Thaltharu and so on.

Dress of Majhi people

The houses of Majhi are made from wood, stone, bamboo and soil in rectangular base. Majhi's have a single or joint family. The family is normally handled by the eldest member who is male/female. The ornaments used by Majhi women are Hasuli, Galari, Mangalsutra, Hari, Pote, Phuli, Bulaki, Natthi, Beruwa, Mundra, Tap, Jhumka, Ring, Pauju, Bala and so on.

Cultural house of Majhi people

Majhi community says that we are "Tantrik" religious group. They have no temple and statue build by people for worship. That is the important place for worshiped where they build statue temporarily in front of forest and in riverfront. They are nature-worshiper and believed to the sprit, ghost, rebirth, "Dhami-Jhakri", "Boksi", "Tantra-Mantra", heaven and hell. They believed that the sprit to live on after the person death so that sometimes they dedicate new food and other alcoholism

to the person who is already died. Otherwise they believed that some problems are originated in their family.

God of Majhi people

They celebrate with equal fervor such diverse religious occasions as Kosipuja, Dashain, Tihar, Maghe Sankranti, Shravan Sankranti and Chaite Dashain. The main festival of Majhi community is “Kosi Puja” which is celebrates on every third Tuesday of “Phagun” month. Also the main religious worship of Majhi people are ‘Kulpuja’, ‘Ladipuja/Kosipuja’, ‘Sansaripuja’, ‘Baishakhepurne/Wayupuja’, ‘Aitabare/Aitabarenipuja’, ‘Gothapuja’ and ‘Bhumepuja’ etc.

The “Nwaran” is performed after when the navel of child is drop down. The navel of child must be drop down for “Nwaran” ceremony. It is done in nine, eleven or in odd days after a male child is born and in five, seven or in odd days after if the child is female. Horoscope of child and consult of astrologer is not necessary in this ceremony. Instead culturally they use date like the day of birth, place and month to give the name for child. For examples: Sukra, Somlal, Aita bahadur, Mangali, Buddhiman, Buddhimaya, Mansire, Maite, Seti, Sante, Batuli, Birman and so on.

The “Pasni” or “Mukha juthyaune” ceremony is celebrate with the gathering of relatives when the male child is six months and female child is five months with giving blessings, money, new cloths and delicious rice.

The marriage is universal ceremony. In Majhi community “Bal-Biwaha” is performed in the ancient period but now a day it is not practiced by them. Same-cast marriage process is an accreditation of Majhi. Everyone Majhi has no permission to marriage with another cast. If so, that is the opposite of Majhi tradition and they are rejected normally in their society. Different types of marriage are found in Majhi community they are as follows: Maghi Biwaha, Chori Biwaha, Bhagi Biwaha, Jari Biwaha, Ghar-Jwain Biwaha, Jabarjasti Biwaha, Bidhawa Biwaha, Inter-casts marriage and so on.

Death is a natural event and the rituals are performed in different ways among the different tribes. Majhi people also have their own way of performing the rituals. The main processes of death retual in Majhi community are as follows: Cremation, “Kuri Basne”, “Chokhine/Sudai”, “Sarat” (Sano Sarat/Thulo Sarat), “Pitri Bolaune”, “Warani Chalaune”, “Bharaki Dhukaune”, “Khaula Gansne”, “Dukha Phukaune”, “Pitri Bagaune”, and “Bhanse Bida Garne”.

I selected the Sindhuli district as a research area in which the population of the study was taken from the Majhi people of “Dhamile”, Chanduli and Chhap villages of Marin village institution, Sindhuli district. Here the population distribution of Majhi people in Dhamile, Chanduli and Chhap villages of “Marin” village institution, Sindhuli district are shown below:

Table 1: Population distribution of Majhi people in Dhamile, Chanduli and Chhap villages of Marin village institution, Sindhuli district.

S. N.	Village	No of Majhi people			Household
		Male	Female	Total	
1.	Chanduli	20	15	35	5
2.	Dhamile	101	89	190	36
3.	Chhap	126	120	246	45

Source: Majhi Samuha "Dhamile" & Majhi Samuha "Chhap" Marin village institution, Sindhuli district 2074/08/25.

Majhi people use the geometrical concepts in their daily life activities. These geometrical concepts include the concepts of circle, triangle, rectangle, square, diagonal, cone, parallel line, perpendicular line, intersecting line, cylinder, plane curve, sphere, pseudo sphere, pentagon, cuboids, parallelogram, slope and so on.

Statement of the Problem

Nepal is a small country in which there are many ethnic groups and every ethnic group has its own religious, language, social and cultural believes. Their cultural activities play the important role in the national culture. Most of the ethnic groups have their own geometrical knowledge. Majhi is one of the ethnic groups of Nepal. Their cultural and hidden geometrical activities are different from other indigenous cultural groups and communities whereas ethno-mathematics is the combine study of their culture and mathematics. But no study has been conducted dealing with basic geometrical concepts practiced by Majhi community in Sindhuli district. So, I intended to study the basic geometrical concepts, cultural activities, hidden geometrical activities and pedagogical implication of geometrical concepts

practiced by Majhi community. In this study I tried to find out the answers of the following research questions:

- What kinds of basic geometrical concepts were practiced by Majhi community?
- How can their geometrical concepts be linked with teaching – learning geometry?

Objectives of the Study

The main objectives of this study were:

- To identify the basic geometrical concepts practiced by Majhi community.
- To explore the pedagogical implications of basic geometrical concepts practiced by Majhi community.

Significance of the Study

Mathematics is a body of knowledge in the area of science, with its own symbolism, terminology, contents, theorem and techniques. Geometry is an important part of mathematics. Now geometry is becoming a most important part of mathematics in school education. But geometry is one of a headache subject for most of teacher, parents and students. Also geometrical concepts introduced in school education are abstract in nature. So, it is necessary to identify use of basic geometrical concepts practically in own cultural groups and what is the difference between their geometrical concepts with school geometry. Therefore this study would be great significance among those students, parents and teachers who are facing geometry as a burning problem. The significances of this study were as follows:

- This study would facilitate to the teachers, students and parents to understand basic geometrical concepts practically used by Majhi community.
- This study would provide knowledge about cultural geometry is related to school geometry with its pedagogical implications used by Majhi community.
- This study would grow up the ethno-mathematical knowledge used by Majhi community.
- This study would help to the mathematics educators, teachers, learners, mathematician, geometers and other ethno-mathematics researcher to understand culture and geometrical concepts of Majhi community.
- This study would provide feedback for curriculum planners and policy maker to consider ethno-mathematics in curriculum and text book.

Delimitation of the Study

Delimitations of this study were as follows:

- This study was focused only in three villages Dhamile, Chanduli and Chhap of Marin village institution, Sindhuli district.
- This study was confined to only Majhi community.
- This study was intended to study the culture and geometrical concepts only of Majhi community.

Definition of Terms

Basic geometrical concepts: The geometrical concepts which are used in everyday life are taken as basic geometrical concepts for example Euclidean geometry.

Majhi: Majhi refers to an indigenous ethnic group of Nepal who has been forced to fall backward politically, economically, educationally and socially.

Ethnographic: The scientific study of people and cultures.

Ethnic group: A category of people who identify with each other based on similarities such as common ancestry, language, society, culture or nation.

Literacy: According to (National Education System Plan) NESP(1971), literacy means being able to at least read and write general Nepali and perform fundamental mathematical operations in daily life.

Chapter II

REVIEW OF RELATED LITERATURE

The review of related literature involves the systematic identification, location and analysis of document containing information related to the research problem. It helped me to know the work carried out in the area of research project and also helped to make the concept clear for the study. Different researchers have done the study on geometrical concepts of different community on the basis of ethno-mathematics. But no studies have been done on “Basic geometrical concepts practiced by Majhi community”. Some reviews of related literatures for the study of this topic were as follows:

Theoretical Review

The review of concepts or theories related to the study is known as theoretical review of literature. There are various concepts or theories about learning mathematics, ethno-mathematics, constructivism and ethnography. Some theoretical reviews of related literatures are as follows.

Ethnography

Ethnography is the in-depth study of naturally occurring behavior within a culture of a social group. It is derived from anthropology and is the scientific study of people and cultures. It is designed to explore cultural phenomena where the researcher observes society from the point of view of the subject of the study. Ethnographic designs or method are qualitative research procedures for describing, analyzing and interpreting a culture – sharing group’s shared pattern of behavior, beliefs and language that develop over time.

According to Iphofen (2011) the broad theoretical assumptions of ethnography are as follows; which are sometimes referred to as the "special commitments" that are attached to the use of ethnography.

Understanding and interpretation: The verstehen (verstehen is a German term that means to understand, perceive, know and comprehend the nature and significance of a phenomena) tradition in the human sciences argues that all human actions are socially constructed and meaningfully intended. People do things for specific reasons and to attain specific outcomes. They are thinking, purposeful creatures communicating their intentions in a variety of ways.

Social events are processual: Social meanings are generated in a dynamic process of negotiation; this is not a static phenomenon. Human beings are engaged in movement and change – they sometimes initiate it and always have to respond to it. So meanings and intentions have to be actively established and maintained.

Naturalism: It is assumed that the artificial manipulation and control of subjects should be avoided – for accuracy and authenticity it is vital to observe them doing what they do 'naturally'.

Holism: Along with naturalism the inauthentic fragmentation of social life should be avoided. Scientific analysis sometimes segments peoples' actions and thoughts in ways which take them out of context. Attitudes and behavior are to be seen as elements in a whole cultural context. Often actions and thoughts can only be understood in terms of the social network that individuals belong to.

Multiple perspectives: A fundamental theoretical assumption is that there is always more than one way of looking at or talking about things. This implies the

avoidance of any ‘dominant hierarchy’ perspective. This requires guarding against assuming the necessary superiority of any one scientific perspective or any one ‘worldview’. People hold different perspectives according to their particular social situation. This might mean different people holding different perspectives on the same situation or event. It also means the same people holding different perspectives when in different contexts or at different points in time. It suggests a kind of ‘relativity’ about how we understand the world. It is does not assume that there is only one, rational, efficient, or correct way to do things – attitudes, values and behavior depend upon social and cultural circumstances.

Van Hiele’s Model of Learning Geometry

In mathematics education the Van Hiele model is a theory that describes how students learn geometry. The best known part of the Van Hiele models are the five levels which the Van Hieles postulated to describe how children learn to reason in geometry. There are five levels, which are sequential and hierarchical. They are

Level 0; (Basic level) Visualization: At this initial stage, geometric concepts are viewed as total entities rather than as having component. For example, geometric figures are recognized by their shape as a whole, that is, by their physical appearance, not by their parts or properties. So that, the students recognized that rectangle is as door of a house. A person at this stage, however, would not recognize that the rectangle have right angles or opposite sides are parallel.

Level 1; Analysis: At level 1, an analysis of geometric concepts begins. For example, through observation and experimentation students begin to understand the characteristics of figures. So that, the students recognized that a square have four equal sides and right angles. Thus figures are recognized as having parts. At this stage

the students establish that the opposite angles of parallelogram are equal. But relationship between properties, however, cannot yet be explained by students at this level, interrelationships between geometric figures are still not seen, and definitions are not yet understood.

Level 2; Informal deduction (Relationship): At this level, students can establish the interrelationships of properties both within figures (e. g. in a quadrilateral, opposite sides being parallel necessitates opposite angles being equal) and among figures (a square is a rectangle because it has all the properties of rectangle). Thus they can deduce properties of a figure and recognize classes of figures. Definitions are meaningful.

Level 3; Deduction: At this level, the significance of deduction as a way of establishing geometric theory within an axiomatic system is understood. The interrelationship and role of undefined terms, axioms, postulates, definitions, theorems and proof is seen. A person at this level can construct, not just memorize, the possibility of developing a proof in more than one way is seen, the interaction of necessary and sufficient conditions is understood, and distinctions between a statement and its converse can be made.

Level 4; Rigor (Axiomatic): At this stage the learner can work in a variety of axiomatic systems, that is, non-Euclidean geometries can be studies, and different systems can be compared. Geometry is seen in the abstract (Crowley, 1987).

Vygotsky's Sociocultural Theory

Vygotsky's sociocultural theories on the extension of constructivist approach. He describes learning as a social process and the origination of human intelligence in

society or culture. The major theme of his theoretical framework is that social interaction plays a fundamental role in the development of cognition. Vygotsky learning theory is based on constructivism. Whereas the learner can learn mathematics own way and use different method to learn mathematics. The learner solves the problem by using new method, prior knowledge, instructional materials and experiences.

He believed everything is learned on two levels. First, through interaction with others, and then integrated into the individuals mental structure. A second aspect of his theory is the "Zone of proximal development" (ZPD) or cognitively prepared students require help and social interaction to learn meaningfully.

This theory stresses the interaction between developing people and the culture in which they live. The central themes of his theory are as follows:

- Cognitive development occurs in social interaction.
- Psychological functioning is mediated by language and other cultural tools.
- Cultural norms and other people influence children's opportunities for learning.
- Social and cultural learning require particular cognitive abilities.

Empirical Review

The review of research report, thesis or research based writing related to the study is known as empirical review of literature. There are several researches about ethno-mathematics which are already done. Some empirical reviews of related literature were as follows:

CERID (1990) studied on "Elementary process of learning mathematical concepts in Nepal: A study on maths concepts and process of Rasuwa Tamang" submitted to UNESCO/Bangkok. The main objective of this study was to investigate the maths concepts and processes locally used by the Tamang people. The specific objectives are to study the basic maths concepts used by Tamang adults with no formal math education, to identify traditional Tamang methods of maths operation and to find out the implications of Tamang processes and tone up the present learning situation. That project work has concluded that the Tamang people have their own numbers name in their native language, system of counting based on 20. Their geometrical concepts are based on the shapes and structure patterns of objects existing around. They measured lengths and breadths by using hand and fingers like as; Haat, Bitta, Ammal etc. Also they have their own system of area measurement, volume measurement, weights measurement, time measurement, mathematical process and concepts for calculation. This study has also showed that the situation of Tamang children into the formal schooling system. But it did not study the effect of ethno-mathematical practices in the classroom setting.

Pageni (2006) studied on "Concepts of geometry used by Chitwan Tharu". The main purpose of that study was to explore the geometrical concepts used by Chitwan Tharu. The design of this study was a qualitative research and tools of data collection were observation and interview. He concluded that; before constructing any objects at first they make a shape and size of that object in their mind and construct an object using traditional method of measuring using hand according to their thoughts designed before. They mostly prefer to construct geometrical object which are circular in shape. They could not distinct between geometrical objects having different shapes (such as: sphere, circle, two dimensions and three dimensions). For some machinery

equipments they could able to tell the name of each part but for some machinery equipments they could say the name of whole object.

