BASIC MATHEMATICAL CONCEPT AND PROCESS USED BY RAI COMMUNITY

A

THESIS

BY

ROSHAN RAI

FOR THE PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE DEGREE OF MASTER OF EDUCATION

SUBMITTED

TO

DEPARTMENT OF MATHEMATICS EUCATION

CENTRAL DEPARTMENT OF EDUCATION

UNIVERSITY CAMPUS, KIRTIPUR

TRIBHUVAN UNIVERSITY

KATHMANDU

2021

त्रिभुवन विश्वविद्यालय
शिक्षा शास्त्र केन्द्रीय विभाग
गणित शिक्षा विभाग
TRIBHUVAN UNIVERSITY
CENTRAL DEPARTMENT OF EDUCATION
DEPARTMENT OF MATHEMATICS EDUCATION

विश्वविद्यालय क्याम्पस
कीर्तिपुर, काठमाडौं, नेपाल
UNIVERSITY CAMPUS
Kirtipur, Kathmandu, Nepal

पत्र संख्या:-
Ref.

मिति:
Date: .....

Letter of Certificate

This is to certify that **Mr. Roshan Rai,** a student of academic year 2072/073 with Exam Roll No. 7228402, T.U. Regd. No. 9-1-9-637-2007and Thesis No. 1510 has been completed his under my supervision during the period prescribed by the rules regulation of Tribhuvan University, Nepal. The thesis entitled "**Basic Mathematical Concept and Process Used by Rai Community"** embodied the result of his investigation conducting the period 2021 at the Department of Mathematics Education, Central Department of Education, University Campus, Kirtipur Kathmandu. I hereby, recommended and forward that his thesis be submitted for the evaluation as the partial requirement to as award the Degree of Masters of Education.

Date: February 7, 2021 ……..

Prof. Dr. Bed Raj Acharya

Head

त्रिभुवन विश्वविद्यालय
शिक्षा शास्त्र केन्द्रीय विभाग
गणित शिक्षा विभाग
विश्वविद्यालय क्याम्पस
कीर्तिपुर, काठमाडौं, नेपाल
UNIVERSITY CAMPUS
Kirtipur, Kathmandu, Nepal
TRIBHUVAN UNIVERSITY
CENTRAL DEPARTMENT OF EDUCATION
DEPARTMENT OF MATHEMATICS EDUCATION

पत्र संख्या:-
Ref.

मिति:
Date: .....

Letter of Approval

This thesis entitled **"Basic Mathematical Concept and Process Used by Rai Community"** submitted by **Mr. Roshan Rai** in partial fulfillment of the requirements for the Master's Degree in Education has been approved.

Viva-Voce Committee	**Signature**
Prof. Dr. Bed Raj Acharya (Chairman)	……..
Prof. Dr. Indra Kumari Bajracharya (External)	…….
Prof. Dr. Bed Raj Acharya (Supervisor)	……..
Shiva Datta Dawadi (Member)	……..

Date: March 4, 2021

त्रिभुवन विश्वविद्यालय
शिक्षा शास्त्र केन्द्रीय विभाग
गणित शिक्षा विभाग
TRIBHUVAN UNIVERSITY
CENTRAL DEPARTMENT OF EDUCATION
DEPARTMENT OF MATHEMATICS EDUCATION

विश्वविद्यालय क्याम्पस
कीर्तिपुर, काठमाडौं, नेपाल
UNIVERSITY CAMPUS
Kirtipur, Kathmandu, Nepal

पत्र संख्या:-
Ref.

मिति:
Date: .....

Recommendation for Acceptance

This is to certify that **Mr. Roshan Rai** has completed his thesis entitled **"Basic Mathematical Concept and Process Used by Rai Community"** under my supervision during the period prescribed by the rules and regulation of Tribhuvan University, Kirtipur, Kathmandu, Nepal. I Recommend and forward his thesis to the Department of Mathematics Education to organize final viva- voice.

Date: March 4, 2021 ……..…….

Prof. Dr. Bed Raj Acharya

(Supervisor)

Phone No.: 977-1-4331337 / 4333229, Fax No.: 4334955, E-mail : foe@tucded.edu.np, Website : tucded.edu.np

Copyright

By

Roshan Rai

Defense Date: March 4, 2021

Declaration

This thesis contains no material which has accepted for the award of other degree in any institutions. To the best of knowledge and belief, this thesis contains no material previously published by any other except due acknowledgement has been made.

.

Date: March 4, 2021 …….

Roshan Rai

Dedication

This thesis is dedicated to my parents who spent their whole life to make me what I am today.

Acknowledgements

I would like to express my sincere gratitude to my thesis supervisor and head of department of mathematics education Prof. Dr Bed Raj Acharya for his invaluable guidance, constructive suggestions, co-operation, constant encouragement and continuous inspiration from the beginning to the end.

I would also like to extend my sincere gratitude to Asst. Prof. Laxmi Narayan Yadav, Department of Mathematics Education and for his constant support. I am equally grateful to Prof. Dr. Eka Ratna Acharya, Department of Mathematics Education for his guidance and valuable suggestions.

I am equally grateful to Prof. Dr. Binod Dhakal, Dr. Bed Prasad Dhakal, Abatar Subedi, Krishna Prasad Adhikari and Shiva Datta Dawadi, for their continuous guidance and support. Similarly, I am highly thankful to administrators, teachers and students for providing me their valuable time and authentic data to accomplish this study.

I would like to express my deepest gratitude to my father Achha Bahadur Rai and mother Nara Maya Rai who's blessing, constant encouragement and help have been the sole source of inspiration throughout my life; my brother Pralhad, Somkumar and sisters Kalpana and Sukhamaya who continuously encouraged and supported me for my study.

Finally, I am very much grateful to my colleagues; Susan Rai, Chawan Kaji Magar, Mamita Rai, Pemlu Rai and Sadiksha Rai who continuously encouraged and helped me to complete this study.

……

Roshan Rai

Abstract

The present study is on the, "**Basic Mathematical Concept and Process used by Rai Community** ". The main objective of the study was to find out identify the numerals used in representing number by Kirati. I used qualitative research with case study. This research is ethnography study, so the sample size in this study is not fixed. Mainly, Interview, Photographs, observations were used as techniques to generate data from the participations. The study was conducted and analyzed based on the conceptual understanding on which information and data were garnered. The research design of the study included survey design. The researcher used two tools to collect data. They were interview and photographs.

This study consists of five chapters. Chapter one includes background of the study, statement of the problem, objective of the study, significance of the study, delimitation of the study and operational definitions of the key terms. Next, chapter two deals with the review of relevant literature and the conceptual framework of the research. Chapter three deals with the methodology adopted for the study in terms of sources of data, population of the study, sampling procedure, tools and process of data collection and ethical consideration. Chapter four contains the analysis and interpretation of the data. Chapter five deal with the findings, conclusion and implications of the study.

Table of Contents

Chapter I

INTRODUCTION

Background of the Study

The word “civilization” comes from the Latin word to be civilized essentially meant being a townsman, governed by the constitution and legal statutes of that community. Highly organized society marked by advanced knowledge of trade, government, arts, science and often time written language. Human society with its well-developed social organizations or the culture and way of life of a society or country at a particular period in time. The word history is derived from the ancient Greek, historian, meaning “a learning of knowing by inquiry, history, record, narrative”. The word civilization is difficult to define and evaluate. Lynn Thorndike says that “civilization is the product of our higher qualities as exercised first by original and superior individuals and then accepted or followed by a sufficient number of human beings to make it a social fact.”

Mathematics is a continuously expanding system of organized thought. It is employed in science, technology, art, music, architecture, economics, sociology, sport in fact, in almost every aspect of human activity and has influenced, and often determined, the direction of philosophical thought concerned with humankind and its universe (CERRID, 1990). Throughout history, mathematics has not only reflected developments in civilization but also made a major contribution to those developments.

The concept of number is fundamental to mathematics. It is probably developed originally with the need for farmers to count their animals and produce. Numbers also led to money systems, making buying and selling possible. All

primitive civilizations developed concepts of number and measure as soon as trade progressed beyond the process of barter. Almost 6,000 years ago the Sumerians were using a number system based on 10 (denary system) as well as the one based on 60 (sexagesimal system). The sexagesimal system still survives in the measure of time and rotation, reflecting the Babylonian preoccupation with the motion of the Sun, Moon, and planets and their influence on man (Carrher, 1989).

The knowledge acquired became not only a religious force but also solved basic problems of agriculture and social organization. The flooding in Babylon and Egypt demanded seasonal surveys of land, the techniques of which led to geometry. Political, commercial and religious pressures to build palaces, ships, temples and tombs stimulated the further development of geometry. At the same time, astronomy regulated social and religious events and thus served the political ends of ruling priests.

The Greeks established mathematics as a rigid study, placing mathematical argument on a logical basis so that propositions, previously not self-evident, could be deduced from basic assumptions. Euclid's Elements, produced in about 300 BC, was a prime example of this approach and dominated geometric thinking for 2,000 years.

According to the religious book ‘Mansarabar’ the lord Shiva is the creator of human beings. So, on the basis every civilization has demanded systems for measuring and each new method have borrowed ideas from previous ones. As civilizations expanded, their influences and trade spread, and the need for standardized units increased. The earlier systems were all based in convenience, so that parts of the body were used for measuring length, the working capacity of oxen for area, stones for weight, and skins for volume. Each society learned to standardize; in 1791 the French devised the metric system based on the meter, one ten-millionth of

the Earth's quadrant (a quarter of the circumference), a distance calculated from an actual survey. International trade has now forced most of the Western world to adopt the metric system of measurement. Mesopotamia; cradle of civilization Ancient Rome civilization across Indus River most terrifying civilizations of the world. Development of mathematical concepts is a major achievement of human civilization. Astrology, structural design, oceans, measurement system, economic planning and transaction are some of the areas which need the use of developed mathematical concepts and reasoning.

Mathematics may be considered a special kind of language developed to convey quality, shape, position etc. and their interrelationships. Its use is determined by rules of logic-the logic that emanates from the law of nature (CERRID, 1990). Mathematics is the gate and key of the science, Neglect of mathematics work injuries to all knowledge.

From the ancient period, human beings use mathematical ideas and concepts to solve their daily problems by different ways. To get present success, people use mathematics in different ways and different fields. Mathematical ideas such as measurement, counting, calculating etc are created from the cultural activities of the people which may be in different nature in different cultural base. People of different culture and society daily use their mathematical ideas to solve their daily problems. These cultural and sociological ideas of mathematics are known as ethno-mathematics (Sharma, 2010, p.1).

In Nepal there are several ethnic groups with their own typical traditions and practices. The different ethnic groups have their own basic mathematical concepts. The Rai people of Nepal are also one of the ethnic group in which they used their own

basic mathematical knowledge, concept and processes in their daily life knowingly or unknowingly.

Ethno mathematics is the study of relationship between mathematics and culture. Nepal is multicultural, multi lingual nation in terms of cultures, religions, customs and language every cultural and cast has its own mathematics practice and procedure. The word Kirata is a derivation from Kirati or Kiranti to name the group of people in Eastern Nepal and Northeast India.

Shree Mahendrodaya secondary school of thought says that it comes from the Sanskrit word *Kirata* found in the Yajurveda; they are described as the "handsome" mountain people and hunters in the forests.They are described as "Kiratas" in the *Mahabharata* and *Kirtarjuniya*. Contemporary historians widely agree that widespread cultural exchange and intermarriage took place in the eastern Himalayan region between the indigenous inhabitants called the Kirat and the Tibetan migrant population, reaching a climax during the 8th and 9th centuries.

In the case of Rai civilization of Nepal, both the religious of Kirantism were extended from Tibet, Nagaland, Sikkim Assam. It is claimed that the Rais were the Mongolians while the Lichhavies were from India. Therefore, the mathematical concept might have developed at this place influence by Hindu mathematics. Although Bantawa Rai language is based on the Tibeto-Barman language family.

Problem of the Statement

Nepal is a multi-lingual, multicultural, multi-religious country with 3.6 billion populations of 126 ethnic groups and their 131 mother languages (CBS Nepal, 2020). Beside these people have different social, economical, cultural and religious background with their own language rule and regulation.

Each and every caste has its own cultural heritage and way of living and the mathematics is now considered as social creation. Culture is the contributing factor for the development of mathematics. Mathematics plays a vital role in the development of culture and civilization and vice versa. Each and every culture has its own way of defining and understanding the things and phenomena.

Even though the Rai people perform different ways of dancing, Rai argues that the dance moreover symbolize the folkloric practice with the aim of requesting agricultural prosperity from the ancestors. It also helps to preserve traditional musical instruments such as different types of cymbals, drums and different types of Sili which have been practiced throughout history.

If we will connect cultural artifacts such as musical instrument (Dhols) in the classroom teaching process, children may be able to enjoy learning and also me to explore their own mathematical and geometrical concepts as well its application in the day to day life. The development of numeral system in Kirati community has very long history. They use the counting system in their daily life using the numeral and their own tradition numbers and counting system were development from the consistent interactions with the development and abstract operation on the environment objects and events. The development of numeral system depends on culture, customs and scripts development and proper use of it. The Kirati are one of the most popular ethnic groups of Nepal. It's necessary to know the numeral system and geometrical mathematical knowledge in people for the purpose is focused on the followings:

- Numerical scripts are used by Kirati to represent number And
- Geometrical concepts used by Kirati.

Objectives of the Study

The main objective of this study was investigated the basic mathematical concept locally practiced by Kirati people. The objectives of the study are as follows:

- To identify the numerals used in representing number by Kirati community.
- To investigate the ways of using Geometrical concept in Kirati community.

Research Questions

This research had following research question:

- What kind of numerical script is using by Kirati Community?
- In which way geometrical concept are using in Kirati community?

Justification of the Study

The Nepalese caste system is the traditional system of social stratification of Nepal. They have own language, script, cultural counting system and numbers. Human civilization is the result due to the development of human consciousness. According to the interim constitution, 2072 of Nepal the Kirati is one of the ethnic group. So, it is the part to study about the art, culture, historical events of a country. There is no doubt that the studies in these fields help to identify the level of development of Kirati civilization the process of development of the human civilization. Such as identified by own culture, language, script and customs. This study would be reflecting the indigenous mathematics knowledge and skills. This study plays a vital role to seek the mathematical concept and practices in Kirati community at Bhojpur district and further significance are:

- This study would be focuses on what are the basic mathematical concepts practiced by Kirati community and how they connect to formal education system.

- This study would be exploring the ethno-mathematical practices in Kirati community, which was valuable further researcher to explain the knowledge of the mathematics of Kirati community.
- The contribution in ethno-mathematics can help to promote explore mathematical knowledge and skill of the Kirati community.
- The study in this direction adds a new dimension of Kirati and their related aspects including numbers. Thus the study of numbers of Kirati explains to highlight the level of richness of the community from different dimension and prospect.
- This study would be help to promote ethno mathematics knowledge. It was remained as a basic to other research and investigation.
- The finding of this study would redound to the benefit of society considering that mathematics plays an important role in social life today.
- The study will cite how it would be to address emerging issues confronting various initiatives.
- This study will help to know the nature of counting system and logarithm of four basis mathematics operations practiced by Kirati.

The greater demand for graduates with mathematics background justifies the need for more effective life. Majority of the world's population lives in the developing world. The study may bring into the open certain related topics that can be subject to future investigations by other researchers, relevance of the study to issues and events at the local, regional or national level.

Delimitations of the Study

This had the following delimitation of the study:

- This study is based on ethno-mathematical concepts in Kirati Community.
- This study is delimited to Arun gaupalika at Bhojpur district.
- This study is based on number system and geometrical concept of Kirati community.

Definition Related Terms

Kirati. Kirati refers to an indigenous ethic group of Nepal who lives in eastern region of Nepal and Darjeling and Sikhim.

Basic concepts. The number and mathematical geometrical concept which used in everyday life in Kirati culture.

Ethinic group. a communityor population made up of people who share a common cultural background or descent.

Literacy. means the ability to read and write. Being able to read and write is an important skill in modern societies. Usually, people learn how to read and write at school. People who can read and write.

Chapter II

REVIEW OF RELATED LITERATURE

A literature review is an account of this has been published on a topic by accredited scholars and researches, is composed of discussion of facts and principles to which the present study is related. For instance, if the present study deals with drug association, literature to be reviewed or surveyed should be composed of materials that deal with drug addiction. Different researchers have done the study on numbers and geometrical concepts of different community on the basis of ethno- mathematics.

Thematic Review

Nepal is a multi-lingual, multicultural, multi-religious country with 3.6 billion populations of 126 ethnic groups and their 131 mother languages (CBS Nepal, 2020). And also there are different background socially, economically, culturally, religiously and there have own language own rule and regulation. *Sakela* is the main festival of Rai people which is celebrated twice a year and is ... Among *Kirats,* Sunuwar and Rai celebrate this festival, whereas the Yakkhas and the Limbus have their own Youchyang and Chasok Tangnam. Sakela is the biggest festival, Kirats of Nepal celebrate. Ubhauli and Udhauli are the two main festivals of Sakela. Ubhauli means upward and Udhauli is downward. According to the Holy book of Kirat 'Mundhum', a year of 365 days is divided into two phases Ubhauli (going up) and Udhauli (going down). The birds migrates from one place from other in these period as well in old days people used to move uphill and downhill during these seasons. The dance have steps similar to the steps of Ducks (hans), River bird (dhobi chara), Black Bird (Kalchuda), Deer (Mirga), Musk deer (Kasturimirga) and other animals. Nakchhong, the main guy, narrates the Mundhum and tells all the stories through dancing these

steps and reciting how their ancestors travelled through Dudh Koshi, Sun Koshi, and Tama Koshi and finally settled in the bank of Bhote Koshi River. There are many castes in Kirati. Kirat has own language. There are many Kirati in Bhojpur district. And I reviewed many literatures but did not get research on the study of basic mathematical knowledge concept practiced by Kirati Community in Bhojpur district. So I am going to study in this area. And how to linkage with curriculum content that will help to easily understand to students?

Numbers and counting system were developed from consistent interactions with the development and abstract operations on the environment objects and events. The development of numbers system depends on culture, customs and scripts development and proper use of it. Each and every casts has its own culture heritage and way of living. Mathematics is now considered as social creation. Culture is the contributing factors for the development of mathematics. Mathematical plays a vital role in the development of culture and civilization and vice versa. Every culture has its own way of measuring calculating and doing basic mathematical process. Thus, cultural diversity and equity of learning opportunity have been considered as one of the problems in mathematics (Thapa, 2011).

In the Rai community, Dhols are played in their festivals such as the Sakelasili, which is one of a few rituals in Nepal that are performed collectively and that is found among all the Kirati people. It gives a noble sense of feeling such as awareness of us togetherness motivations and mystical harmony with a defied nature. The main characteristic of this festival is the Sakela dance performed by large group of Kirati people. The beating of the Dhole and Jhayamta (drums and cymbals).

Accompampes the rhythms and styles guided by the Silinagpaand the Silimangma the remind them of their devotion towards their god and goodness,

ancestors, home, village and the mother natural. The Dhols that they play reflects their tendency to dance and run around with the drum during performance. They use the Dhole in chandisili on the important full days of Ubhauli and Udhauli.

Empirical Review

Empirical research is based on observed and measured phenomena and derives knowledge from actual experience rather than from theory or belief. How do you know if a study is empirical? Read the sub-headings within the article, book, or report and look for a description of the research "methodology."

Rai (2015) has conducted a research entitled "Development of ethnic Groups" is to identify the numerals used in representing number by Kirati and to investigate development process of numeral scripts of Kirati. His research design is qualitative research focuses on understanding the social phenomenon. This study is basically in numeral scripts developed by Kirati ethic group. His research findings are the script of Kirati is influenced by Bhrami script so the numerals are also influenced by Bhrmi numerals the numeral systems are based on decimal sacks. The script (Sirijanga) was develop by king Sirijiangha and re discovered by second Sirijangajah. Thus the numerals are written in Sirijangajja script.

Carrher (1989) conducted the oral practices and described one general strategy used to solve addition and subtraction problems and strategy for solving multiplication and division problems. This study shows that the written and oral algorithms have stratified the same properties but it does not describe the differentiate between written and the oral algorithms. Measurement unites are culture specific has pointed among the Brazilian tribes that in the rural zone.

(CERID, 1990), conducted research entitled on "Elementary process of learning mathematics concepts and process of Rasuwa Tamang". In this research focused on identify the basic mathematical concepts used by Tamang adults with no formal mathematics education, to identify traditional Tamang method of mathematical operation and to find out the implication of Tamang process and tone up to the present learning situation. This research concludes that Tamangs have their own system of measurements contenting and their own mathematical processes and geometrical concepts.

Giri (2010), conducted a research entitled on "A study on basic mathematical concepts practiced by Kulung Rai community in Sankhuwasava district" with objectives are to identify the measurement systems practices by Kulung Rai , to document the mature of counting system of Kulung Rai community and to indentify traditional methods practiced by Kulung Rai community while doing is describe and qualitative research in nature. This study was conducted on the basis of field work, observation and interview ethnography research heavily relies on observation description and qualitative judgment of interpretation of whatever phenomena on is being studied. His research study concluded that these systems were locally developed in the past when there was no need of standardizing.

Mainali (2002), has studied on "the development of numeral system of Limbu ethnic group". This research conclude that Limbu have their own numeral system. Their using the numeral system form medieval age in different form, scale with position number system was adopted.

Majhi (2018), conducted a research entitled on a "basic geometrical concepts practiced by Majhi community". The main purpose of that study was to identify the basic geometrical concepts practiced by Majhi community, and to explore the

pedagogical implications of basic geometrical concepts practiced by Majhi community. The design of this study was qualitative in nature and ethnography was the approach of the study. He concluded that before Ek Khute (game) 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 plays and next crossed diagonally with making circle and making alcohol three stone in circle shape at every 120 angle to firing, locally called Chula. Then, placePhosi on that Chula keeping water and ale which was perpendicular to the land. Theses 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.Chakati is center of a circle, and diameter of a circle. This material is the perfect example circle and concentric circle. Peranga is 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. Ghatta and Janta are basic concept of slope and straight line. The slope and straight dur makes an angle around 70 to 80 with the land. In this material we can see that conical and rectangular shape.

Chaudhary (2017), conducted a research entitled on "mathematical practices in Tharu community". This study focuses on to find out the mathematics practices in Tharu community, and to explore the pedagogical implication of mathematical practices in Tharu community. The research designed is qualitative with ethnography approach. Delwa (mujela) is conical shape. We can use this figure as a teaching material while teaching cone and tessellations. Tharu community chills practices and uses in their daily life. Dela (dalo) is two types by making procedures. It helps to teach in students about the concept of regular hexagon, circle, parallel line and curves. It also helps to teach slope of angle.

Millroy (1992), conducted a research entitled" an ethnographic study of the mathematical ideas of groups of carpenters". This research focused on the mathematical ideas that are embedded in the every wood working activation of group of a carpenter. The second objective was to examine and to give a firsthand account of the teaching learning of mathematical ideas in the context of research apprentice.

Adhikari (2009), conducted a research entitled on "ethno mathematical studies on the heritage of Tharu". It attempt at searching Tharu mathematical knowledge ideas. He found that cultural and traditional concept practicing by Tharu community special in geometry.

D' Ambrasio (1984 & 1985), conducted a research entitled on "ethno mathematics" refers to the form of mathematics that was a consequence of having embedded. In cultural activities whose purpose in the"doing mathematics" on everyday activates such as building house valuation, exchanging money weighting products and precise geometrical pattern. These applications of mathematics often look different from those used in school today.

K.C. (2008), has studied on " Basic mathematical concepts and processes of Pahari community ". The focused on this study was to find a document the counting system and carry out the measurement system practiced in Pahari community. His research was based on Pahari community at Sathighar vagawati V.D.C. Of Kavrepalanchok district. He has used qualitative research design. He has selected 20 people from Kavrepalanchok with purposive sampling for the study. He has used interview, observation to collect the data. This research has been founded the numeration system of Pahari is base 10. It seems that their numeration system is same like as Hindu-Arabic numeration system. Pahari has no their own separate script. So there is no any specific symbol to represent the particular number.