Dahal (2010) studied "Basic mathematical concepts and processes of Sherpa community in Solukhumbu district". The design of this study was ethnographic in nature and data collection tools were observation and interview. He found that; Sherpa have no their own script. They have been following the Tibetan script. He found their specific symbols to represent the numbers from 1 to 10 only. They did simple mathematical operations orally. The mathematical process is based on traditional practices and they use it through physical object of the environment in particular situations. The counting system of Sherpa has gone by adding suffix for each 10, 20, 30… 100 numbers. They measured lengths and breaths by using hands and fingers. Amal, Kuret, Bitta and Haat are the measuring units of length and breaths. The area measurement is reflected in construction of house and the area of house is measured in terms of Haat. The units of volume measurement are Chimti, Muthi, Chauthi, Pala, Mana, Kuruwa, Pathi and Muri. The units of weight measurement are Pau, Bisauli, Dharni, Chhatak, Pather, Aathpol, Kg etc. He did not focus on the geometrical knowledge of Sherpa community.

Bhusal (2010) has studied on the topic "A study on the use of geometrical concepts by Darai community: An ethno-mathematics study of Chitwan district". The main objective of this study was to explore the geometrical concepts used by Darai community. Design of this study was qualitative and tools of data collection were observation and interview. His research was based on primary and secondary data. He concluded that; while constructing any object, they make a conceptual vision of the concerning objects (i.e. size, shape, etc.), then they construct it using their indigenous method before they designed. The circular shaped objects are mostly preferred, so that

it covers more area. They are not able to differentiate among geometrical objects having different shapes (such as: sphere, circle, two dimensions and three dimensions). They are able to tell the shape of each parts of some machinery equipments, but not able to tell the name of some machinery equipments, which they told the name of whole object. Some younger and literate persons are becoming aware of formal geometrical concepts and first prepare sketch of object in paper then construct an object according to their thought, also able to distinct different shape. Some younger people are able to use their cultural concepts of geometry for acquiring formal geometrical concepts in school curriculum. Students having their guardians literate are developing and receiving geometrical concepts strongly and those students whose guardians are not literate receive slowly geometrical concepts through formal school education.

Nyaupane (2012) has studied on the topic "Basic mathematical concepts and numerical system used by Magar community". The design of this study was qualitative. The tools and instruments of this study were observation, interview and photograph. He concluded that; the numeration system of Magar is base 20 and they have only up to 10 number names in their native language, for the greater number then above 10 they have adopted Nepali name. Greater then 10, two or three number can get in their native name now a day their native name above five is going to be disappeared. Greater numbers are expressed in the system of 20s. They had the concepts of numbers, scale, circle, cylinder, straight, parallel lines, perpendicular, plane, cone and congruence.

Lama (2012) has studied on the topic "understanding basic concepts of mathematics by Tamang community". The design of this study was ethnographic and tools of data collection were in-depth interview, observation form and written

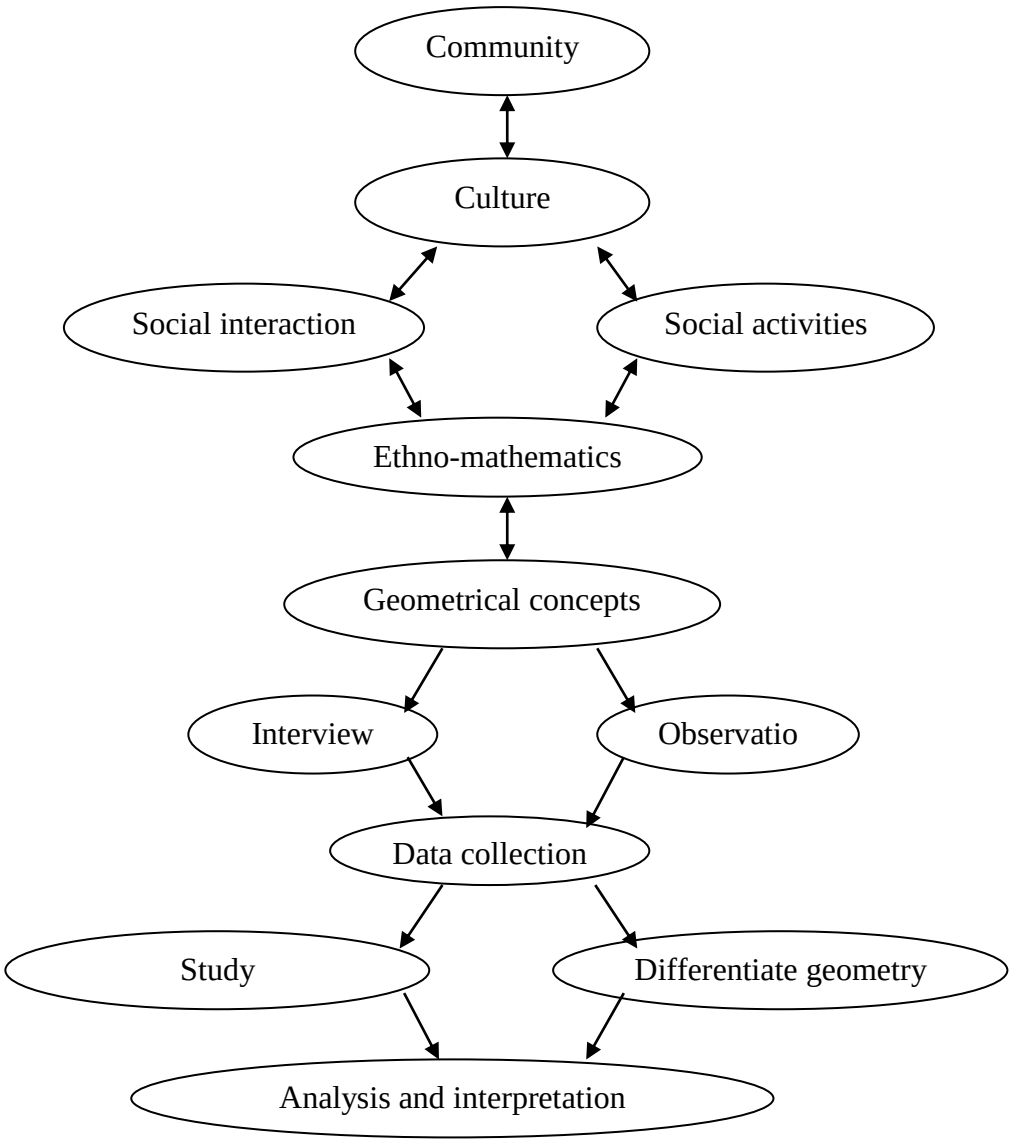
documents. He found that; base 10 and base 20 numeration system have been practiced in Tamang community for counting purposed. Tamang have no their own script. They have been following the Tibetan script. They did simple mathematical operation orally. The counting system of Tamang has gone by adding suffix for each base 20 numbers after twenty. The mathematical process is based on traditional practices and they use it through physical object of the environment in practical situation. They measured lengths and breadths by using hand and fingers like as; Ammal, Kuret, Bitta, Haat etc. The area measurement is reflected in construction of house and the area of house is measured in terms of Haat. The units of volume measurements are Muthi, Chauthai, Mana, Kuruwa, Pala, Chakanchi, Pathi and Muri. The units of weight measurement are Chhatak, Pau, Dharni, Pather, Aathpol, kg etc.

The above review of related literature is important sources for further study of research work. The review of related literature is essential for guidance of research planning. Among these studies, some were directly related to learning strategies of mathematical concepts of different ethnic groups. The different ethnic groups perform their mathematical concepts by their own way. So, the review of above literatures encouraged me to study the basic geometrical concepts practiced by Majhi community.

Conceptual Framework

A conceptual framework is a representation, graphically of the main concepts and their presumed relationship with each other. It can be thought of as map or a travel plan. It is a type of intermediate theory that attempt to connect to all aspects of the study and it is generally derived from conceptual framework. The following model is the conceptual framework of this study.

Geometrical Concepts in Majhi Community



Community, culture and geometrical concepts are inter-related. Different geometrical concepts are developed in the community. These geometrical concepts can be found by interview and observation. According to the above model of conceptual framework, first I visited Majhi community to observe their culture, social interaction, social activities and ethno-mathematics. Then I selected geometrical concepts only from their ethno-mathematics. Then I collected data by the help of interview and observation. Then I studied the data and differentiate geometrical concepts to analysis and interpretation data.

Chapter III

METHODS AND PROCEDURES

In this chapter I presented the methods and procedures of the study. Research methods and procedures is a plan, which determines how to complete the research systematically. It carried out to achieve the objectives of the study and to get answer of the research questions. It described the design of the study, study area, sample of the study, tools of data collection, data collection procedure, data analysis and interpretation.

Design of the Study

The design of the study was qualitative in nature and ethnography was the approach of the study. Qualitative research is a generic term for a variety of research approaches that study phenomena in their natural settings, without predetermined hypothesis. It was conducted on the ethnographic basis, ethnography sometimes known as cultural anthropology, is a method of field study observation. The nature of this study is of descriptive type and descriptive method was adopted for the analysis of data. I tried to identify the basic geometrical concepts practiced by Majhi community and its pedagogical implication. The information and sources needed for the study was based on primary as well as secondary sources of data. Primary data was collected from observation, face to face interview and photographs.

Study Area

Sindhuli district is one of the districts among the seventy-five districts of Nepal. The Sindhuli district is lies in the middle part of Janakpur zone. Sindhulimadi is its district headquarters. It covers an area 2,491 sq. km and has a population 296,192

(national census report 2068). Sindhuligadhi is an ancient and famous place of the Sindhuli district. In the Sindhuligadhi war the Gorkha force defeated British in November 1767 (Kartik 24, 1824 BS). According to national census report 2068, there are 10,279 Majhi in Sindhuli district, which is the highest population as other district. There are two municipalities Kamalamai and Dudhouli, seven village institutions Golanjor, Ghanglekh, Tinpatan, Phikkal, Marin, Sunakosi and Hariharpurgadhi in Sindhuli district. Among these various places of Majhi, this study was taken from "Marin" village institution which is the main area of Majhi in Sindhuli district. So, the study area was:

"Marin" village institution: "Marin" village institution is one of the seven village institution of Sindhuli district. This village institution is lies in the middle-west part of Sindhuli district. This village institution has boundaries as Sarlahi district in the south, Hariharpurgadhi village institution in the west, Ghanglekh village institution in the north and Kamalamai municipality in the east. There are several communities in this village institution like Brahmin, Chhetri, Tamang, Majhi, Magar, Kami, Damai, Newar, Sarki and so no. The Majhi communities are involved in agriculture, husbandry and fishing in this village institution. They have their own language, cultures, religious, rituals, belief, dress, festivals, tradition, norms, activities, living style and god. So, "Marin" village institution of Sindhuli district was essential for this study. The population of the study was taken from the Majhi people of Dhamile, Chanduli and Chhap villages of Marin village institution, Sindhuli district. The population distribution of Majhi people in Dhamile, Chanduli and Chhap villages of Marin village institution, Sindhuli district is shown in table 1 page no 10.

Sample of the Study

This study was based on qualitative research. So the sample size of this study was not fixed. According to Anderson, there are no rules for sample size in qualitative inquiry. At first three villages Dhamile, Chanduli and Chhap were selected by purposive sampling and then respondents were also chosen by the purposive sampling. I selected eleven Majhi people from Dhamile two from Chanduli and five from Chhap including twelve farmers, four students and two teachers. Among them thirteen were male and five were female. Moreover, I discussed with other senior Majhi people as available and needed.

Tools of Data Collection

The consequences of the research depend on technique of data collection. There are many techniques for the qualitative research to get the information during the research. To collect the primary data, the following tools were used.

In-depth Interview

At first, I prepared interview guidelines including open-ended topics on the basis of research document, objective of the study, suggestion from supervisor and according to situation of environment. Then I met the Majhi people personally again and again as needed. With the help of interview guidelines, I took the in-depth interview with Majhi farmers, teachers and students to collect primary data. The main objective of the in-depth interview was to identify the basic geometrical concepts practiced by Majhi community and its pedagogical implication. At that time, I took photos and made field note. The data from interviews consisted of direct questions to

people about their skill, opinions, experiences, ideas and knowledge of geometrical concepts.

Observation

To collect the information observation is one most important technique in the qualitative research. I visited directly and indirectly around the study area to know the villagers cultures, daily life activities (agricultures, construction process of domestic goods and other specific activities), experiences, geometrical concepts and environment. Then I collected and categorized those objects which gave the basic geometrical concepts and took photos of that objects with making field note. I used both the participant and non-participant observation for the study. After overall observation, I identified their basic geometrical concepts and its pedagogical implication.

Data Collection Procedure

There are many approaches for the qualitative research to get the information from the people about their ideas, experiences, skill, believes, histories and so on. At first, I visited the selected villages and then discuss with the Majhi farmers, students and teachers about their basic geometrical concepts and cultures. The sources of data collection were primary as well as secondary also. The data were collected by using the in-depth interview, digital photograph, observation, audio-video records and written documents as a secondary source like personal diaries, journals, program record, report, books, and thesis, published and unpublished research documents related to this study. At that time I took photos and made field note.

Data Analysis and Interpretation

Data analysis involves reducing and organizing the data, synthesizing, searching for significant patterns, and discovering what is important. At first, I visited the field of the study and then by using the tools of data collection I collected the information as needed. At that time for the identification of basic geometrical concepts and its pedagogical implication I asked research questions to the Majhi farmers, teachers and students. At the same time I took audio-video record and field note. Then I categorized and organized the collected information according to the different geometrical concepts. Then I had been coding that field note, similar coding was organized together and then gave theme for that organized similar coding. A rigorous and systematic reading and coding of the transcripts allowed major themes to emerge. Then I utilized those different field notes and themes to explain data in their perspectives, in the analysis and interpretation of research work. The validity and reliability of this study was maintained by triangulation, thick description and prolonged engagement in the field.