Research Gap

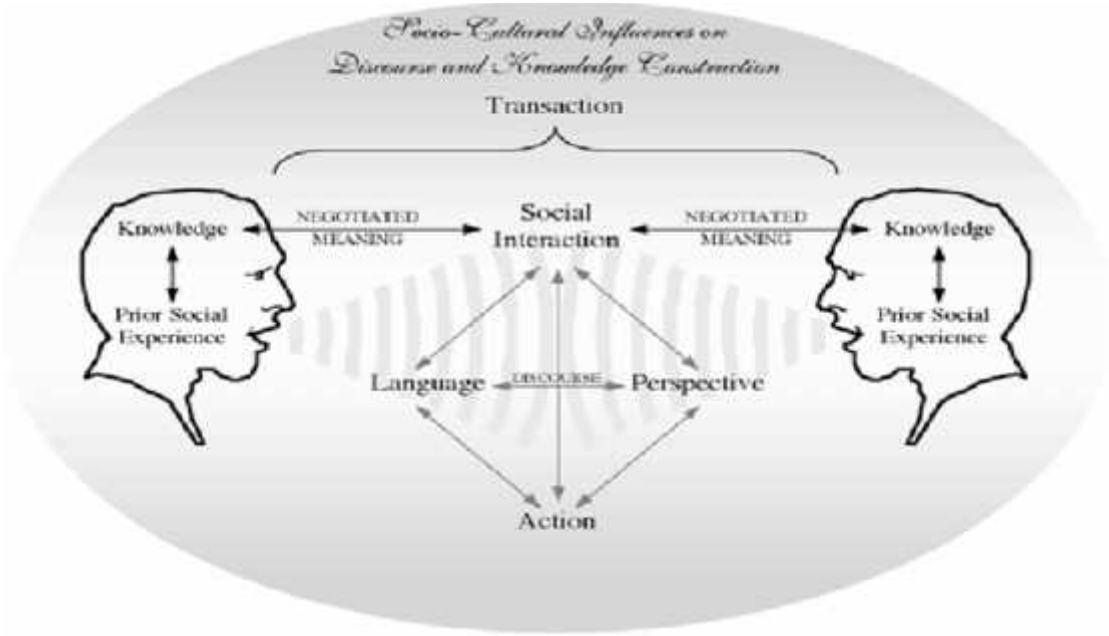
All the aforementioned research studies were carried out some particular culture and ethnic group in Nepal. Most of the researches have been interconnected to an ethnomathematicsand mathematics education in classroom practices and I have gone through the entire research's projects and devoted my efforts to explore the mathematical concepts from different cultures. During this time, I could not find any research studies which attempted to explore culture of mathematical practices in Kirati community. Therefore, I have intended to explore research on ethno mathematics practices in Kirati community and its culture. I also attempted to explore the teaching and learning practices in Kirati community.

Theoretical Review

Theories are formulated to explain, predict, and understand phenomena and, in many cases, to challenge and extend existing knowledge within the limits of critical bounding assumptions. The theoretical framework is the structure that can hold or support a theory of a research study. The theoretical framework introduces and describes the theory that explains why the research problem under study exists.

Social Constructivism

Knowledge is constructed through human activity and individuals create meaning through their integrations interaction with one's physical and social environment is essential for cognitive development.



Like social constructionist, that people work together to construct artifacts. While social constructionist focuses on the artifacts that are created through the social interactions of a group, social constructivism focuses on an individual's learning that takes place because of his or her interactions in a group. In constructivism there is no any knowledge that exists of the person, there is no objective reality. Knowledge must be actively constructed by learners as they are already "knowing beings" who bring previous knowledge and experience to any learning events (cited in Acharya, 2015).A virtual community is a social network of individuals who interact through specific social media, potentially crossing geographical and political boundaries in order to pursue mutual interests or goals. Some of the most pervasive virtual communities are online communities operating under social networking services. A social construct or construction concerns the meaning, notion, or connotation placed on an object or event by a society, and adopted by the inhabitants of that society with respect to how they view or deal with the object or event in that respect, a social construct as an idea would be widely accepted as natural by the society.

A major focus of social constructionist is to uncover the ways in which individuals and groups participate in the construction of their perceived social reality. It involves looking at the ways social phenomena are developed, institutionalized, known, and made into tradition by humans.

L. Vygotsky Social constructivist knowledge in constructed in two ways in the social context. Firstly, Social interaction influencing the natural of knowledge that is constructed and process of individual use to unconstructed. Thus, the constructions are socially centered as in value, process of understanding constructing of knowledge on children. Children construct knowledge. Development cannot be separated form it's social context. Language plays a central role of mental development. Vygotsky believed that community plays a vital role in the process of making meaning. Vygosky gave following concepts:

More knowledgeable other (MKO)

It refers to someone who has better understanding or higher ability level than the learner.

Zone of proximal development (ZPD)

Vygotsky found that more knowledge other (MKO) comes in between of known and unknown, and then the learning process becomes easier for the child.

Vygotsky is constructivism theory emphasizes on society. This theory is based on social phenomenon. People take the knowledge from their social practices and they internalize the skills. The main concern of the Vygotskian social constructivism theory is knowledge, human practice, society and culture.

From the above discussion theories would guide me on what and how Rai Community people do and think about mathematical construction in their daily works.

People have their own beliefs and experiences. They construct new ideas from what they see, listen and perceive. History of mathematics argues that the mathematical practice began from the society and social activities. So, I think these two theories constructivism and Vygotsky's social constructivism will help me to analyze the Rai Community's traditional and local mathematical thinking and their mathematical behavior in their society and day to day works.

Ethno mathematics

In mathematics education, ethno mathematics is the study of the relationship between mathematics and culture. Often associated with "cultures without written expression", it may also be defined as "the mathematics which is practiced among identifiable cultural groups". It refers to a broad cluster of ideas ranging from distinct numerical and mathematical systems to multicultural mathematics education. 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 is a vehicle explores sociocultural, cognitive, conceptual, education, could ethno mathematics. Itself become implicated in the formatting power of mathematics? Is there a possibility that ethno mathematics, in the very process of interesting the activity of say basket weaving invents new .every culture has contributed to literature. It's a universal language numbers belong to everyone. Study of the nature of mathematical ideas involves multiple perspectives on mathematics. Can result in cross cultural harmony. Link the practical with the abstract (Arismendipard, 1994). Ethno mathematics is related to the evaluations, quantities, qualities and the relationship between known realities may involve both physical and

spiritual aspects. Early western mathematics searchers disregarded indigenous perspectives and ways of understanding knowledge are obtained by discovery and revelation. Students benefit from exploring multiple cultural groups such as national tribal society's ways of reasoning and inferring. According to D' Ambrosio the mathematics competencies learned at home and which are lost in the first years of schooling are essential for everyday life and labor. Ethno mathematics in the school curricula is an important methodological posture towards a new teaching method. Ethno mathematics extracted from the cultural contracted in the academic mathematics.

Cognitive Constructivism

Cognitive is the study in psychology that focuses on mental processes, including how people perceive, think, remember, learn, solve problems, and direct their attention to one stimulus rather than another. Psychologists working from a cognitive perspective, then, seek to understand cognition. A developing child builds cognitive structures for understanding and responding to physical experiences in his or her environment. Piaget's theory cognitive structures include"

- Mental "maps"
- Schemas
- Networked concepts

Piaget's theory of constructivism argues that people produce knowledge and form meaning based upon their experiences. Piaget's theory covered learning theories, teaching methods, and education reform. Two of the key components which create the construction of an individual's new knowledge are accommodation and assimilation. Assimilating causes an individual to incorporate new experiences into the old

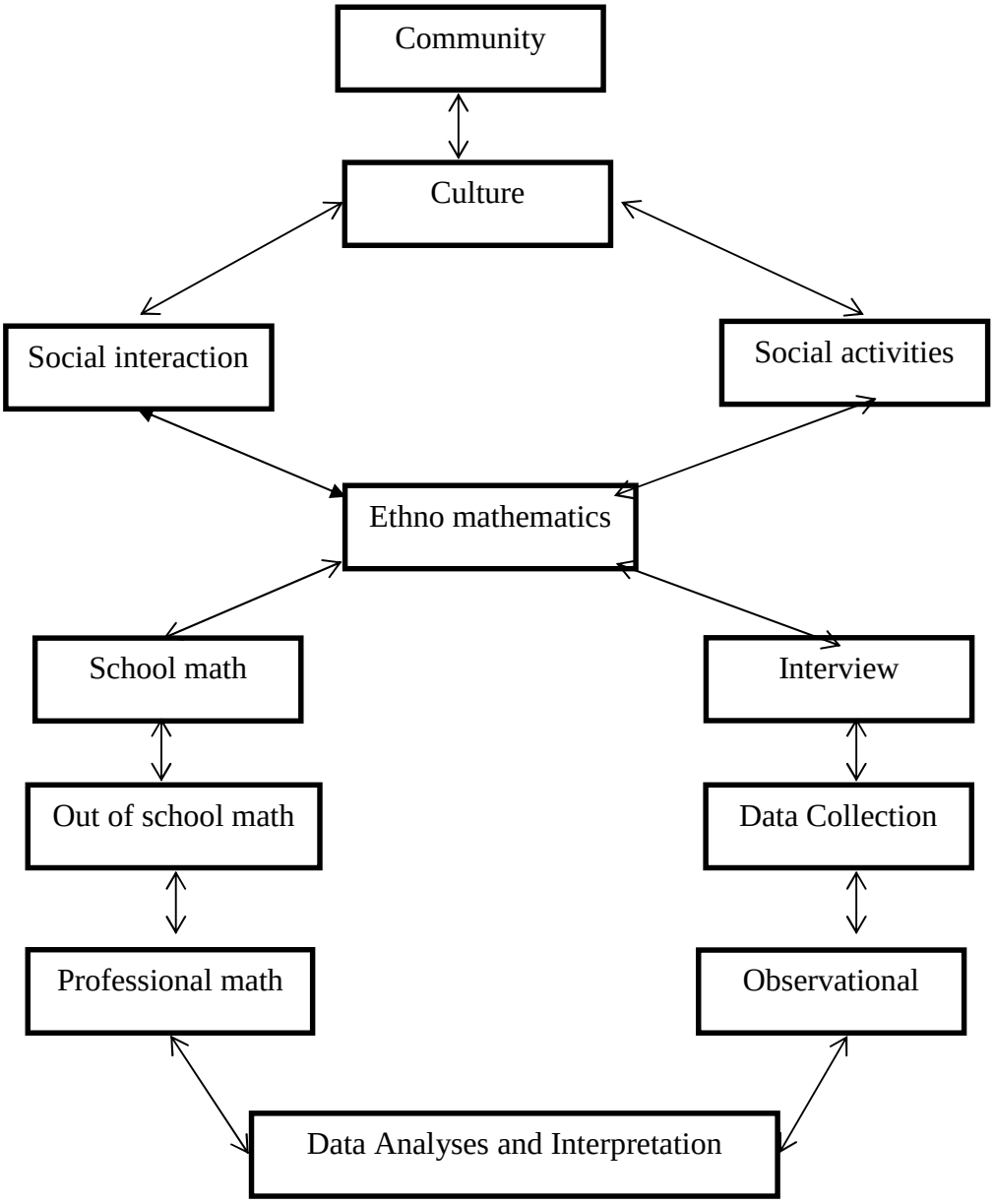
experiences. This causes the individual to develop new outlooks, rethink what were once misunderstandings, and evaluate what is important, ultimately altering their perceptions. Accommodation, on the other hand, is reframing the world and new experiences into the mental capacity already present. Individuals conceive a particular fashion in which the world operates. When things do not operate within that context, they must accommodate and reframing the expectations with the outcomes. Some strategies for teacher include having students working together and aiding to answer one another's questions. Another strategy includes designating one student as the "expert" on a subject and having them teach the class. Finally, allowing students to work in groups or pairs and research controversial topics which they must then present to the class.

From the above discussion, in the postmodern era, constructivist teaching can be important for the learners. In constructivist teaching the students or learners get a chance to think actively about the learning. This is a theory about teaching learning process. Constructivist theory is instructional techniques which can be abstracted from the proposed as a constructivist approach to teaching and some general principles of learning derived from constructivism which may be helpful to keep mind, however, as we rethink and reform our educational practices.

Constructivism recognizes that mathematics must make sense to students if they are to retain and learn mathematics. For the students, to develop appropriate knowledge, they must be provided with rich learning experiences so that their constructed meaning and understanding are in keeping with the discipline of mathematics (Ernest, 1991 as cited in Acharya, 2015).

Conceptual Framework

A conceptual framework is an analytical tool with several variations and contexts. ... It is used to make conceptual distinctions and organizes ideas. Strong conceptual frameworks capture something real and do this in a way that is easy to remember and apply. A conceptual framework was formed different factors is a type of theory that attempts to connect all aspects of inquiry such as mother language-based education, school mathematical knowledge, theories, geometrical knowledge practice in Rai community and mathematical knowledge in school level, data collection, and analysis with the propose of systematic study on ethno mathematics.



This framework is mainly based on constructivism theory and social constructivism theory as well as ethnography study as research methodology. Based on this framework, I collected data by the help of in depth interview, observation and Photograph observation. At the same time, I took photos, audios and video records. Then I analyzed and interpreted the collected data in mathematics education, Ethno mathematics is the study of the relationship between mathematics and culture. Often associated with "cultures without written expression", it may also be defined as "the mathematics which is practiced among identifiable cultural groups". It refers to a broad cluster of ideas ranging from distinct numerical and mathematical systems to multicultural mathematics education. 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.

Chapter III

RESEARCH METHODS AND PROCEDUCERS

In this chapter I presented the method and procedures of the study. Research method and procedures is a plan, which determines how to complete the research systematically. 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 is qualitative in nature through ethnography approach. The researcher tries to explore the mathematical concept, measuring system, counting system and geometrical knowledge of own traditional equipment by Kirati ethnic groups. My research design was qualitative because it helps me for systematic and scientific study of socio-culture of the Kirati community. So, qualitative research methodology guides me to click and every moments of in my study. "Qualitative research is multi method in focus, involving an interpretative, naturalistic approach to its subject matter" (Creswell, 2004). This study lays in the observation of natural behavior in a real life sitting, free from the constraints of more conventional research procedures.

Area of the Study

This ethnographic case study research aims to find the mathematics concept and practicing among Kirati community. The research area of this study is based on the Arun Rural Municipality in Bhojpur district.

There are many Rai communities in Bhojpur District. Even in test, Arun village is the village where I live, so it is easy for me to understand the way of life of saskarsaskriti. Since there is no research on the mathematical content of the Rai in my

own community. I have made Arun municipality my area of research. Since my thesis belongs to the Rai community is in the Arun village, the area of my thesis has become Arun village.

Sample of the Study

This research is ethnography study, so the sample size in this study is not fixed. This research was qualitative research. I was use purposive sampling for my study. This study was an ethnographic based qualitative inquiry. For this I selected four Rai people of the sample of the study.

Tools of Data collection

There are so many methods in qualitative research, which are different kinds of procedures to get information during the research. There are different methods for collecting primary and secondary data. I was collect secondary data from different books, journal, articles and other published and unpublished documents. I used the observation, interview and photographs to get primary data. The research tools that I described below briefly.

Observation

To collect the information observation is one most important technique in the qualitative research. I was 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 activates), experience, number system and geometrical concepts and environment. I was meeting the people familiar with that study area. I was taken some information about the environment, cultural, customs, profession and economic condition of that Kirati community by the help of senior person. I noted information on my note book, and some pictures. I was observed and

identify their mathematical activities on the basic number system and geometry bases in their daily life activates.

Interview

In my research study interview is an important method in data collection. Interview is the process of data collection from face to face with interaction. There are many types of interview: I was applied guide line approach. It is a data collection procedure including verbal communication between the researcher and respondent by face situation. For this I prepare the interview's guideline the interview schedule on the basis of the suggestion from supervisor and the study of research book. I was taken interview with selected person on the basis of interview schedule. The interview would taken to collect data about mathematical concept and practicing, counting number system, measuring system and geometrical knowledge of own tradition equipment.

Photographs

Photographs are important tools for my research study. I was taken some photographs of Kirati activities. Specially, making wood, Bamboo Murchunga, Binayo, Doka, Chakati and clay works, making wood and their life style.

Data collection Procedure

There are many approaches for the qualitative research to get the information from the people about their ideas, experiences, believes, histories, skill and so on. It was easy for me because the social environment is not new for me. Therefore, I didn't need to adjustment time with people where sample of the study more accessible. I was visited their house, forms, workplace, etc for detail information. At that time I was

taken some photo and some made field note. Also I would discuss with the Kirati leaders, farmers, senior students, educators and adults.

Data Analysis Procedures

Data analysis involves reducing and organizing the data, synthesizing searching for significant patterns, and discovering what is important. Regarding data analysis and interpretation, I was helped me to develop a detail description of their behavior, cultural setting, I was translated audiovisual and recorded data in written form. The foundation of ethnography analysis is the belief that information has cultural knowledge. By systematically examination an informants words and environment, one can see the relationship among the parts. It is the examination of these parts the helps the researcher to understand the overall culture of informants" (leech & Onwuebuzie 2008). Cross match and triangulation would adopt to maintain the reliability and validity of the information. I was analyzed the data by linking with different theories and literatures described in literature review section.

Chapter IV

ANALYSIS AND INTERPRETATION OF DATA

This chapter deals with analysis and interpretation of data. This chapter mainly divided into two section such as, numerals used in representing number by Kirati and development process of Geometrical concept of Kirati.

Section: I TheNumerals used in representation number by Kirati

The Kirati script is called 'Sirijanga's script which was developed in 9thcentury king Sirijangas.

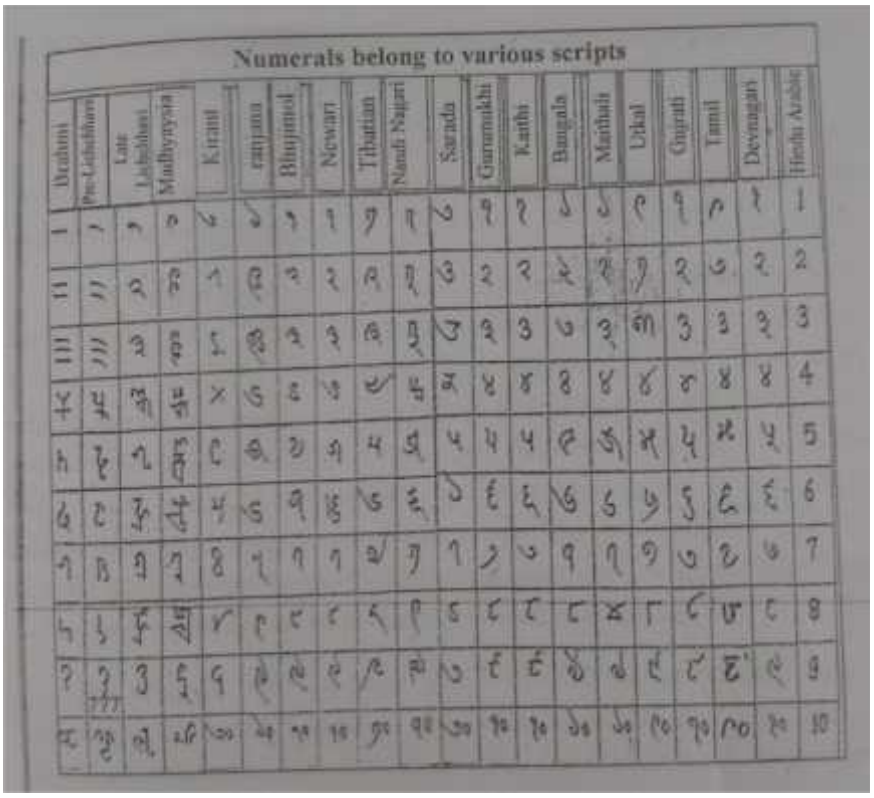
The script of Kirati (Rai) was developed in ninth century by king Sirijanga. But there were not any preserved documents written by king Sirijanga. Some evidence can be found (see Appendix 1) numerals and prepared carved block of wood where numerals are used in ancient form of Sirijanga script, (see Appendix II). In Kirati civilization, there are ten symbols to write numerals and number of Kirati (Rai) is same as numerals and numerals of Limbu. Using the numerals large number can be formed and this is noticed form the block of wood (see Appendix III).

On the tenth century, the son (Paruhang) and daughter in law (Sumnima) of Kirati too had lived in east Dudkoshi River. Kirati culture calling the name of mother and father was an easy. So they had been starting to say 'ee' (big and high stone) and 'ha' (small and low stone). After some time, the word 'Ha' became 'Huwa' nowadays remember of them, they celebrated festival of Udhouli and Ubhauli. (cited in Rai, 2016)

The Kirati have customs, when the son born, after six month he eats meals and when the daughter born, after born five month she eats meals it is called the 'Koksukma' (pasni). Koksukma time, it has made different types of meals and to speak 'Mundhum'. Then, to bath the new son/daughter and to wear the new cloth and cap then to put the womb of mother.

Table-I

Numerals Belongs to Various Scripts



(Subba P.s. Sirijangalipi,1983)

From this table, it can be observed that, in every civilization the development of numeral exists in certain areas and some numerals changed its shape and writing style as the time passed. Different symbols were used to indicate number in different civilization the way of writing style is different and towards change.

Word numeral system and style of writing

Before the invention of numeral (symbol), word numerals are widely used in Kirati community. Kirati script was developed about 9th century A.D. But there are no any evidence of the use of numeral. Hodson Manuscript (volume 79 to 84) are related to Bantawa Rai script there is place for counting and the numerals are written by words like 'Ea' (one) to 'Paau' (ten) 'Huwa', 'Paau', 'Sumpaau', ……..Bom (20,30,……100). Where, Hope (0) means vacuum, absent, birth, origin. (See, Appendix III).

Thus from the above evidence the development of numerals, word numerals were widely used with positional value. In Hodson (1864) manuscript there was no symbol to indicate number. Thus the tradition of counting exists widely before Hodson (1864) in oral form in Kirati community. But there were no were no evidence when the numerals come into existence. But later the numerals were widely used form the time of Run Dhoj Nembang who prepared inscription about numerals and its multiple up to infinite but it is said that all those numerals that were carved in the block of wood by Run Dhoj were taken from ancient and medieval period. The above statement is also justified by Bairangikaila (one of the scholars of Rai script). But in the book Tum Yakthung Ninwa fusalpa published by Bajbir Thalang (1928 AD) some numerals were written to indicate number.

Thus the ancient word numerals were replaced from 18th century AD by using proper numerals. Then from 18th century AD the wide application of numerals can be seen in their daily life.

The style of writing numerals was slightly changed into modern age as composed to medieval age. Runa Dhoj Nembang used (x) symbol to indicate numeral

four is written as a symbol ($). Similarly there were some changes in writing style (shape and size). Compare the numeral given by Run Dhoj Nembang (see appendix IX) and present day is numeral (appendix V) use in Kirati numeral system.(cited Rai)

In my research study, I have selected four people who are the expert of numeral system and Karati script form Arun Gaupalika. According to the topic, I asked about representing number by Kirati. All of them had the idea of counting mostly used their native representing counting system. But young people who are literate used Hindu Arabic country system also they had good knowledge of script and number. The young people used it in very rare case to keep their communication secrete. Researcher have got research time in the field, the numeral system and script of Kirati people have written as same but pronunciation is different. (See appendix V)

In research time, researcher told the respondents to represent the number in their language Krisna Bahadur Rai (92 years) from Arun Gaupalika had counted as bellow, Hop, Ee, ha, sum, Fake, Chuk, Suk, Vuk, Nu, Nuna, Pau, EepauEe, Ee Pau Huwa……..when I asked, do you have any idea to write? And the answer was I know about Kirati script is out script like this –"O,U,……"

Some question, researcher repeated to Fulmaya Rai (83 years) from Jarayotar. Photo had counted as below Aktai, Hatai, Sumkutai, Charkatai…….

When I asked "do you have any idea to write?" and the answer was "I know about the script kirati is so our script" like this:-O, U, ……

Similarly, researcher repeated some question Hari Bahadur Rai (79 years) from Khamare with had. Counted as below Ee, Ha, Sum, Fake, Chuk, Suk, Vuk, Nu. When I asked, "do you have any idea to write?" and answer was "I don't know about the script." Researcher repeated same question, Bir Bahadur Rai (62 years) from

Palpale had counted as bellow Ekgota, Hangota, Sumkagota, Fegota, Chukgota,……

When I asked "do you have any idea to write?" and answer was 'I know about our kirati script like this …….....