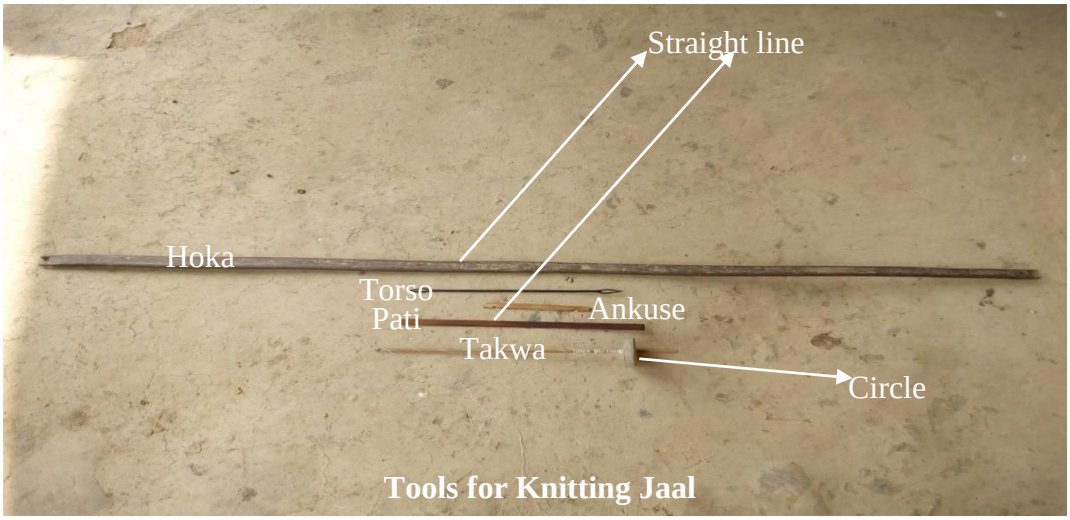
Chapter IV

ANALYSIS AND INTERPRETATION OF DATA

This chapter is devoted to analyze and interpret the data collected from the field of observation, interview and photographs related to my topic “Basic geometrical concepts practiced by Majhi community” and its pedagogical implication.

Jaal (Fishing Net)

At first, I visited my study area for the data collection of the study. At that time, I asked research questions to one of the Majhi people Bal Bir Majhi about his concepts of geometry which used in this material by the help of interview guidelines. Then he replied that to construct it he took Tosro, Pati, Takwa, and nylon rope, Chutti, Ankuse, Gotti and Hoka. At first, he knitted nylon rope by the help of Pati and Tosro from the starting point Chutti with making holes. I found that each side of holes was determined by breadth of Pati so that every hole was square in shape and equal. Its upper part was already closed by Chutti where as the lower part was open with hanging Gotti by the help of Batan. It was a famous material for fishing. It becomes in circular shape if spreading in river to fishing. But the overall shape of this material was conical. They made it in such shape so that it covers more area.



Tools for Knitting Jaal

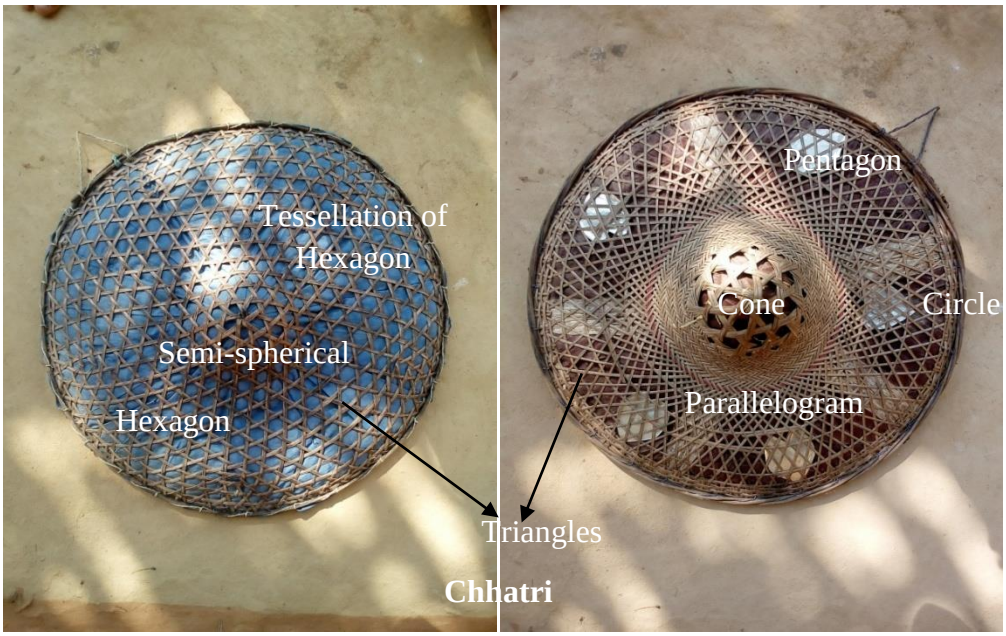
Pedagogical Implication

In this material, we can find the different types of basic geometrical concepts which are directly linked with school geometry. We can see that every hole is square in shape. As a whole it is a conical in shape but circular if spreading. Also we can see that the stone of Takwa is circular and other tools for knitting Jaal are straight line in shape. So that, if we use this material as a teaching material in the classroom to teach the concept of square, conical and circular shape and straight line students can understand easily at the school level.

Chhatri

The respondents of the study Bal Bir Majhi and Krishna Majhi replied to my research questions that the shape of this material was circular like as umbrella and used for protecting from the rainfall and sunlight like as a hat. At first, to construct it they took five small piece of bamboo according to the size they prefer. Then by the help of additional small pieces of bamboo they knitted it with making hexagonal holes like as a tessellation of hexagon. I found that it had some small holes in the shape of triangle, parallelogram and pentagon which was the main strategies to construct it. It

had the diameter around at least one hand and its Kachauni was conical or semi-spherical in shape. They made it in such shape so that they are able to work easily.



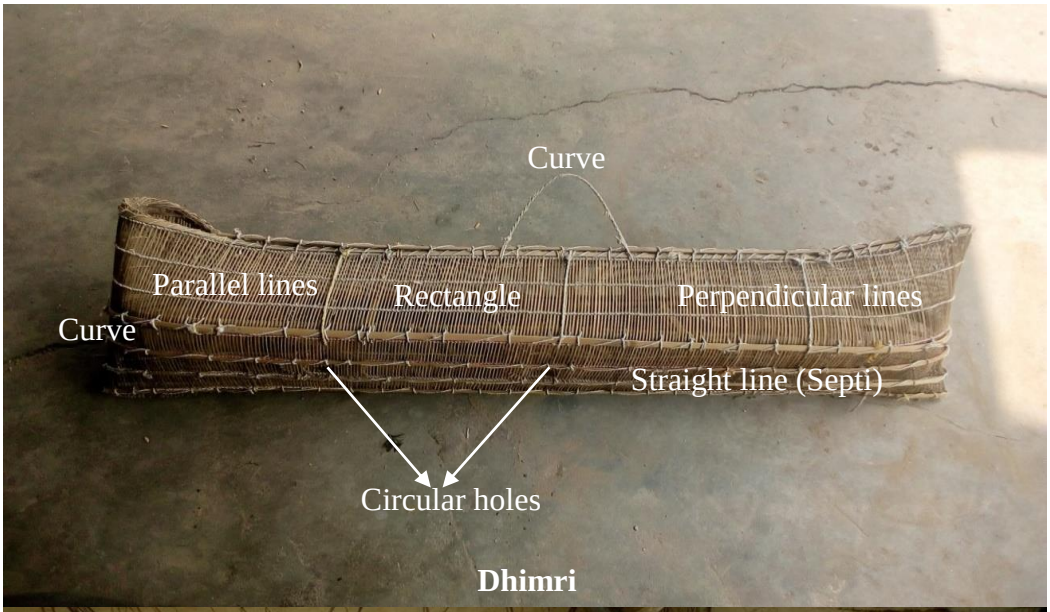
Pedagogical Implication

In this material the different types of basic geometrical concepts are found. Its Kachauni is conical in shape as well as semi-spherical also but Mareula or Bit is circular in shape. We can see that some holes are regular hexagon, some are pentagon, some are parallelogram and some are small triangle in this material. All regular hexagonal holes are arranged like as a tessellation of regular hexagon. So we can use it as a teaching material to teach the basic concept of cone, circle, triangle, parallelogram, pentagon, hexagon, tessellation of regular hexagon, and semi-spherical shape in the classroom at school level.

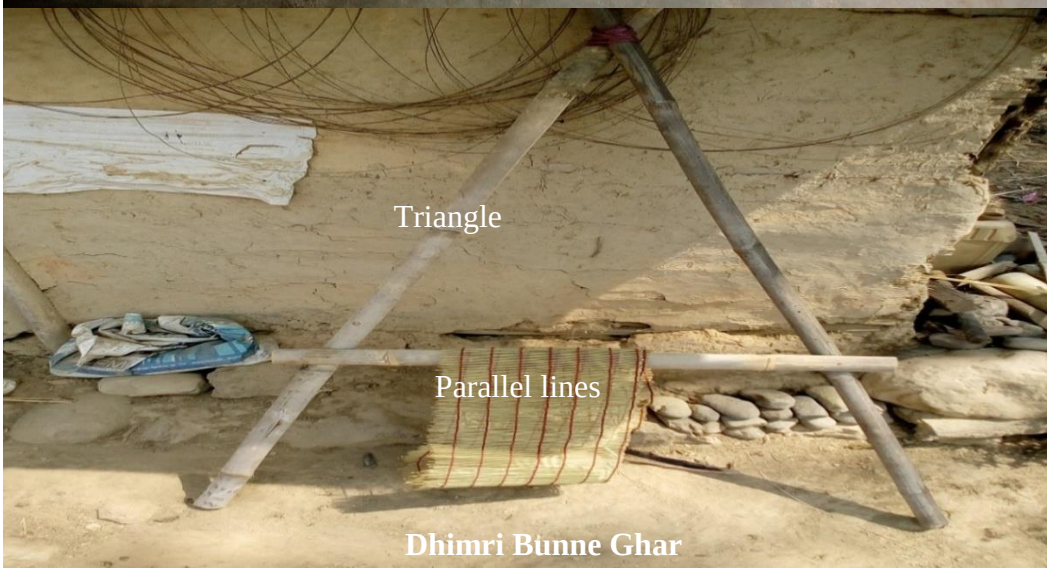
Dhimri

I visited my own community for the data collection of the study. At that time I asked research questions to one of the Majhi people Krishna Majhi about his concepts

of geometry which used in this material by the help of interview guidelines. Then he replied that it was a kind of material used for fishing. It had six faces like as a closed material, in which four faces were equal and rectangular in shape; other two remaining faces were equal but curve in shape. With the help of small pieces of bamboo, circular holes (Pari) were made in the lower rectangular faces of both sides. At first, to construct it they used the concept of parallel line, and then fold with making rectangular and curve shape. He constructed it by the help of Dhimri Bunne Ghar in such shape so that the fishes can go inside from the circular holes (Pari) but cannot come back outside.



Dhimri



Dhimri Bunne Ghar

Pedagogical Implication

In this material we can see that every small splits of bamboo are parallel to each other. Its four sides are rectangular but two sides are curve in shape. In this material its Bunauta (plastic rope) are parallel and perpendicular to each other which makes the small rectangles. Also we see that its Pari are circular and all Septi are straight line on the rectangular faces but curve on the curve faces. The Dhimri Bunne Ghar is a triangular in shape. So it is used for teaching the basic geometrical concepts of parallel line, perpendicular line, rectangle, circular hole, curve, triangle and straight line at the school level.

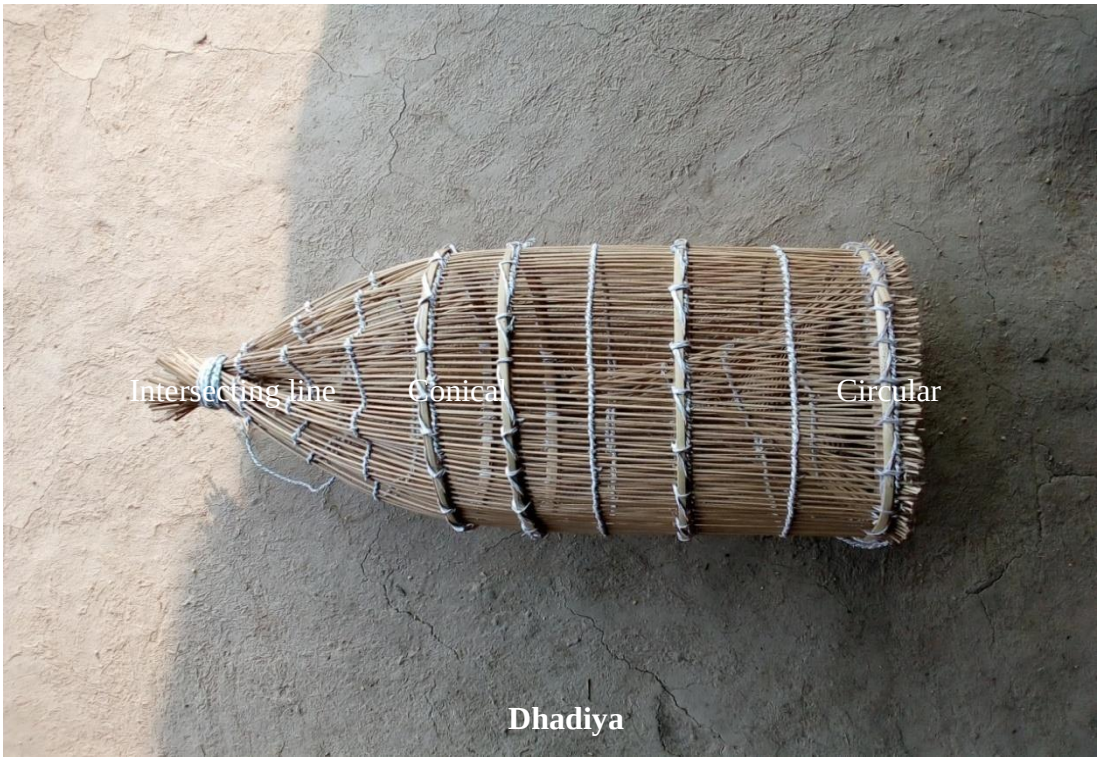
Dhadiya

A respondent of the study Bal Bir Majhi said that to make it he took plastic rope, small piece of bamboo and Dhimri Bunne Ghar (showed in above figure). It is a kind of material which was used for fishing and had a conical in shape. For the fishing its lower part must be tightened by plastic rope with in a conical shape but its upper part was already closed with its small circular hole. So that, the fishes can go inside from that holes but cannot come outside, this was the main strategies to make it in such shape. It had at least one Bitta diameter and one hand height. For fishing it was placed in narrow and slope passage of water. So that, fishes pass through from the small circular hole and were trapped. He used the concepts of intersecting and parallel line to construct it and then fold circularly.

Pedagogical Implication

Different types of geometrical concepts are used in this material. We can see that its upper part and all Septi are circular but lower part is conical in shape. Its every

small splits of bamboo are intersecting to each other at a point. So we can use this material at school level as a teaching material to teach the concept of conical, circular shape and intersecting line.