From above information I have concluded that represent number of Kirati written numerals are same but pronunciation are some different in different area.

They represent number are mainly based on 10. The number formation after 10 is the same as Hindu Arabic number system. In daily activities of Kirati, the respondents shared also their age income and mathematically knowledge of division, multiplication, addition etc.

One of the respondents Sabitri Rai said her age75 other mathematical activities in base twenty. She told her age this way, ha kori (dui bis) and eegande (aak five) which means her age is of 45 years. Mainly Kirati people used the represent the counting number in basically used the represent the counting in basically used ganda, kori, and bisa in their daily life activities.

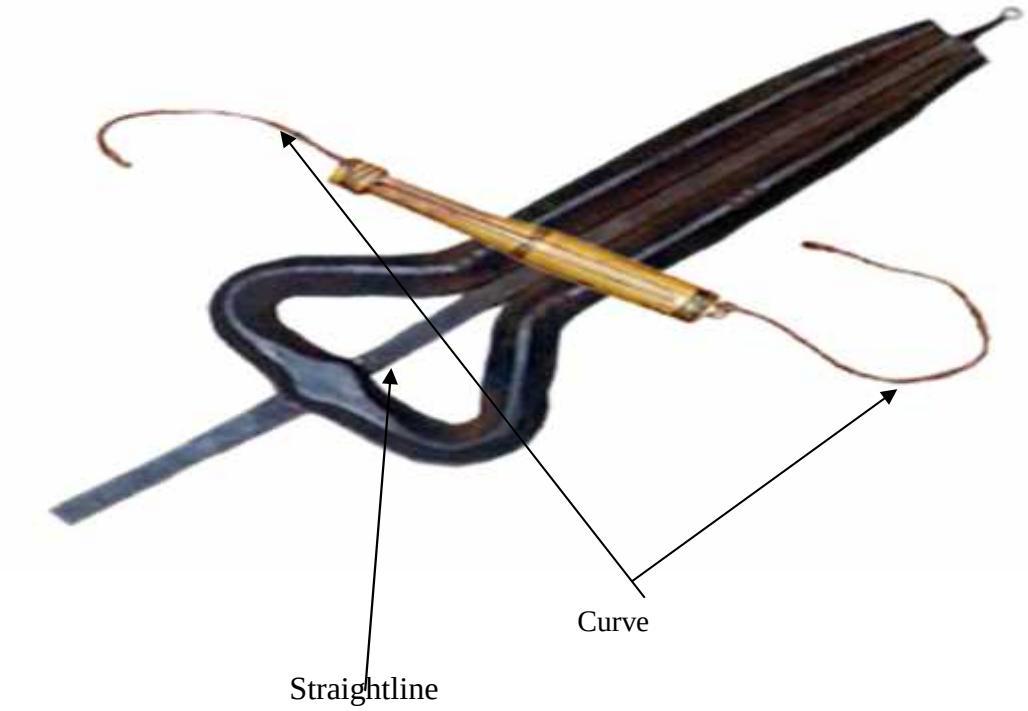
Kirati community used 'Ganda', 'kori', 'Dharni' etc for counting number addition, subtraction, multiplication and division are to solve the daily life problem. In Kirati script, there are ten symbols one to nine and including zero. Using zero and one to nine symbols they represent all numerals as Hindu Arabic system.

Section- II The ways of using Geometrical concept in Kirati community.

Geometry is a branch of mathematics that studies the sizes, shapes, positions angles and dimensions of things. Flat shapes like squares, circles, and triangles are a part of flat geometry and are called 2D shapes. Geometry is traditionally used in Rai community.

The following cultural artifacts used by Rai (Kirati) Coummunity explore the geometrical concept:

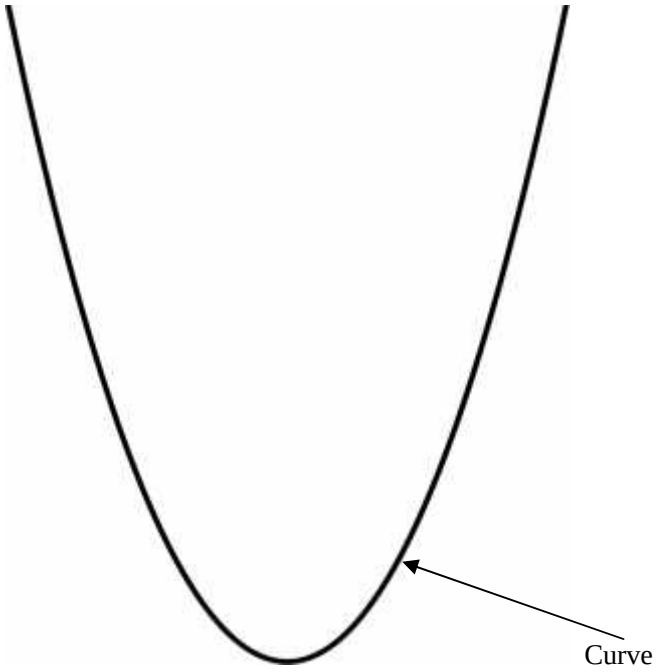
Binayo



Binayo is a traditional instrument of Rai community used these instruments in various cultural festivals. Binayo is found that Rai community has the clear concept of straight-line and curve. Binayo may be found curve, straight-line, rectangle shape depending on the will of theof the marker Mainali (2002). It is used for musically instruments are found in several Rai house. Small Bamboo is used to make Binayo.

Pedagogical Implications

In mathematics, a curve (also called a curved line in older texts) is an object similar to a line, but that does not have to be straight. A curve is the image of an interval to a topological space by a continuous function.



This is applied pedagogically to teach the concept of the straight-line and curve etc (Thapa, 2011). Students can develop various mathematical concepts through the use of Binayo. Using the Binayo, the learner can be informed about the rectangular shape of the curved line as well as the cylinder

.

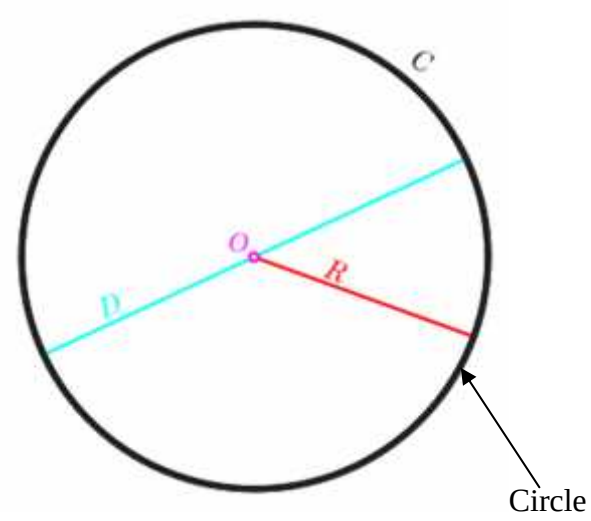
Jhyamta

Circle Semi - Circle

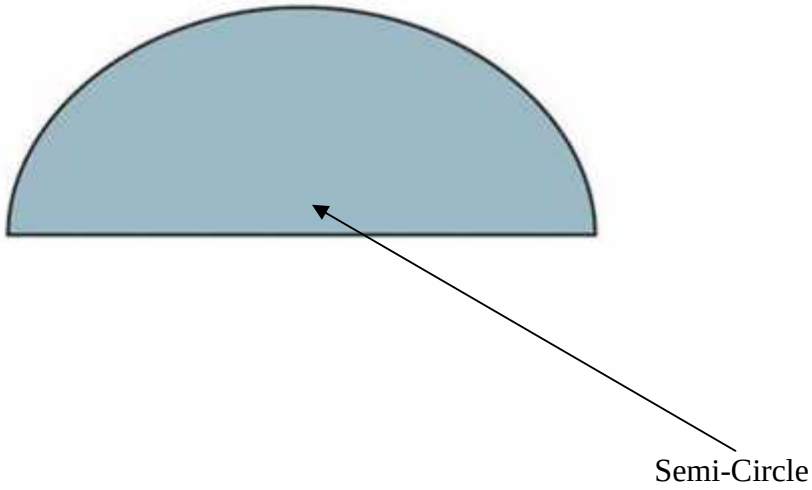
Jhyamta is a traditional instrument of Rai community used these instruments with Dhol in various cultural festivals such as Sakela, Udhauli, Ubhauli and other social functions. Students can be taught the concept of circle as well as semi- circle from the middle of the Jhyamta.

Pedagogical Implications

A circle is a shape consisting of all points in planes that are a given distance from a given point, the centre; equivalently it is the curve traced out by a point that moves in a plane so that its distance from a given point is constant.



This is good applied pedagogically to teach the basic concept circle. By using Jhyamta, students in the classroom can develop real ideas about the circle (Giri, 2010).



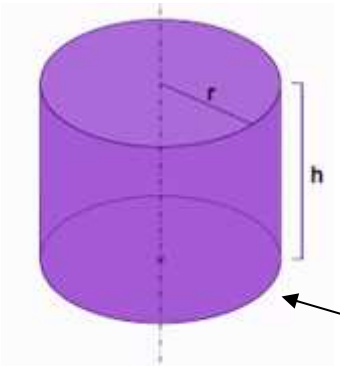
Semicircle is a one-dimensional locus of points that forms half of a circle. The full arc of a semicircle always measures 180°. It has only one line of symmetry.

Through it, learners or students can develop the concept of semi- circle. By using it, knowledge about different parts of circle can be provided.

Chindo (Wabuk)

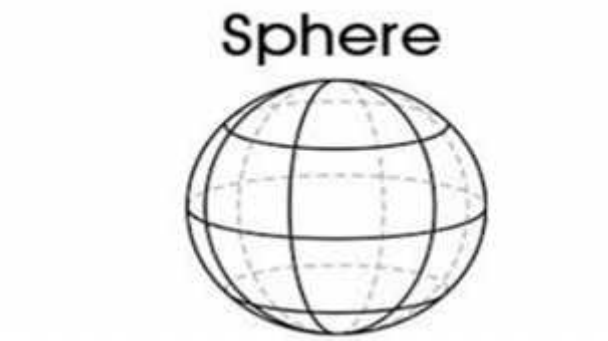
Chindo is type of traditional material used in the Rai community. It is especially used for weddings. Through this medium information about the circle can be given to the students. Students can be given a sphere from the Chindo as well as a Cylinder.

Pedagogical Implications



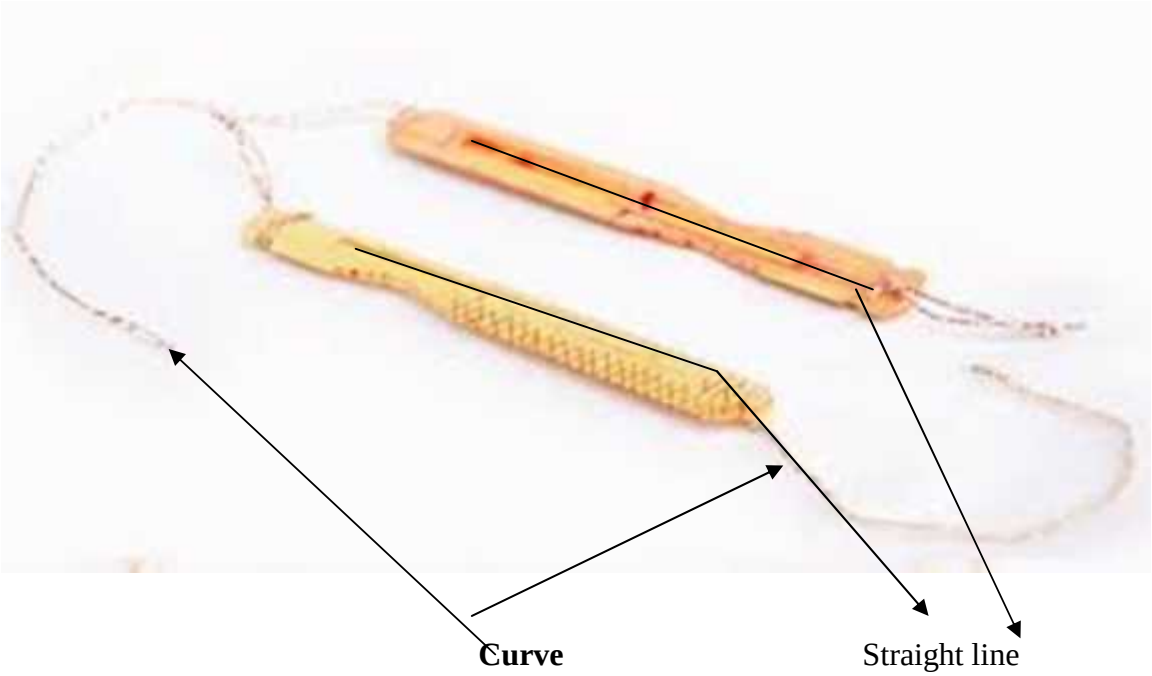
A sphere is a geometrical object in three-dimensional space that is the surface of a ball. Like a circle in a two-dimensional space, a sphere is defined mathematically

as the set of points that are all at the same distance r from a given point in a three-dimensional space.



This is good applied pedagogically to teach the concept of the Cylinder, sphere etc.

Murchunga

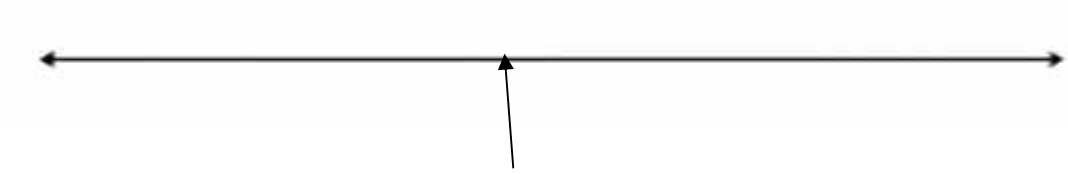


Murchunga is a traditional instrument of Rai community used these instruments in various cultural festivals. Murchunga is found that Rai community has the clear concept of straight-line and curve. Murchunga may be found curve, straight-line, rectangle shape depending on the will of the marker. It is used for musically

instruments are found in several Rai house. Small Bamboo is used to make Murchunga.

Pedagogical Implications

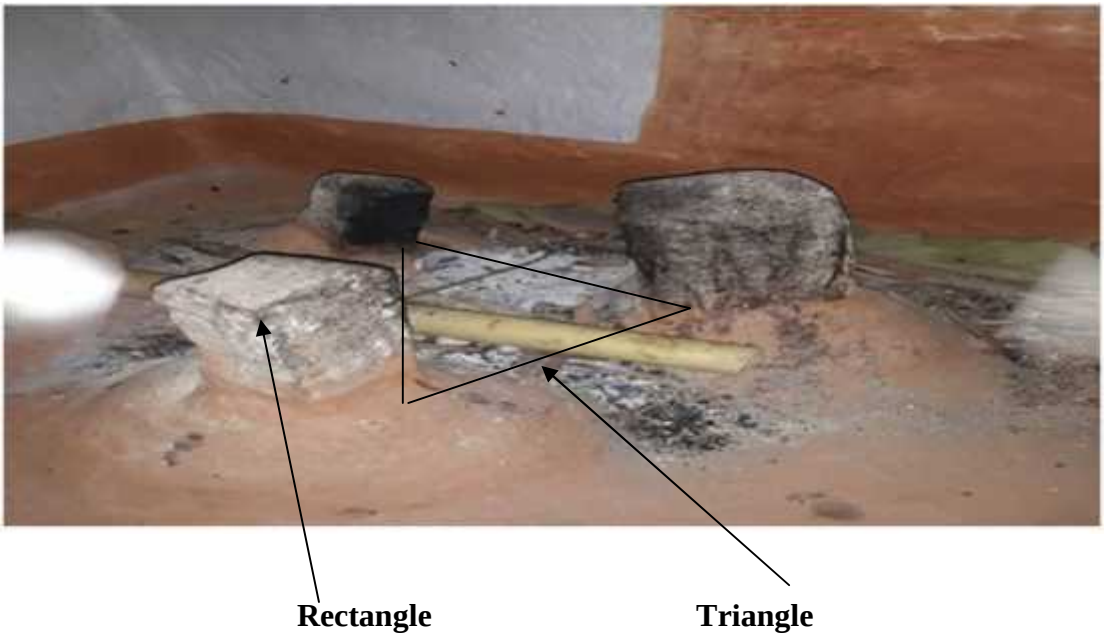
It has no width, volume, thickness, length or depth. Yet when you have two points, if we connect every point between those two points, we have a straight line.



Straight line

This good is applied pedagogically to teach the concept of the straight-line and curve etc. various mathematics geometric concepts can be developed in learners through the use of Murchunga. Using it students can learn about curved lines and straight lines (Majhi, 2008).

Deuta (Mang)

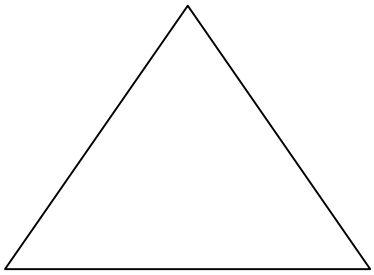


Deuta is a type of traditional material used in the Rai community. It is especially used for yearly functions in Kul- Deuta. Through this medium information about the rectangle can be given the students. Students can be given a sphere from the Deuta as well as a Triangle.

Pedagogical Implications

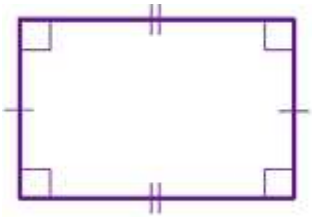
A triangle is a three-sided polygon that consists of three edges and three vertices. The most important property of a triangle is that the sum of the internal angles of a triangle is equal to 180 degrees. This property is called angle sum property of triangle. If ABC is a triangle, then it is denoted as ΔABC, where A, B and C are the vertices of the triangle. A triangle is a two-dimensional shape, in Euclidean geometry, which is seen as three non-collinear points in a unique plane.

Triangle



Rectangle is a quadrilateral with four right angles. It can also be defined as: an equiangular quadrilateral, since equiangular means that all of its angles are equal (360°/4 = 90°); or a parallelogram containing a right angle (CERID, 1990).

Rectangle



It helps to teach the students about the concept triangle and Rectangle etc. Various mathematical concepts can be developed in learners through the use of Deuta through this students can be given the knowledge of rectangle objects, square objects. In the can be given by using a Deuta (CERID, 1990).

Matiya

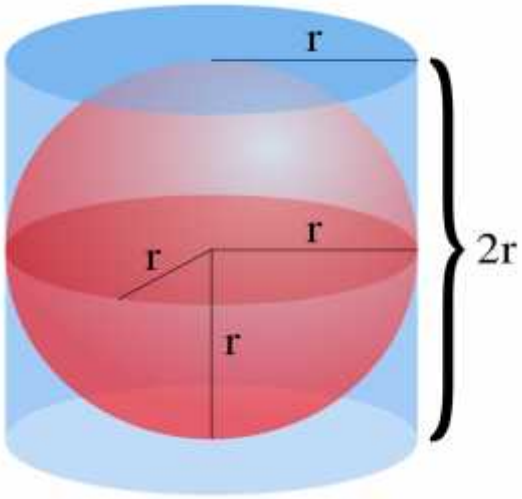
Circle

Cylinder

Matiya is type of traditional material used in the Rai community. It is especially used for carrying Alchohol at weddings. Through this medium information about the circle can be given to the students. Students can be given a sphere from the Matiya as well as a Cylinder.

Pedagogical Implications

A cylindrical surface is a surface consisting of all the points on all the lines which are parallel to a given line and which pass through a fixed plane curve in a plane not parallel to the given line. Any line in this family of parallel lines is called an element of the cylindrical surface (K.C, 2008).



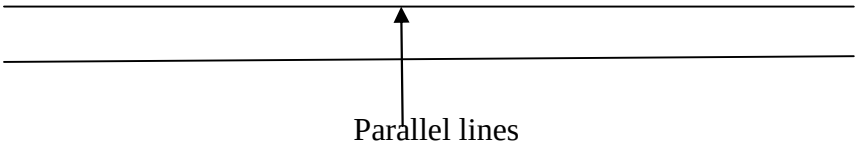
Using Matiya can help students develop a realistic perception of the circle in the classroom. Students can be given a sphere from the Matiya as well as a cylinder. This is good applied pedagogically to teach the concept of the Cylinder, sphere etc.

Thunche (Tongwat)

Thunche is a type of traditional bamboo material used in the Rai community. Thunche is used to carry Koseli at wedding. It can give students a variety of mathematical concepts. From the middle of the Thunche, students can be given the idea of a soli as well as a rectangle. By doing the idea of parallel lines and circles can be given.

Pedagogical Implications

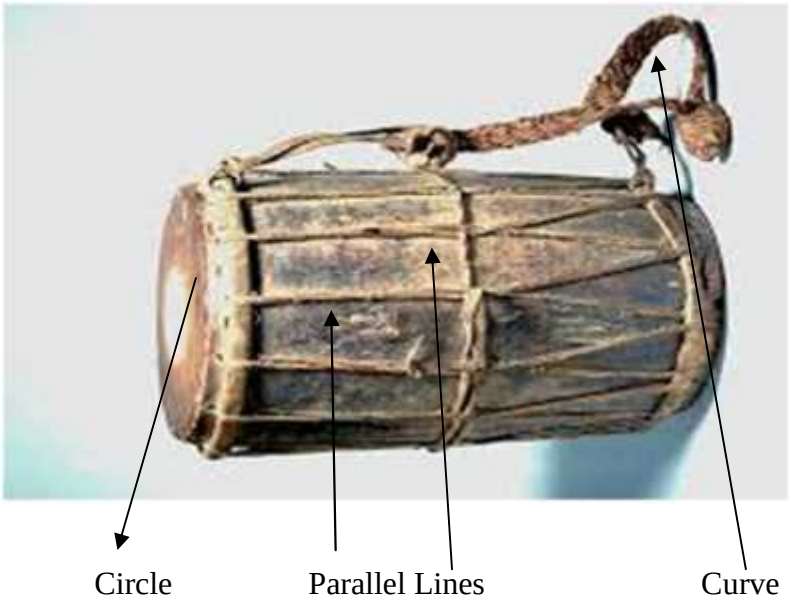
Geometry, parallel lines are lines in a plane which do not meet; that is, two straight lines in a plane that do not intersect at any point are said to be parallel.



Parallel lines

Students can develop a variety of mathematical concept using Thunche. Soli knowledge can be impacted by using Thunche (Rai, 2019). The use of this can be used to develop ideas about circles and rectangular objects. It provides clear concept of Circle and Parallel lines.

Dhol



Dhol is the traditional instrument of Rai. It is used in various festival of Rai. The festival of Dhol rai is used in Sakela and many other festivals. Different concepts related to mathematics can be imparted to the students the medium of Dhol. Through the Dhol, parallel lines, circles and cylinders can be given to the students.

Pedagogical Implications

Using Dhol students can develop a variety of real mathematical concepts. It's given students or learners an idea about parallel lines, intersecting lines, by using knowledge of circle and cylinder can also be given. It provides clear concept of parallel lines, circles and cylinders and radius and also to find out the aria. It provides knowledge of circle and cylinder can also be given (Yamphu Indra, 2009). It provides clear concept of parallel lines, curve, circles and cylinders and radius and also to find out the aria.

Okhal

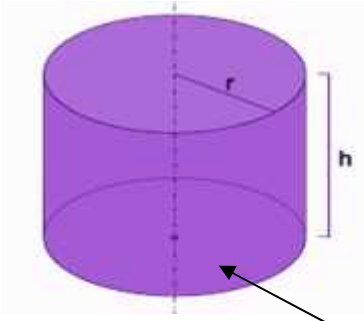
Cylinder Circle

It was found that Rai community are using concept of cylinder in their daily activity made of wood bamboo, etc. Sawyers separate tree into the places of cylindrical logs called "Mudha". They also make a hollow inside have made of wood. It is a grinding machine made of wood (Rai Kalpan, 2001). It has two separate parts. One part is called Okhal. The other part is solid cylindrical called Chim. It is length is about two feet. These two parts are grinding species and medicinal herbs. It was

constructed in such a shape so that species and herbs are ground into very small pieces.