Chhapni

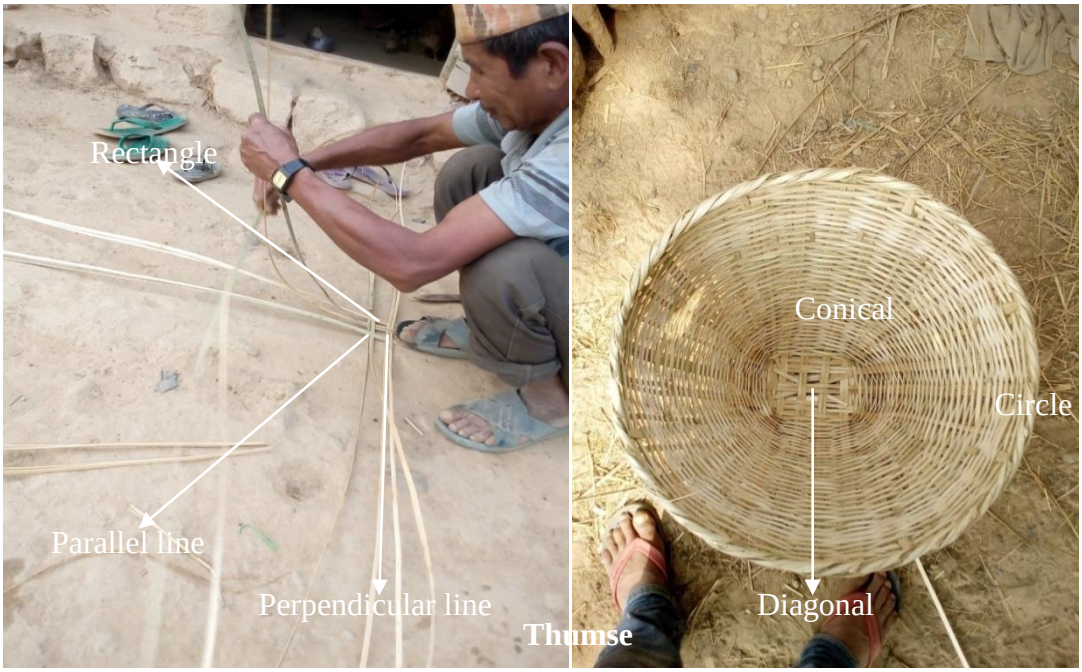
A respondent of the study Krishna Majhi replied to my research questions that the shape of this material was as a cone. It is used for filter Jad (ale) and fishing which was constructed by the small splits of bamboo and plastic rope. To make it he used the concepts that every hole was square in shape. It must have at least one Bitta diameter of circular part and at least one Bitta height. He constructed it in the shape that lower part was already closed with conical in shape and upper part was open with circular in shape. He made it in such shape so that he can filter Jad and catch fish from water easily.

Pedagogical Implication

It is a three-dimensional geometric shape. We can see that the mouth of this material is circle and every hole is square in shape. As a whole it is a perfect example of cone at the school level. So that, by the help of this material we can teach the basic concept of cone, circle and square clearly at the school geometry.

Thumse

I asked research questions to one of the Majhi people Krishna Majhi about his concepts of geometry which used in this material by the help of interview guidelines. Then he replied that it was a kind of basket in the shape of conical. It was made from small pieces of bamboo and used for carry grass, small wood, corn, compost manure, small domestic goods and to covering chicken. At first, he used the concept of rectangle, parallel line, perpendicular line and then circular to construct it. Its upper part was open with diameter at least one hand. But its lower part was already closed by its rectangular base which was diagonally crossed by two small pieces of bamboo. He made it in such shape to carry more objects at a time.



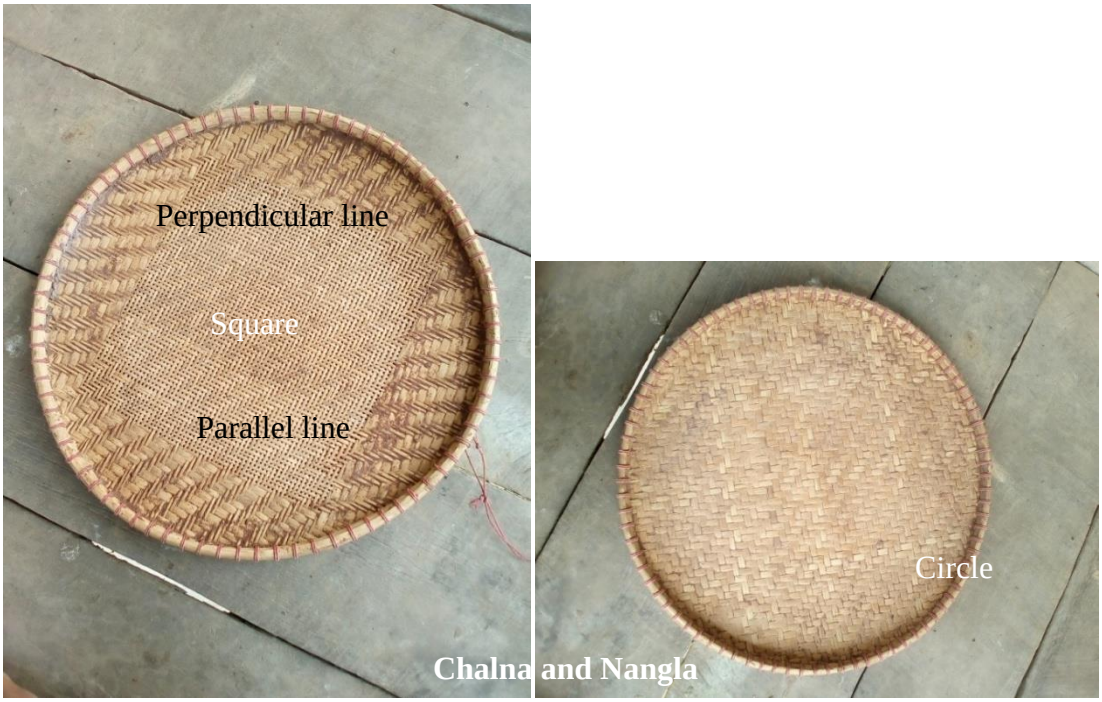
Pedagogical Implication

In this material we can see the various geometrical concepts. All small pieces of bamboo are arranged parallelly, perpendicularly and diagonally with making rectangular holes in the base part of this material. But its mouth and middle parts are circular in shape. As a whole it is a conical in shape. So that, we use this material as a teaching material to teach the basic concepts of parallel, perpendicular and diagonal line, conical, rectangular and circular shape .

Chalna and Nangla

A respondent of the study Krishna Majhi explained to my research questions that these materials were constructed by small pieces of bamboo in the shapes of circular. At first, he used the concept of parallel line, perpendicular line and then circular to construct it. I found that every hole of Chalna was square in shape and part of holes was also a square in shape which is the geometrical concepts that the combinations of square are again a square. These materials had at least one hand

diameter. They made it in such shape to keep more grain and to filter more flour at a time.



Chalna and Nangla

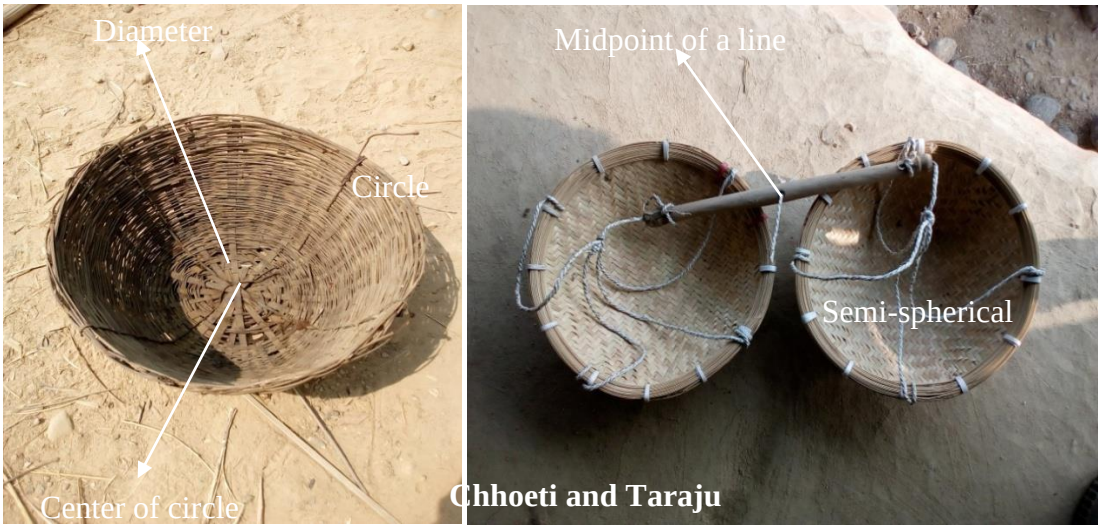
Pedagogical Implication

We can find the different types of geometrical concepts in these materials. Some small pieces of bamboo are parallel and some are perpendicular to each other. Its Bit is a perfect example of circle. Also we see that the combinations of square are again a square. So, these materials help us to teach the basic concepts of circle, square, combinations of square are again a square, parallel and perpendicular line at the school level in geometry class.

Chhoeti and Taraju

I asked the research questions to the respondent Krishna Majhi by the help of interview guidelines then he replied that these were the domestic goods and semi-spherical in shape. These were made from small pieces of bamboo by using the same process. To make Taraju they placed the Chitra Mandra on the small Chhoeti. I found

that its base parts were circular in shape whereas he used the concepts of diameter and circle to construct it. It was used to collect and sell vegetables and to take weight of meats and vegetables.



Chhoeti and Taraju

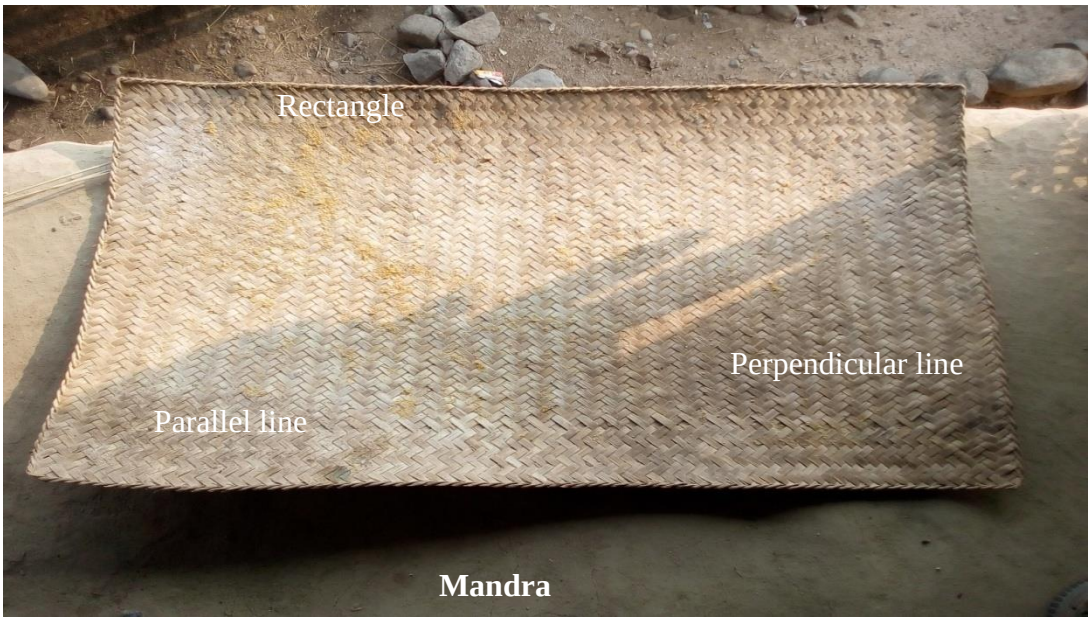
Pedagogical Implication

We can see the several geometrical concepts in these materials. In these materials all small pieces of bamboo are arranged as a diameter in the circular base. Its upper parts are circular in shape. We can see that the entire diameter passes through from the center of circular base parts. We can find the small circular hole at the mid-point of the stick in this material. As a whole these are semi-spherical in shape. So these materials provide the clear concepts about semi-sphere, diameter, and circle, center of circle and midpoint of a line at the school geometry.

Mandra

I visited my study area for the data collection of the study. At that time, I asked research questions to one of the Majhi people Dhanukha Majhi about his concepts of geometry which used in this material by the help of interview guidelines. Then he replied that it was a rectangular type of material and used to sleep, make ale, drying

paddy, wheat and other grain from sunlight. He did not know about rectangular shape but he made it by using her concepts of Charpate which is known as rectangle. I found that it was made from small splits of bamboo in rectangular shape for sleeping one or more person and to drying more grain at a time. It had at least three hand lengths and two hand breadth. All small splits of bamboo were knitting to each other as a parallel and perpendicular line procedure.



Pedagogical Implication

Ever children know about the shape of Mandra. In this material we can see the several geometrical concepts. It is a perfect example of rectangle to teach the geometry at school level. If we use this material to teach the concept of rectangle students can understand easily that the opposite side of rectangle are parallel and equal but adjacent side are perpendicular to each other. This implies that every corner of a rectangle is right angles. So in this material we can easily show that all the properties of rectangle. Some small splits of bamboo are parallel and some are

perpendicular to each other. So by the help of this material we can give the clear concepts about parallel and perpendicular line and all the properties of rectangle.

Chyadi (Dhedanga)

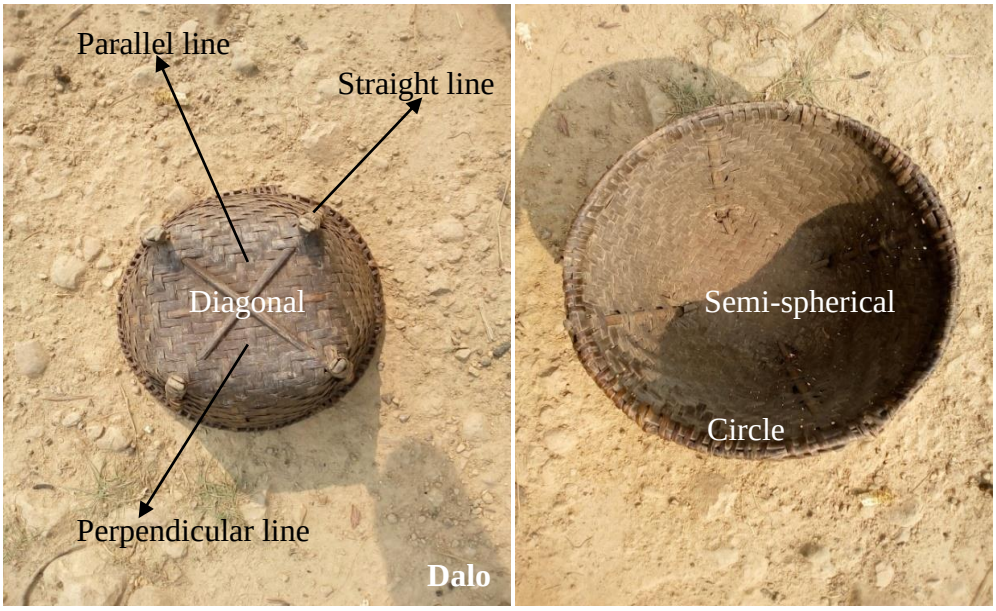
A respondent of the study Dhanukha Majhi replied to my research questions that it was a kind of domestic goods in the shape of circular and used for covering chicken. Its base or lower part was rectangular in shape whereas every hole was also rectangular in shape. But its upper and middle part were circular in shape whereas every holes were hexagonal and small triangular in shape. I found that its upper part was open with circular hole but lower part was closed by its rectangular base. It was made from small splits of bamboo by knitting each other. At first, he used the parallel and perpendicular line and then circular procedure to construct it. He made it in such shape for covering more chicken. Two strong pieces of bamboo were knitting diagonally in rectangular part to give support for the small splits of bamboo.

Pedagogical Implication

We can find the different types of geometrical concepts in this material. Its base part is the combinations of rectangles which is again a rectangle. All small split of bamboo are arranged parallelly, perpendicularly and diagonally with making rectangular holes in the base part. Some small splits of bamboo are circular in upper and middle parts of this material. In this material we can see that some holes are rectangle, some are regular hexagon and some are small triangle. So that, it can be used to teach the basic concepts of rectangle, diagonal, circular, triangle, hexagon, parallel and perpendicular line.

Dalo

A respondent of this material Dhanukha Majhi answered to my research questions that it was a type of pot constructed by small pieces of bamboo which was semi-spherical in shape and used for keeping more grain, fishes and flour. He made it in such shape to keep very small grain, fishes and flour. At first, he used the process of parallel line, perpendicular line and then circular to construct it. Then two strong pieces of bamboo were knitting diagonally in lower part.

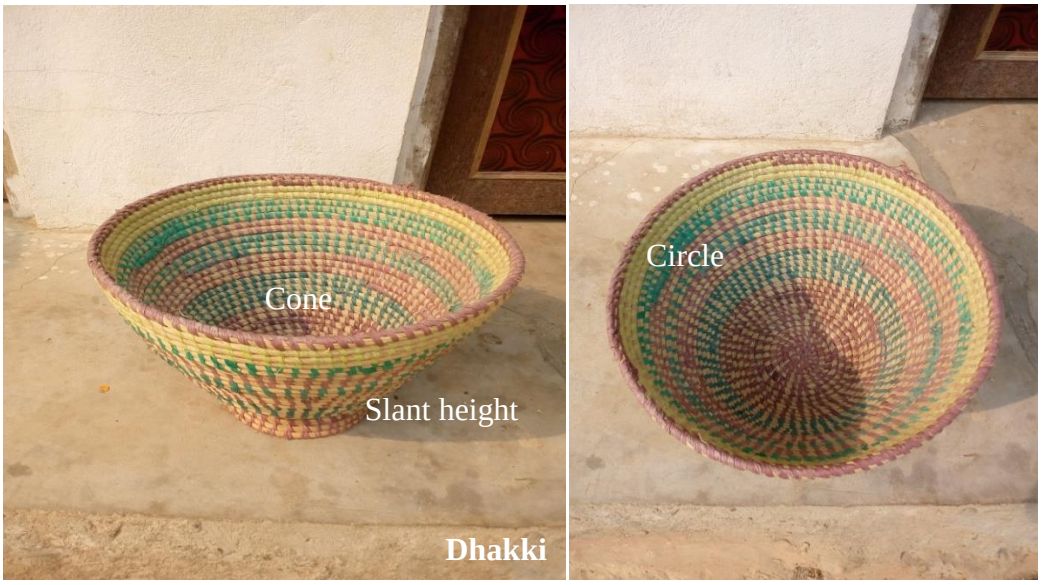


Pedagogical Implication

In this material we can find the different types of geometrical concepts. Some small splits of bamboo are arranged parallelly, diagonally and perpendicularly to each other in the base part. Its mouth is circular and legs are straight line in shape. As a whole it is a semi-spherical in shape. So it can be used to teach the basic concepts of circle, diagonal, straight line, parallel line, perpendicular line and semi-sphere at school geometry.

Dhakki

I asked research questions to one of the Majhi people Santi Majhi about her concepts of geometry which used in this materal by the help of interview guidelines. Then she replied that it was a kind of basket made from plastic rope and Babiyo. The shape of this material was conical and used for keeping small grain and flour. I found that its upper part was open with diameter at least one Bitta but its lower part was closed with diameter at least three Ammal. It had height at least one Bitta which was constructed by circular procedure. They made it in such shape to collect different small grain and flour.

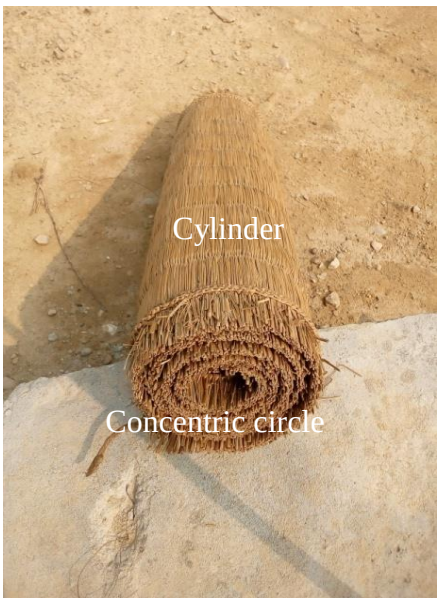


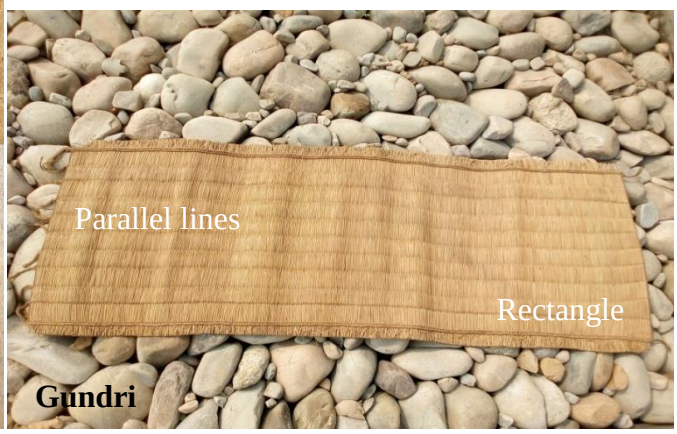
Pedagogical Implication

We can see the several concepts of basic geometry in this material. All parts of this material are circular and as a whole it is a conical in shape. Also we can see the slant height of this material. So if we use this material in the classroom as a teaching material we can give the clear concepts about cone, circle and slant height.

Gundri

A respondent of this material Santi Majhi replied to my research questions that it was a kind of mat constructed by Gucha or Paral (stalk of paddy) locally called Soya and rope of Jute. She used the concept of parallel line to construct it. The shape of this material was rectangular locally called Chaukune. I found that it was used to sleep and sit comfortably, so that she constructed it in such shape. If we fold circularly, it became in the shape of cylinder or concentric circles.





Pedagogical Implication

In this material we can find the different types of geometrical concepts. Every ropes of jute are parallel to each other. As a whole it is rectangular types of material

and we can see that all the properties of rectangle. If we fold circularly it becomes as a cylinder and concentric circle in shape. It is a kind of mat which is famous in the Majhi community. So that, if we used this material as a teaching material at the school level students can understand the concept of rectangle, cylinder, concentric circle and parallel line clearly.

Chanj

At the time of field study I asked research questions to two of the Majhi people Hari B. Majhi and Suka Majhi at the same time as a group discussion about basic geometrical concept which was used in their daily life activities by the help of interview guidelines. Then they replied that at the ancient period it used for fishing but now days it is used around in their field to protecting the vegetable from chicken, goat and other animal. It was made from small pieces of bamboo and rope of jute by using the parallel line procedure. They made it in such shape to protecting the vegetable because of any domestic animals cannot pass through from the holes between any two parallel lines.

Chanj

Pedagogical Implication

This material shows that every small splits of bamboo are parallel to each other. This is the perfect example of parallel line at school level. If we use this material to teach the concept of parallel line and straight line student can understand easily.

Chhoeta (Chhapri)

I asked the research questions to one of the Majhi people Asbir Majhi about his basic concepts of geometry which was used in his daily life activities to make different types of domestic goods by the help of interview guidelines. Then he answered that it was a kind of material to dry fishes and meat from fire which was constructed by the small pieces of bamboo in the shape of square. I found that two strong pieces of bamboo were joined diagonally to give support for other small piece of bamboo. This material was constructed by using the concepts of parallel and diagonal line. He made it in such shape to dry fishes and meats easily from fire.

Chhoeta (Chhapri)

Pedagogical Implication

This material shows that all the small pieces of bamboo are parallel to each other except two diagonal pieces of bamboo which is the main strategies to construct

it. We can see that two strong small pieces of bamboo are crossed diagonally under the parallel splits of bamboo. The overall shape of this material is square. So by using this material in the geometry class we can teach the basic concepts of parallel line, diagonal line and square clearly at the school level.

Beri (Bhakari)

A respondent of the study Krishna Majhi answered to my research questions that he used Beri (Bhakari) to store paddy which was made by small piece of bamboo in the shape of cylinder. But he did not know what is cylinder? Only knew that he could store more paddies in this shape. In her house different types of paddy were found so that he constructed it in this shape to separate paddy. At first he used the process of parallel line, perpendicular line and rectangle and then folds circularly to construct it.

Beri (Bhakari)

Pedagogical Implication

We can see that this material is open in both sides with circular holes. This material is considered as a perfect example to clear the concept of cylinder at the school level. So if we use this material to teach the concept of cylinder students can understand easily.

Khoga and Thatera

I asked the research questions to my respondents Bal Bir Majhi, Hari B. Majhi and Suka Majhi by the help of interview guidelines then they answered that it was constructed from the bamboo and used for fishing. To make it they must had at least three hands bamboo. Then only upper part of bamboo was split into small parts and knitted to each other with making circular hole in the upper part whereas the lower part was already closed. I found that as a whole the shape of Khoga was as pseudo-sphere as well as conical also. For fishing, they placed it in narrow and slope passage of water called Thatera which was made by small pieces of bamboo using the concept of parallel line where the water ran fast. They made Khoga and Thatera in such shape so that fishes passed through from narrow and slope passage of running water to the circular hole of Khoga and were trapped never came back.

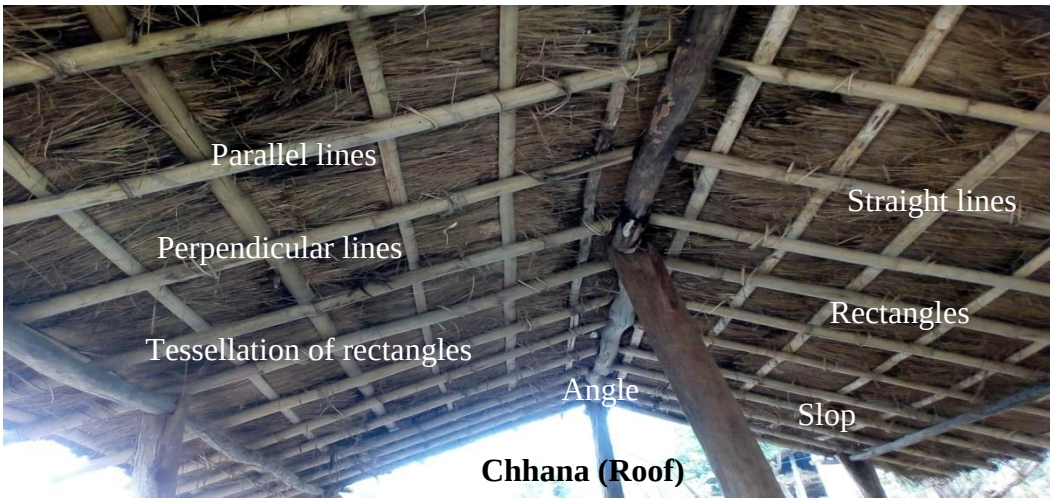
Pedagogical Implication

In this material we can find the different basic geometrical concepts which are used in school curriculum. The mouth of Khoga is circular but as a whole it is as pseudo-sphere as well as conical also. The Beruwa or Bunauta of this material is as a curve. Also we can see that every small splits of bamboo of Thatera are parallel to

each other and are placed in slope surface. So by the help of these materials we can teach the basic concepts of pseudo-sphere, circle, curve, cone, slope and parallel line at the school level.

Chhana (Roof)

In the research area, I asked the research questions about Chhana (Roof) to my respondent Asbir Majhi by the help of interview guidelines. Then he replied that to construct a Goth there were two parts of the roof as two rectangles in which these two rectangular parts made an angle around 110° to 120°. So that fall water easily to the downward. These two rectangular parts were slope in nature which was made on the long size of wood locally called Bola. I found that there were many combinations of splits of bamboo which were joining by the concepts of parallel and perpendicular line. So that two rectangular parts were divided into many sub-rectangular parts which are known as tessellation of rectangle. It was used for protecting the cow, goat, oxen, grass and small wood from rainfall and sunlight.



Chhana (Roof)

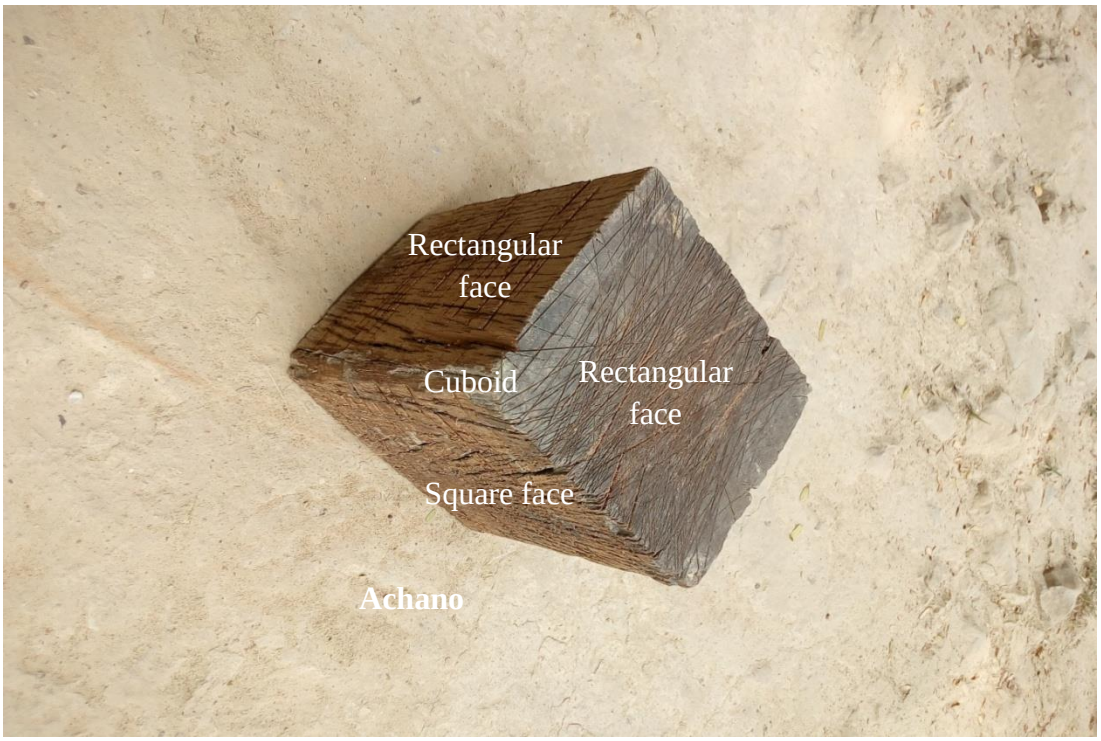
Pedagogical Implication

In this roof we can see that the several basic concepts of school geometry such as the combinations of rectangles are again a rectangle. All straight splits of bamboo

are joined parallelly and perpendicularly to each other. We can see it is as a tessellation of rectangle. As a whole there are two rectangular slope parts of the roof which makes an angle around 110° to 120°. So by the field observation of this roof we can teach the different basic geometrical concepts like as rectangle, parallel line, perpendicular line, slope, angle, straight line, tessellation and coordinate geometry.