Pedagogical Implications

A cylinder has traditionally been a three-dimensional solid, one of the most basic of curvilinear geometric shapes. It is the idealized version of a solid physical tin can having lids on top and bottom (Millroy, 1992).



Cylinder

It provides clear concept of cylinder by practically etc. knowledge of circle and cylinder can also be given. It provides clear concept of parallel lines, circles and cylinders and radius and also to find out the aria.

Naglo

Circle

It is a traditional household material made of strips of bamboo by knitting each other. The edge of Naglo is also made of bamboo stick. It is circular in shape. They use it for threshing cereals and crops. This household appliance was constructed in such a shape so that separation of grains of rice, wheat, etc because faster and easier.

Within observation period, use of parallel line occurred much more than other concept but sample population couldn't answer the question about parallel lines. It means that they have no terminology to speak for parallel lines. Despite of this situation, they used the concept of parallel lines in their daily activity.

Rai community were using concept of parallel lines in his field, in the work of wicker and another place. Researcher asked them how they make parallel to color the wicker. They said the wicker size are similar so they count the wicker then color them to make parallel.

Pedagogical Implications

This is good applied pedagogically to teach the concept of the parallel, intersection made by curve shapes, were rectangle, some were square etc.

Bedo

Circle

It was found that Rai community are using concept of circle. A ring used to hold pot. The design of triangular, parallel, line, patter and flower design made to make it beautiful.

Pedagogical Implications

The use Bedo can give a variety of mathematical concepts to students or learners. It provides clear concept of circle and their solid are. It helps to teach area of ring that is area of big circle, small circle. It helps to teach of ring that is area of big circle small circle.

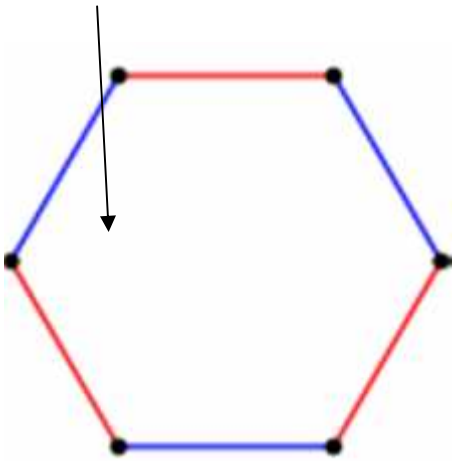
Pyarungo

It is a kind of traditional domestic tool. It's constructed by using small strips of bamboo and knitting the strips of bamboo and knitting the strips together and small hexagon holes are formed in the overall construction on the whole.

Pedagogical Implications

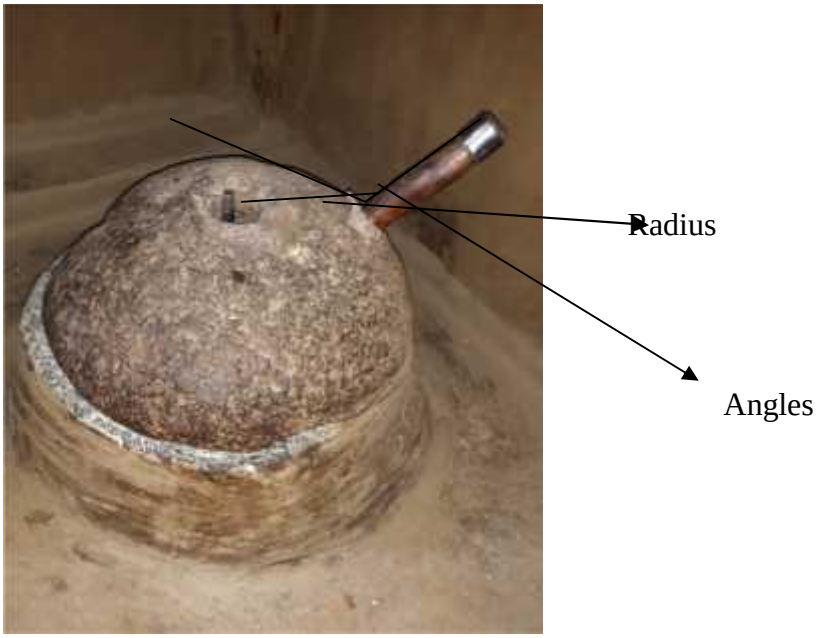
In geometry, a hexagon is a six-sided polygon or 6-gon. The total of the internal angles of any simple (non-self-intersecting) hexagon is 720° (Adhikar, 2009).

Hexagon



It helps to teach the students about the concept hexagon, parallel lines and intersecting line. By using Pyrango, students can develop perceptions about different angles. It helps to teach the students about the concept hexagon, cylinder, parallel line, intersection.

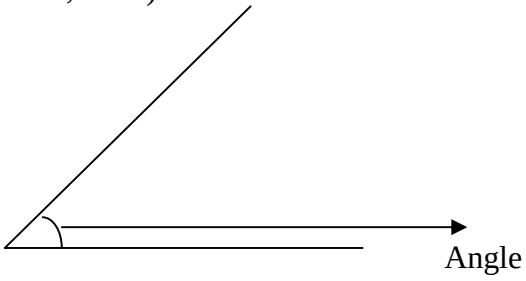
Jato (Jhanta)



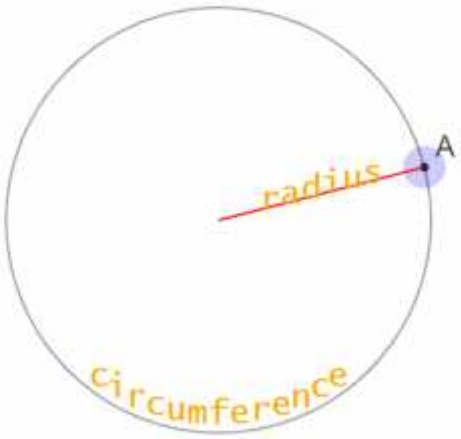
This is traditional domestic tool used as alternative to a mill. To construct this tool, two semi-spherical stones are connected by a wooden stick or metal rod. The lower part is fixed on the ground and a wooden handle is inserted on the edge of the upper part so that they can move round. On the whole it looks spherical in shape. This machine is designed in spherical shape so that they can move it round easily and grind cereals and crops.

Pedagogical Implications

An angle is the figure formed by two rays, called the sides of the angle, sharing a common endpoint, called the vertex of the angle. Angles formed by two rays lie in the plane that contains the rays. Angles are also formed by the intersection of two planes (Rai Biman, 2019).



The distance from the centre to the circumference of a circle.Radius of a circle or sphere is any of the line segments from its center to its perimeter, and in more modern usage, it is also their length.



It helps to teach the students about the concept of sphere, circle of radius and angles etc.

Chapter V

FINDINGS CONCLUSION AND IMPLICATIONS

Findings of the Study

On the basis of analysis and interpretation of data, the major findings of this study were as follows.

- The concept of rectangular and squares shape is in common practice among the Rai.
- The Rai people have their own system of measurement and their own math processes. These are all based on traditional practical utility value.
- Rai have the concept of constructing circular, cuboids, cylindrical, parallelepiped and spherical object of facilitate the daily life.
- The script of Kirati is influenced by Bhrami script, so the numerals are also influenced by Bhrami numerals.
- Wood numeral systems were widely used before the development of proper numerals (system to indicated number).
- The Sirijangha script was developed by king Sirijangha and re-discovered by second Sirijangha. Thus numerals are written in Sirijangha script.
- Most of the Kirati people (different clan) used same numerals but vary in pronunciation.
- Almost selected Kirati farmers are illiterate and unfamiliar with formal counting system and geometrical concept. However, they always used the concepts of formal counting system and geometrical concept.

- To construct domestic objects knowingly or unknowingly they make first concept of shape and size in their mind of the concerning domestic object to construct it.
- They used the process of regular hexagon, square, and parallelogram, rectangular and triangular holes to construct some domestic objects.

Conclusion

Many ethnic groups in Nepal, there are own typical traditions and practices. The Rai community is also one of the ethnic groups of Nepal. They use their own traditional number system and geometrical knowledge and practices in their daily life knowingly or unknowingly. Their geometrical concept are essential for understanding the formal geometrical concepts of Rai community has not been expanded, explored and linked with formal geometry.

The representations numeral system and geometrical knowledge is strongly embedded in socio-cultural activities of the Kirati community. Kirati are used to do mathematical work using their own numeral and still using because Kirat have their own script.

In conclusion, Kirati have their own numerals system from medieval age in different from decimal scale with position number system was adopted and all Kirati people adopted same scripts in writing but varies in their pronunciation. Also the Kirati use geometrical concept in their own daily life. School geometry can be more interesting and worthy while linking it with socio-culture activities such as religious ritual, cultural, object and artifact. It also helps the students and teachers to improve their fields likewise, this study is applicable to curriculum maker, textbook writer, policy maker, in service teacher and out-service mathematics teacher.

Implications

This study was conducted taking short period of time. On the basis of the finding of this research the following suggestions have been made further researcher.

Practice Related Implications

- This study was limited to the basic numerable scripts and geometrical concepts practiced by Kirati community.
- It is interesting to replicate this type of study in different socio cultural content of Kirati villagers.
- The Kirati measurement and counting system, their math's process are based on the daily life need. They do it through the use of real, physical objects but lake of standardization. Therefore, need to be developed standardized and preserved.

Policy Related Implications

- It will help local curricular developer, teacher and teaching assist in developing curriculum that enhance the indigenous knowledge of Kirati (Rai) Community.
- It will help the students who study their mother tongue of Kirati language.
- It will help local curricular developer to include indigenous knowledge in curriculum.
- To motivate for using of locally available low cost materials in order to create conceptual understanding of the concept of geometry.

Further Research Related Implication

- This study on the numeral script of Kirati suggests that further studies of different aspects of cultural ethno-mathematics be carried out.

- It will help researchers who carry out the cultural, ethnic related researcher further.

There is various mathematical knowledge in socio-cultural activities that can be linked with formal curriculum and these concepts & ideas can be used in local mathematics curriculum in primary level.

References

Acharya, B.R. (2015). *Foundation of mathematics education.* Kathmandu: Dikhsanta Prakashan.

Bloom, B.S. (Ed). (1956). *Taxonomy of educational objectives, Handbook 1: The cognitive domain,* New York: Mckay.

Chaudhary, D.K. (2017). *Mathematical practices in Tharu community.* T. U.

Census, N.P. (2011). *National population census*. Kathmandu: Central Bureau of Statistics.

CERID. (1990). *The elementary process of learning mathematics concepts and process of Rasuwa, Tamang. Kathmandu.*

Creswell, W.J. (2004). *Research design: Qualitative, Quantitative, and mixed method approaches.* SAGE Publication.

Creswell, W.J. (2012). *Educational research: planning, conducting, and evaluating quantitative and qualities research.* New Delhi: Sage Publication.

Derry, S.J. (1999). *A Fish called peer learning: Searching for common themes*. In A. M. O' Donnel & A. King (Eds.)

Doll, W. (1993). *A post-modern perspective on curriculum.* New York: Teachers College Press.

Giri, Y. (2010). A study on basic mathematical concepts practiced by Kulung rai community in Sankhuwasava district, T.U.

J.C. (2018). *Basic geometrical concepts practiced by Majhi community.* Unpublished Master's Degree Thesis, Department of Mathematics Education, T.U. Kirtipur, Kathmandu.

Karki,R.(2017). *Basic mathematical concepts practiced by Hayu community*. Unpublished Master's Degree Thesis, Department of Mathematics Education, T.U. Kirtipur, Kathmandu.

Kim, B. (2001). *Social Constructivism. In M. Orey (Ed.), Emerging perspectives on learning, teaching, and technology*. Unpublished Master's Degree Thesis, Department of Mathematics Education, T.U. Kirtipur, Kathmandu.

Mahji, C.J. (2018). *Basic geometrical concepts practiced by Majhi*. T.U.

Milloray, (1990).*Ethnographic study of mathematical ideas of group of charpenter.*

Rai, S.K. (2019). *Access of girl's participation in mathematics learning at higher level.* Unpublished Master's Degree Thesis, Department of Mathematics Education, T.U. Kirtipur, Kathmandu.