Achano

I visited my study area to collect the data as needed. At that time, a respondent of the study Asbir Majhi answered to my research questions that it was made by a piece of wood in the shape of cuboid and used to cut meat and small pieces of bamboo. It was a three dimensional figures but he did not know about three dimensional figure cuboid. He only knew that it is as a kind of box in shape which has six faces. He made it in such shape, aiming that he used different faces at different time to cut meat and small pieces of bamboo.



Pedagogical Implication

The different types of basic geometrical concepts are found in this material. It is a perfect example of cuboid at school level. We can see that it has six rectangular faces and eight vertexes. Also in this material opposite faces are equal in shape which is rectangle or square. In this material four faces are rectangular and two faces are square in shape. Cuboid is a three dimensional figure and is abstract in nature if we cannot show it practically. So to teach the basic concepts of cuboid we can use this material as a teaching material at the school geometry.

Deli and Gedra

I asked research questions to two of the Majhi people Bal Bir Majhi and Krishna Majhi about their basic concepts of geometry by the help of interview guidelines. Then they answered that these were made by small piece of bamboo and used for keeping fishes. I found that the shape of Deli was semi-spherical but Gedra was conical. The upper part of Gedra was open with small circular hole but lower part was tightened by plastic rope in which every holes were parallelogram in shape. Also the upper part of Deli was open with circular hole but lower part was already closed. They made it in such shape so that fishes cannot fell easily downward.

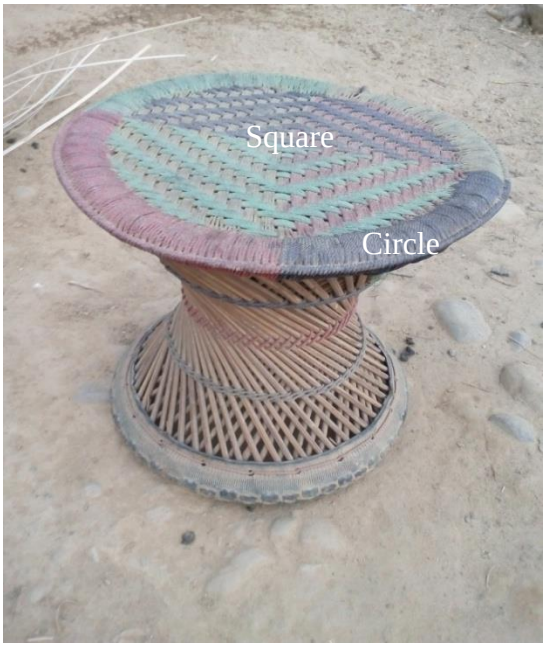
Deli and Gedra

Pedagogical Implication

In these material different types of geometrical concepts are used. The mouths of both materials are circular in shape. As a whole the shape of Deli is semi-spherical but Gedra is conical. Every small holes of Gedra are parallelogram in shape. So these materials are used to teach the basic concepts of geometry like as the concepts of conical, circular, parallelogram and semi-spherical shape at the school level.

Muda

At the time of field study Krishna Majhi replied to my research questions that it was a kind of chair used to sit which was a circular conical surface in shape like as union of two cones at a fixed vertex. It was made from small sticks of bamboo, nylon rope and tire of bicycle. He constructed it in such shape to sit comfortably. I found that its upper circular part was closed by square shape of nylon ropes which were knitting to each other with making square shape. But its lower part was open with circular hole of tire of bicycle in which each sticks of bamboo were knitted with making parallelogram holes between every four sticks of bamboo.

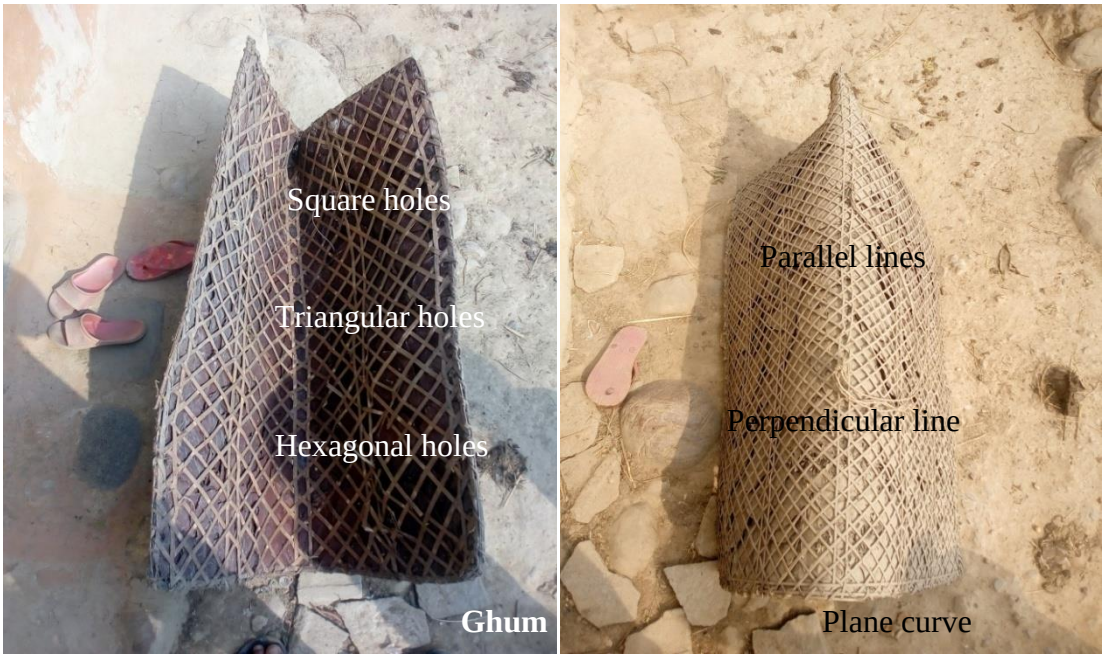


Pedagogical Implication

We can see the different types of basic geometrical concepts which are used in this material such as its upper and lower parts are circular in shape. On the upper part of this material all nylon ropes are knitted with making square shapes. We can also see that all small splits of bamboo are arranged with making parallelograms holes. As a whole it is a circular conical surface. So it can be applied pedagogically in school level to teach the basic concepts of a circular conical surface, square, circle and parallelogram.

Ghum

A respondent of the study Krishna Majhi replied to my research questions that it was a kind of traditional domestic goods of Majhi community. The shape of this material was as plane curve and constructed from small pieces of bamboo. It was used to protecting from the rainfall and sunlight. I found that he used the process of parallel line, square, triangle and hexagonal holes to construct it. He made it in such shape so that it covers all the body of human from rainfall and sunlight.



Pedagogical Implication

In this material the different types of basic geometrical concepts are found which are directly linked with school geometry. We can see that some small splits of bamboo are parallel and some are perpendicular to each other. In this material we can find the different kinds of holes in which some are squares, some are regular hexagons and some are triangles. As a whole it is a plane curve in shape. So, by using basic geometrical concepts of this material we can teach the basic concepts of geometry like as parallel and perpendicular line, triangle, square, plane curve and regular hexagon if we consider it as a teaching material.

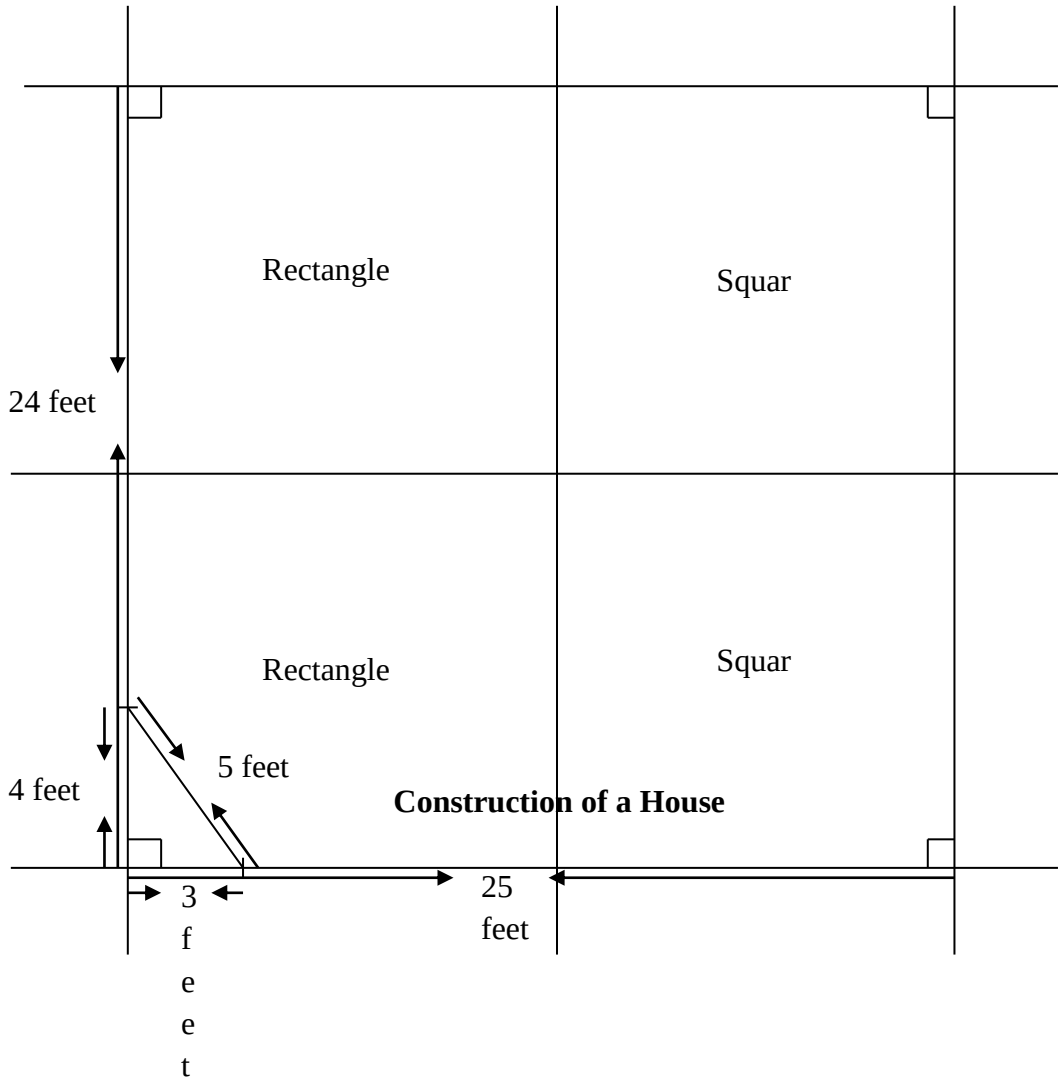
Construction of a House

At the time of field study, I asked research questions to my elder brother Sujan Majhi about his concepts of geometry which he used at the time of construction of a house by the help of interview guidelines. Then he answered that, normally he constructed the house in the rectangular or square base. To construct the house he used the concept of Pythagoras theorem unknowingly at that time when he made every corner of the house in 90° angle because every corner of house must be in 90° angle locally called in Batam. He said that in a rectangular base house if one corner was in 90° angle then other three corners must be in 90° angle itself. For this concept he used the concept of Pythagorean triple (3, 4, 5) but he did not know what is Pythagorean triple? This is shown bellow as his own procedure.

Pedagogical Implication

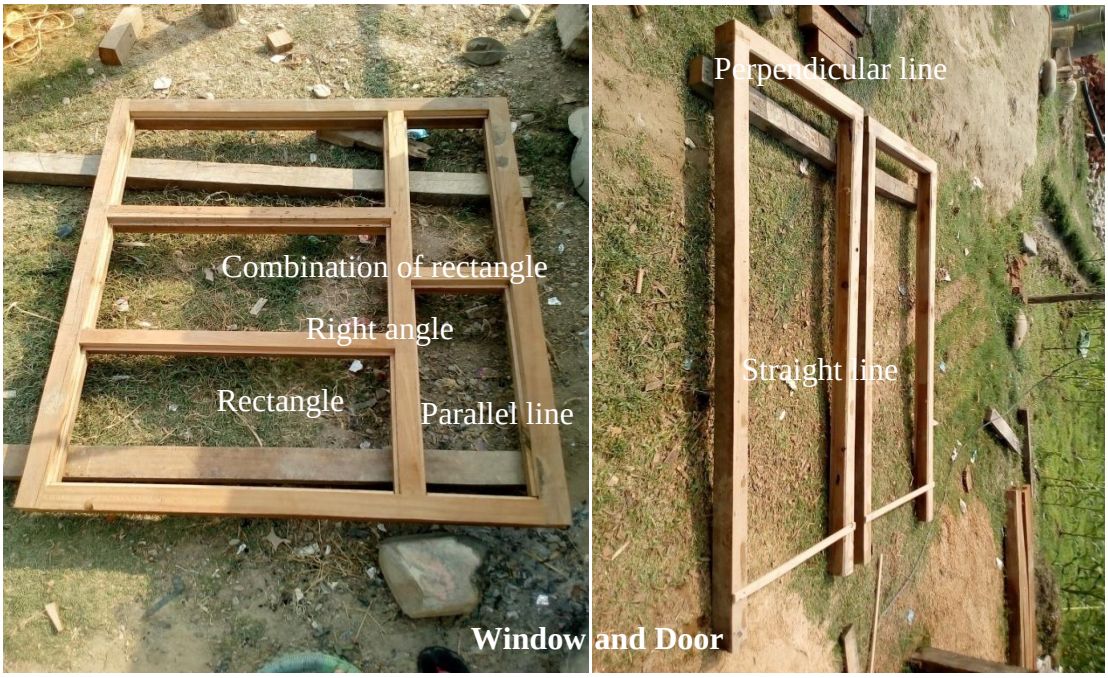
In this process of construction of a house he used the several basic geometrical concepts. In this process we can see that the combinations of rectangles and squares

are again a rectangle. Some rooms are rectangles and some are squares in shape. Every corner of the house and rooms are right angle. The Pythagoras theorem and Pythagorean triple are the main geometrical concepts of the process of construction of a house. So if we teach Pythagoras theorem practically in the field as a real life problem of Majhi community, then students can understand Pythagoras theorem easily and they never forget it. In this process we can see that h=5, p=4 and b=3 so that the Pythagoras theorem $h^2=p^2+b^2$ implies that $5^2=4^2+3^2$ or 25=16+9 or 25=25 which implies that (3, 4, 5) is a Pythagorean triple. So by the help of this process of construction of a house we can teach the concepts of Pythagoras theorem, Pythagorean triple, combinations of rectangles and squares are again a rectangle, square, angle and rectangle.



Window and Door

I asked the research questions to my respondent Santa B. Majhi about his geometrical concepts which used to make the window and door by the help of interview guidelines. Then he replied that the shapes of these objects were perfect rectangular and used for making attractive rectangular holes on the wall of a house. These were constructed by wood locally called Kadi. I found that the rectangular window was divided into many sub-rectangular parts. But rectangular door was not divided into many sub-rectangular parts. These objects were made by using the concept of parallel line, perpendicular line, right angle and combinations of many rectangles are again a rectangle. He made it in such shape to use on the wall of a house easily.



Window and Door

Pedagogical Implication

The different types of basic geometrical concepts are used in these materials. We can see that the combinations of rectangles are again a rectangle. All corners of

the window and door are right angle. Some straight pieces of wood are parallel and some are perpendicular to each other. As a whole these are rectangular in shape. So by using these materials we can teach all the properties of rectangle like as parallel line, perpendicular line, right angle, straight line and combination of rectangles are again a rectangle if we use these material as a teaching material.

Table

A respondent of this material Santa B. Majhi replied to my research questions that it was a kind of plane face material used for placed book, pen and other small domestic goods. It was constructed from wood by using the different geometrical concepts such as parallel line, perpendicular line, rectangle and right angle. I found that in this material each leg was perpendicular to the Dar. Its upper part was plane and rectangular in shape and each two Dar which was in the opposite sides were parallel to each other. He made it in such shape to read and write comfortably.

Pedagogical Implication

We can find the different types of basic geometrical concepts in this material. In this material it is clear that some splits of wood are parallel and some are perpendicular to each other. Its upper part is plane and rectangular in shape. Some pieces of wood are joined with making 90° angle in this material. So it is used for teaching the basic concepts of parallel line, perpendicular line, plane, angle and rectangle at school level.

Mola (Mukhauro)

I asked the research questions to two of the Majhi people Hari B. Majhi and Suka Majhi at the same time as a group discussion about basic geometrical concepts which used in their daily life activities by the help of interview guidelines. Then they replied that the shape of this material was as semi-spherical and used to hang in oxen mouth when plowing field. It was constructed by the help of small splits of bamboo. At the construction time they used the concepts of hexagonal and triangular holes. They made it in such shape because the mouth of oxen is round in shape.

Pedagogical Implication

In this material we can see the several types of basic geometrical concepts which are directly linked with school geometry. Its upper part is circular, some holes are regular hexagon and some are triangle in shape. As a whole it is a semi-spherical in shape. So we can use it to teach the basic concepts of semi-sphere, regular hexagon, triangle and circle at school geometry.

Pata and Juwa

Two respondents of the study Hari B. Majhi and Suka Majhi replied to my research questions that these were a kind of ancient material made from wood and used to make the field plane after plowing. I found that to make the field plane Pata was pulled by Juwa and Juwa by oxen. These materials were constructed by using the process of perpendicular line, parallel line, midpoint, curve, angle, slope and distance between two points. The shapes of these materials were slope and straight line. They made these materials in such shape so that they were able to making the plowing field plane easily.

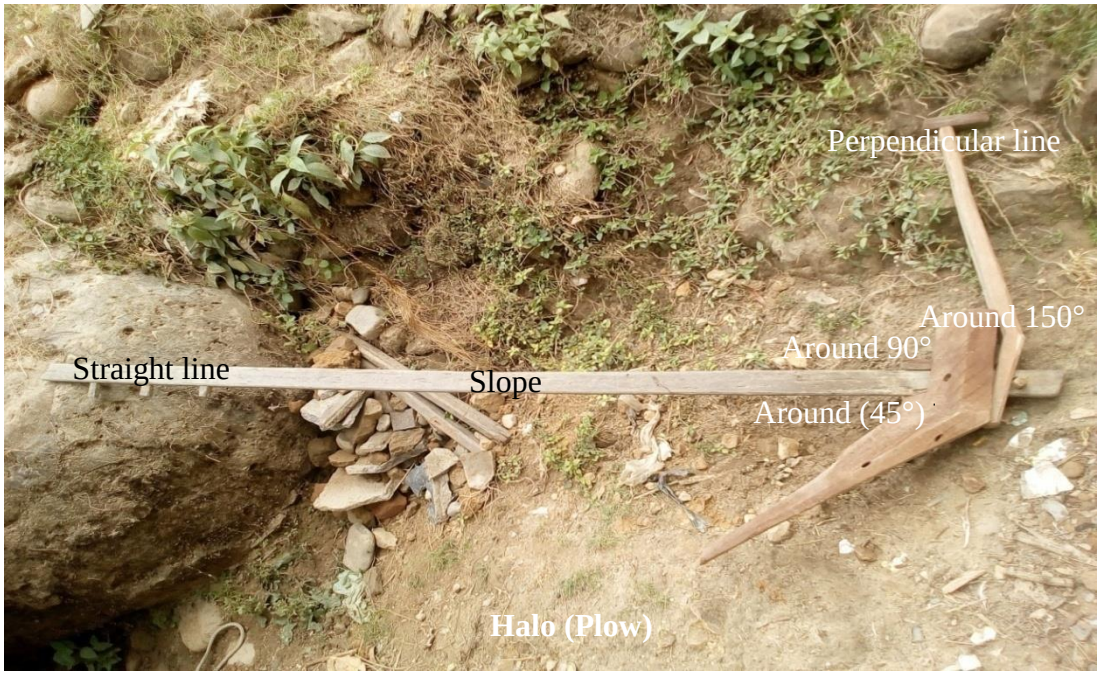
Pedagogical Implication

Different kinds of school geometry are used in these materials. We can see that two straight legs of Pata are perpendicular to the Pata and Sakatha of Pata is in the

slope form but two legs are parallel to each other. Also four Soila of a Juwa are perpendicular to the Juwa but are parallel to each other where the distance between a pairs of Soila have around one Bitta. We can see that the Rajghar at the midpoint of Juwa and the curve shapes at the left and right of Rajghar. So by using these materials we can teach the basic geometrical concepts of perpendicular line, parallel line, straight line, midpoint, slope, and distance between two points, curve and angle at the school level.

Halo (plow)

Two respondents of this material Hari B. Majhi and Suka Majhi answered to my research questions that it was a kind of ancient machine constructed by wood in angle shape and used for plowing field. To construct it they used the concepts of angle, slope and perpendicularity. I found that it had around 45° angle between Haris and Phali (iron stick) but plow was constructed around 135° angle. They made it in such shape to plowing more lands at a time which was pulled by Juwa and Juwa by ox.

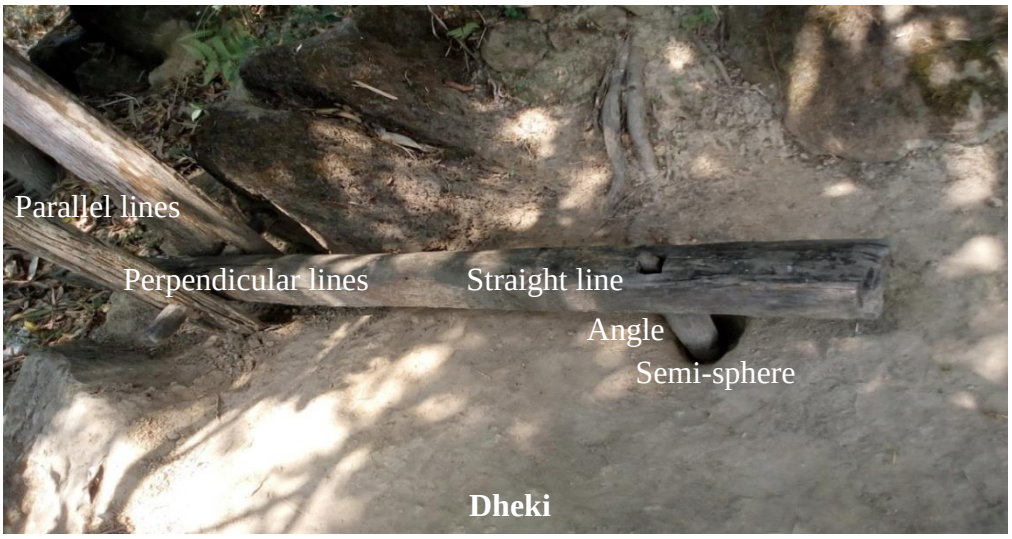


Pedagogical Implication

This material shows that the different types of geometrical concepts. We can see that, around 45 ° angles between slope Haris and Phali, around 90° angle between slope Haris and head of plow. This implies that angle of plow is around 45°+90°=135° angle. Also we can see the concept of perpendicularity in the handle locally called Pachhwa which is made in around 150° angle and joined to back side of plow. So it provides the clear concepts about angle, sum of angle, slope, straight line and perpendicular line at the school level to teach geometry.

Dheki

The respondents of tha study Hari B. Majhi and Suka Majhi explained that, at first, to make it two poles (locally called Mudka) were parallelly buried with distance at least one Bitta. Its two poles were perpendicular to the land, Agla and Dheki in which two poles and Dheki were connected by Agla. In front of Agla of Dheki about three hand its Musal was connected perpendicularly to the Dheki which beating the grain on semi-spherical hole locally called Okhal. It was a kind of traditional machine constructed by wood and used for beating rice, paddy and other grains. They made it in such shape so that they were able to beating more grains easily.



Pedagogical Implication

In this material we can find the different types of school geometry. Two poles are parallel to each other but perpendicular to the land and Agla. In this material Musal is joined to the Dheki with making 90° angle and the shape of Okhal is semi-spherical. So by the observation of this traditional machine we can teach the basic geometrical concepts of parallel line, perpendicular line, straight line, semi-sphere and angle at school level.

Ghatta and Janta

I asked the research questions to four of the Majhi people Purna B.Majhi, Chandra Maya Majhi, Hari B. Majhi and Suka Majhi about their concepts of geometry which were used in Ghatta and Janta by the help of interview guidelines. Then they replied that these were traditional machine constructed by stone and used for grinding grain. The shapes of these materials were semi-spherical. To make both traditional machines they must had four semi-spherical stone with circular holes on the center point. They placed the Mani vertically in the circular holes of two semi-spherical stone to make Janta which was started by pulling Hataso. But they placed the Phali horizontally at the center of upper semi-spherical stone to make Ghatta which was starting by running water. They made the slope Dur which had at least six hand lengths in where the water running fast. This running water started the fan of Ghatta which was joined to the Phali of upper semi-spherical stone. Then they made the rectangular wall around the Ghatta to stop the flour after grinding grain. Also they placed the cone to keep more grains at the top of circular hole of Ghatta. They made it in such shape so that they were able to grinding more grain quickly.

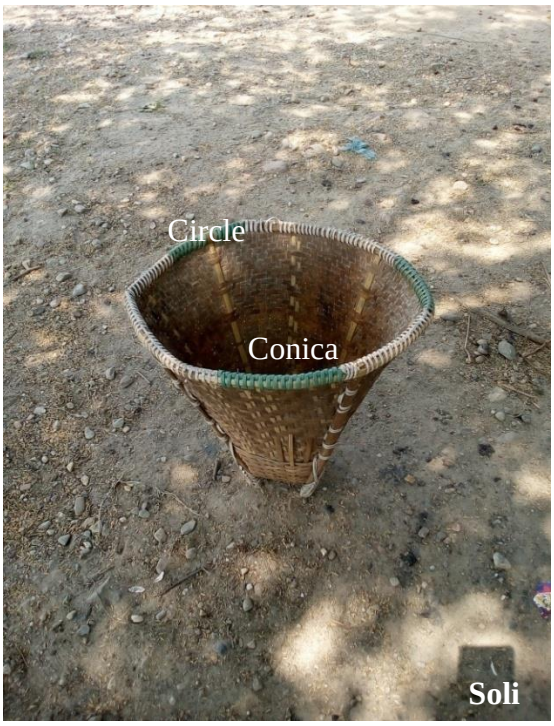
Pedagogical Implication

These materials give the different types of basic geometrical concepts. The slope and straight Dur makes an angle around 70° to 80° with the land. The shapes of these materials are semi-spherical which have the circular holes at the center point. In this material we can see that conical and rectangular shape also. So by the field

observation of these machines we can teach the concepts of slope, angle, rectangle, cone, semi-sphere, center of a semi-sphere and straight line at the school level.

Soli

A respondent of this material Dhanukha Majhi said that it was a type of basket constructed from small pieces of bamboo which was conical in shape and used for keeping more grain and flour. I found that he constructed its base part by using the concept of square and then used the concept of circle. Its upper part was open with circular in shape and diameter around one hand. But its lower part was already closed by its square base which was diagonally knitted by two small pieces of bamboo. He made it in such shape so that it kept very small grain and flour.



Pedagogical Implication

This material shows that the various types of basic geometrical concepts which are directly linked with the school geometry. Its mouth is circular but base part is

square in shape in where two small pieces of bamboo are crossed diagonally. As a whole it is a conical in shape. So it can be used to teach the basic concepts of conical shape, circle, square and diagonal at the school geometry if we consider it as a teaching material.

Peranga

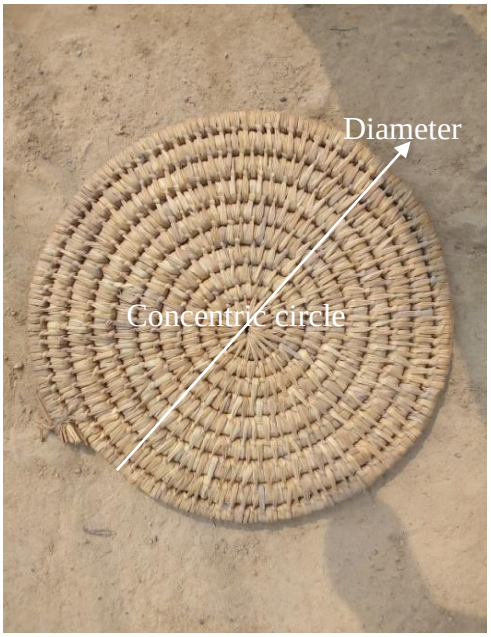
A respondent of the study Dhanukha Majhi replied to my research questions that the shape of this material was as an ellipse which was used for keeping salt, dry fishes and meat; to keeping the salt at first he placed the leaf of Bharla on the Peranga and then salt at the ancient period. It was a kind of basket made from small pieces of bamboo by knitting each other with making regular hexagonal and triangular holes. After keeping more salt, dry fishes and meat they tightened its mouth by using the rope of jute. He made it in such shape so that his salt, dry fishes and meat cannot be damaged in a certain time.

Pedagogical Implication

We can find the different types of basic geometrical concepts in this material. As a whole the shape of this material is as an ellipse. We can also see that some holes are regular hexagon and some are small triangle. So it can be used to teach the concepts of ellipse, regular hexagon and triangle at the school geometry if we consider it as a teaching material.

Chakati

I asked the research questions to my respondent Santi Majhi about her concepts of geometry which was used in this material by the help of interview guidelines then she replied that the shape of this material was as a circular and used to sit comfortably. It was constructed by stalk of paddy locally called Paral or Soya. She used the process of rounding to construct it which had diameter around one hand. She made it in such shape so that she was able to sit comfortably when taking lunch, dinner and breakfast.



Pedagogical Implication

The different kinds of basic geometrical concepts are found in this material which is linked with school geometry. In this material we can see that center of a circle, radius of a circle and diameter of a circle. This material is the perfect example circle and concentric circle. So it provides the clear concept about circle, diameter, radius, center of a circle and concentric circle at the school level to teach geometry.

Making Alcohol

At the time of field study, I asked research questions to my mother Lali K. Majhi about her ideas to making alcohol by the help of interview guidelines. Then she replied that, at first, to make alcohol she must had Marcha which was sphere in shape and constructed by flour of rice and leaf of white Dudhi. After around seven days it was ready to make ale locally called Jad. Then she mixed the Marcha and cooked flour of corn which was placed in circular shape to make ale. Then after around 24 hour she kept ale into the Drum which was ready to make alcohol after around 10/11 days.

Marcha and Ale

I found that she arranged the three stone in circular shape at every 120° angle to firing, locally called Chula. Then she placed the Phosi on that Chula with keeping water and ale which was perpendicular to the land. Then she placed the Manchhi on the top of Phosi and was also perpendicular to the land which kept the Nani inside of it to collect the alcohol. Then on the top of Manchhi she placed the Bata to keep and change water again and again which was changing the steam of water and ale to alcohol. These all pots were perpendicular to the land. To close the all holes in this process she placed the Septi between Phosi and Manchhi, Pageri between Manchhi and Bata. She notified that Tinpane for very hard alcohol, Satpane for good alcohol and Terapane for soften alcohol. She used this process to make alcohol because she must change the steam of water and ale in water again which is called alcohol.

Making Alcohol

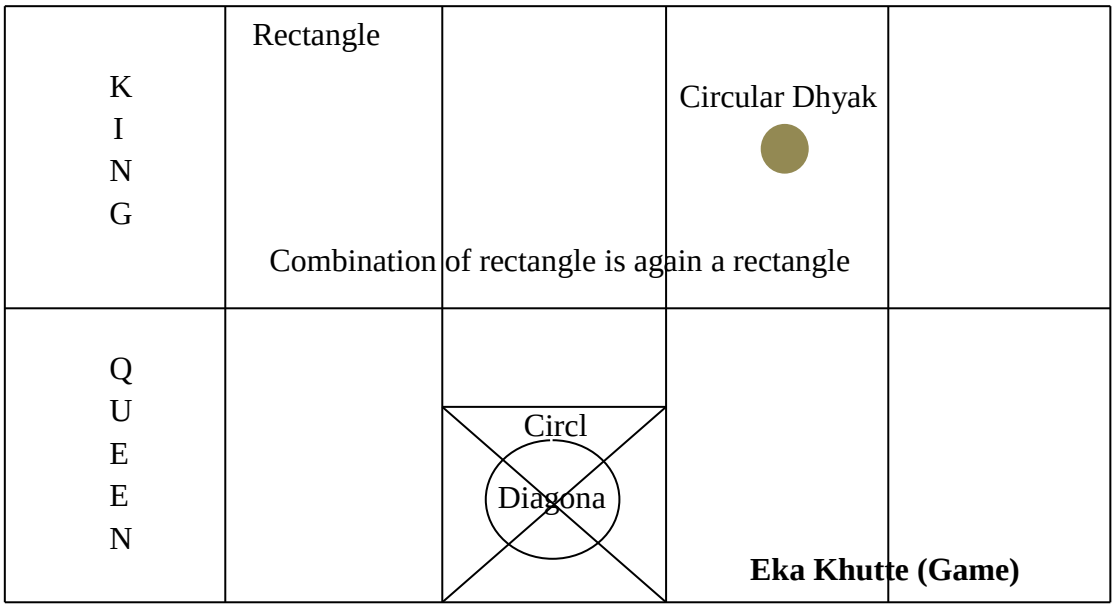
Pedagogical Implication

In this process of making alcohol different types of geometrical concepts are found. We can see that the shape of Marcha is perfect example of sphere. Mixed of

Marcha and cooked flour of corn is placed in circular shape to make ale. In the process of making alcohol stones of Chula are arranged in circular shape at every 120° angle and all pots are perpendicular to the land. So by the observation of this process of making alcohol we can teach the basic concepts of sphere, circle, angle and perpendicularity at the school geometry.

Eka Khutte (Game)

About this game a child respondent of the study Suman Majhi replied to my research questions that, at first, to play this game he constructed a big rectangle with length around six hands and breadth around three hands in the plane field. Then he divided big rectangle vertically in two but horizontally in five equal parts which gave the ten equal rectangles. I found that he played this game with placing the small circular stone (locally called Dhyak) in each rectangle. After won a rectangle he divided it vertically in two parts in which one rectangle was small passage to other players and next was crossed diagonally with making circle.

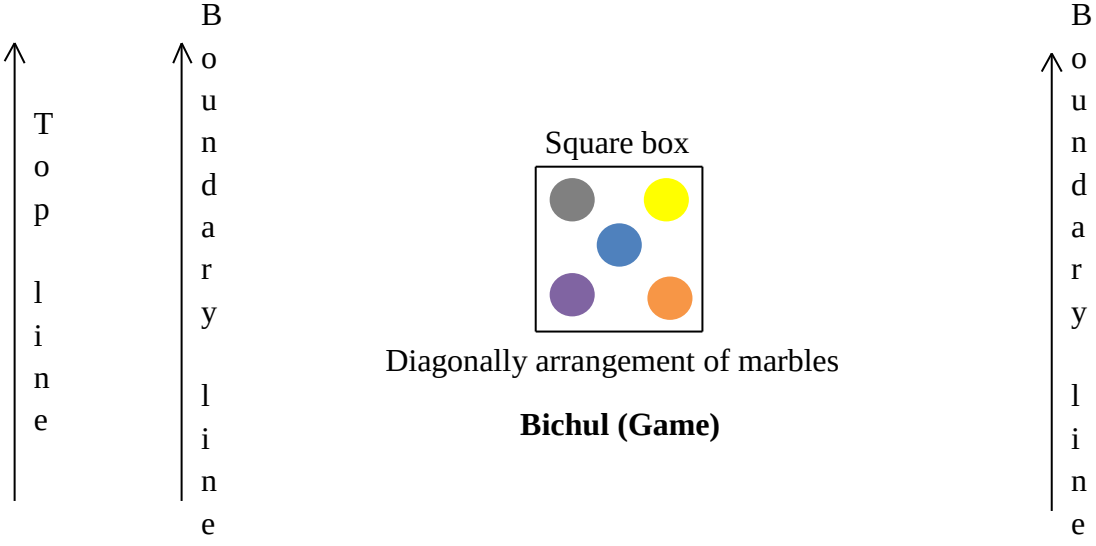


Pedagogical Implication

The different kinds of basic geometrical concepts are used in this game. The combinations of rectangles are again a rectangle is the main geometrical concept of this game. Some lines in the big rectangle are parallel and some are perpendicular to each other. In this game we can also see that the concepts of circle and diagonal line. So by the help of this game we can teach the basic concepts of rectangle, combinations of rectangles are again a rectangle, parallel and perpendicular line, circle and diagonal at the school geometry.

Bichul (Game)

I asked the research questions to my child respondent Suman Majhi about this game by the help of interview guidelines. Then he replied that it was a kind of game to play marble. To play this game he constructed a square box in the plane field in where he arranged the marbles diagonally. Then two lines were drawn parallelly in the upper part of square box around in three and four hands respectively. Then next one line was drawn in the lower part of square box around in three hands which was also parallel with next two parallel lines. The line which was in the top of upper part determined that who is first, second, third, and so on. Other two lines were boundary to beating marbles which were in the square box.



Diagonally arrangement of marbles

Bichul (Game)

Pedagogical Implication

In this game we can see the different types of basic geometrical concepts which are directly linked with school geometry. We can see that top line and other two boundary lines are parallel to each other in this game. There is a square box in this game in where the spherical marbles are arranged diagonally. So we can use this game to teach the basic concepts of parallel line, properties of square and diagonal line at the school geometry.

Chapter V

FINDINGS, CONCLUSIONS AND IMPLICATIONS

In this chapter I have presented the findings of the study, conclusions of the study and implications of the study. During the analysis and interpretation periods of my research work in the previous chapter, I have answered to my research questions; what kinds of basic geometrical concepts were practiced by Majhi community? How can their geometrical concepts be linked with teaching-learning geometry? For this purpose, I visited the Majhi community and observed their basic geometrical concepts. Then took interview with twelve Majhi farmer, four Majhi students and two Majhi teachers at the same time I took photos of different domestic goods. On the basis of their information and field data I have presented the following findings, conclusions and implications of the study.

Findings of the Study

The main findings of the study are as follows:

- Almost all of Majhi farmers are not literate and unfamiliar with formal geometry. But they always used the concepts of formal geometry to construct domestic goods knowingly or unknowingly.
- At first, they make a conceptual shape and size in their mind of the concerning domestic goods to construct it.
- Some younger persons apply the concepts of Pythagoras theorem unknowingly at the time of construction of a house.
- They are not able to distinguish between two dimensional and three dimensional shapes among several domestic goods.

- The circular, conical and rectangular shaped materials are mostly preferred.
- The parallel and perpendicular line procedures are mostly preferred to construct different types of domestic goods.
- They are not able to distinguish between the different geometrical shapes, such as parallelogram and square, circle and semi-sphere.
- Some younger and students are able to relate their cultural geometry to the school geometry.
- They used the process of regular hexagonal, square, parallelogram, rectangular and triangular holes to construct some domestic goods.
- They are not able to tell the shape of some domestic goods just for show, but they are able to tell the shape of each part of some domestic goods.
- Majhi students are poor in school geometry whose guardians are not literate and unfamiliar with school geometry.

Conclusions of the Study

In Nepal, there are several ethnic groups with their own typical traditions and practices. The different ethnic groups have their own geometrical concepts and practices. The Majhi community of Nepal is also one of ethnic groups. Their hidden geometrical concepts are different from other indigenous groups. They used the own traditional geometrical knowledge and practices in their daily life knowingly or unknowingly. Only a few ethnic groups' geometrical concepts had been studied. The present study of Majhi community has found that they are always using the geometrical concepts for making domestic goods, fishing material and in playing game. Their geometrical concepts are directly linked with formal geometry and are

essential for understanding the formal geometry. But the geometrical concepts of Majhi community has not expanded, explored and linked with formal geometry.

It is concluded that they used the different types of basic geometrical concepts in their daily life activities such as concepts of circle, triangle, square, parallel line, perpendicular line, cone, hexagon, parallelogram, rectangle, diagonal, semi-sphere, slope, cylinder, cuboids, curve, angle, diameter, sphere and so on. We can use their geometrical concepts at school level as a teaching material to teach the basic concepts of geometry and thus advancement of geometry will be certain increased in their community.

The government of Nepal also trying to apply education up to primary level in their mother tongue of different ethnic groups but it is not practically implemented by many problems. Almost all of Majhi people are unfamiliar with formal geometry but they used formal geometrical concepts unknowingly in their daily life activities. At this situation, if their geometrical concepts are totally implemented from primary level then there will be more chance to connect the cultural geometry with formal geometry. Then the advancement of geometry will be certain increased in their community and in the field of geometry. For this purpose, Majhi people need to learn formal geometrical concepts and their cultural geometrical concepts should be introduced in the formal geometry.

Implications of the Study

This study was limited in several aspects. This study was done within a limited number of samples in a short time period at a fixed area within only one community. The findings of this study may have covered certain field. So considering these

limitations of the study the following suggestions and implications have made for further research.

- This study was limited to the basic geometrical concepts practiced by Majhi community only. Similar study can be done with in counting and measurement system also which have not covered by it.
- The several ethnic groups have their own geometrical concepts in Nepal. So similar study can be done in other ethnic groups.
- This study was confined only in Marin village institution-6 Sindhuli of Nepal. So further studies should be done in other places.
- The study ethno-mathematical practice in the classroom can be done similarly.
- This study was conducted in few days field work with little number of samples. So that future study can be done intensively with larger number of samples.

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Appendix I

Interview Guidelines

Date of interview:-…… Sex:-..... Age:-……..

Name:-…….. Address:-
……

Religion:-…….. Qualification:-……. Occupation:-
……

The interview with Majhi people were taken in the following basis:

For Majhi Farmers

- Name of the domestic goods in Majhi language.
- Raw materials to make domestic goods.
- Shape and size of the domestic goods.
- Construction process of the domestic goods.
- Different parts of the domestic goods.
- Uses of the domestic goods.

For Majhi Students

- Name of the domestic goods in Majhi language.
- Raw materials to make domestic goods.
- Uses of the domestic goods.
- Different geometrical concepts related to the school geometries which are used in the domestic goods.
- Games.

For Majhi Teachers

- Name of the domestic goods in Majhi language.
- Different geometrical concepts related to the school geometries which are used in the domestic goods.
- Pedagogical implication of the domestic goods which are used in teaching-learning geometry.

Appendix II

Observation Guideline

To find the answer of the research questions, I observed the Majhis culture, daily life activities, geometrical concepts and its pedagogical implications at the same time observation of practice, working in group and working individual. At that time I observed their raw materials, shape, size, construction process, different parts, uses, different geometrical concepts and pedagogical implication of their domestic goods and made field note.