Rai, S.K. (2015). *Development of numerical scripts in rai ethic.* T.U.

Rai, B. (2019). *Basic mathematical concept practiced by Nachhiring rai community in Khotang district.* Unpublished Master's Degree Thesis, Department of Mathematics Education, T.U. Kirtipur, Kathmandu.

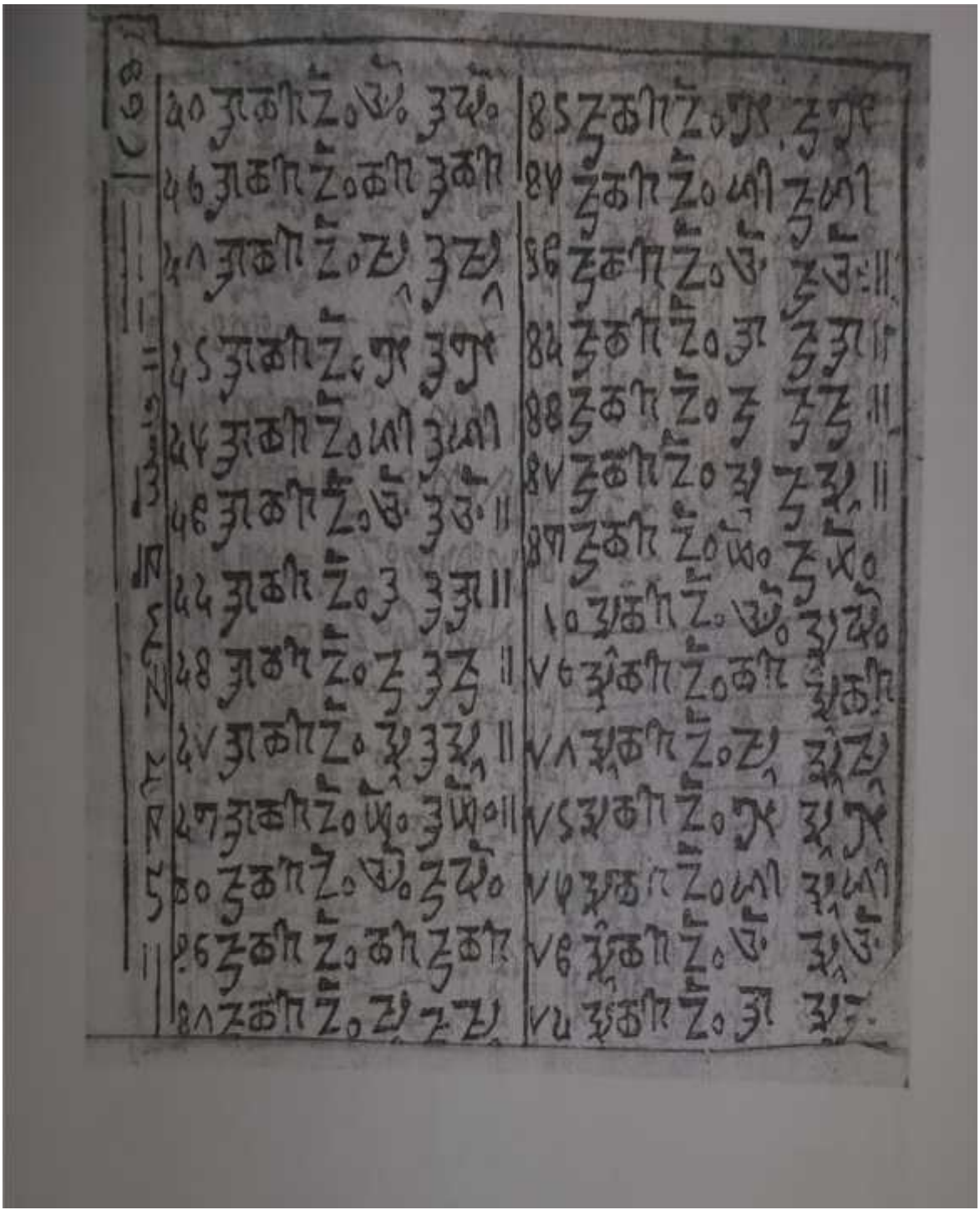
Rai, S.(2019).*Basic mathematics concept practice by Nachhiring rai community in Khotang district*. Unpublished Master's Degree Thesis, Department of Mathematics Education, T.U. Kirtipur, Kathmandu.

Vygotsky, L. S. (1962). Learning and mental development at school age. In B. Simon and J. Simon (Eds.), *Psychology in the U.S.S.R.* (pp. 21-34). London: Routledge & Kegan Paul. (Originally published 1934.).

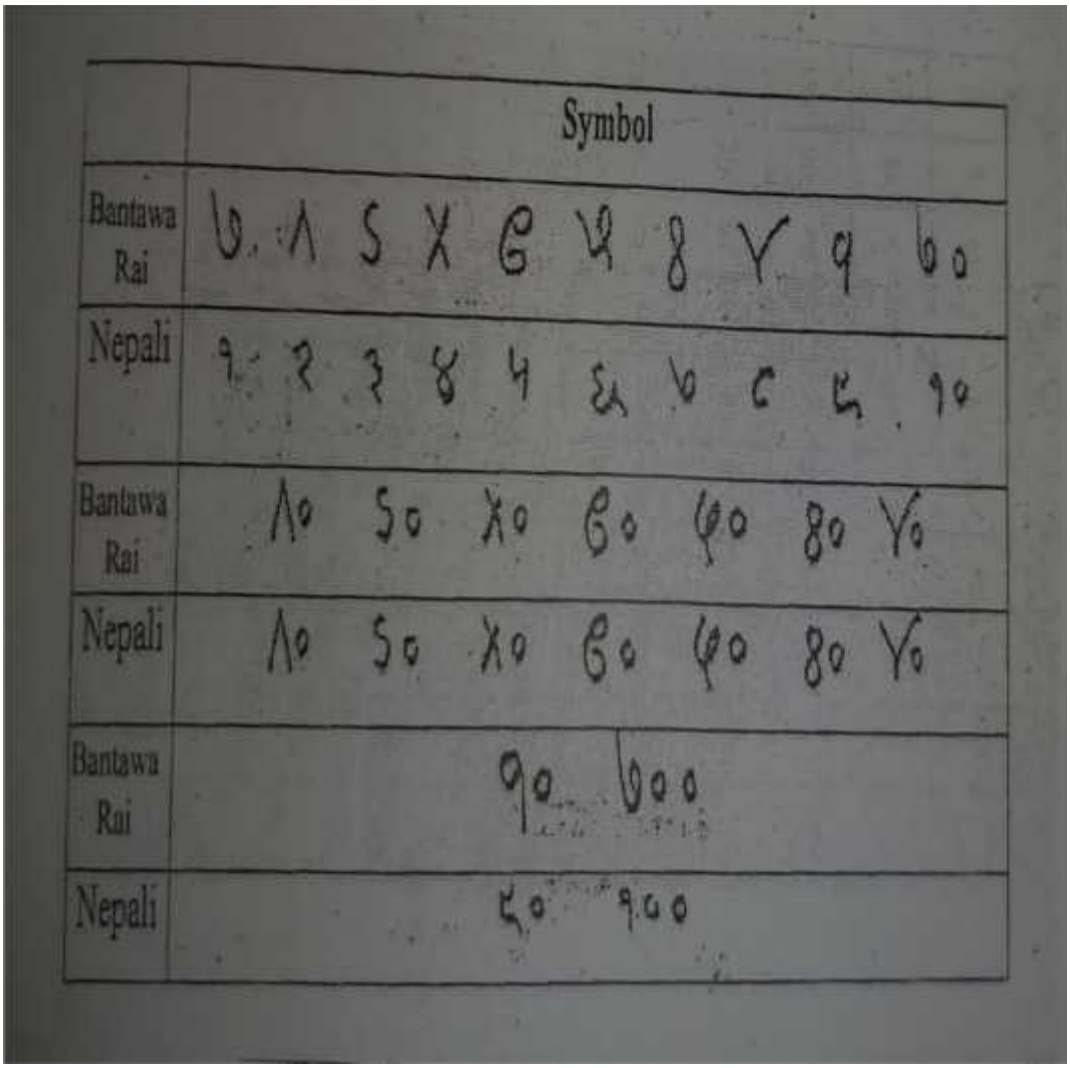
Vygotsky, L. S. (1989). Concrete human psychology. *Soviet Psychology, 27,* 53-77. (Original unpublished manuscript 1929)

Appendix-1

Numerals of Kirati and their Corresponding Pronunciation

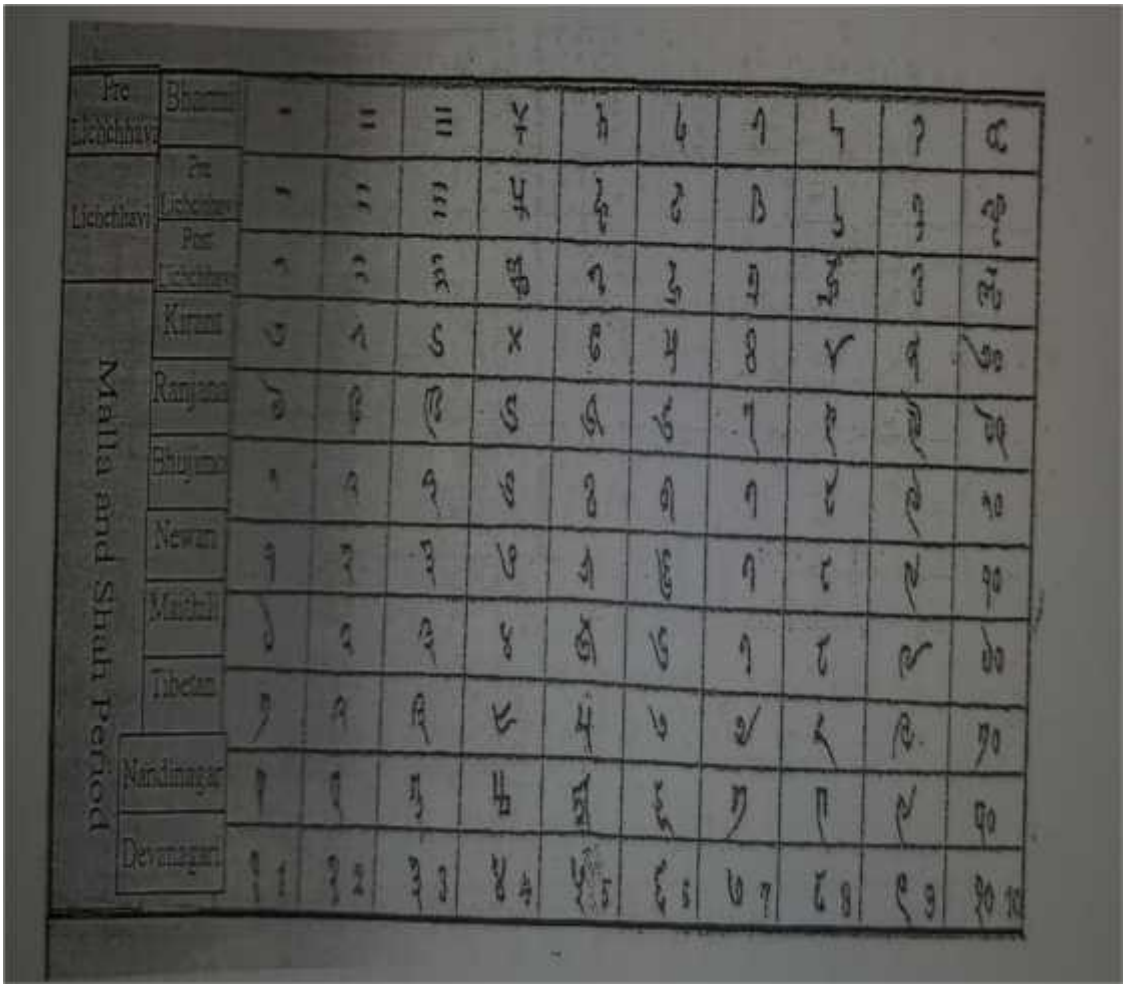


Appendix-2

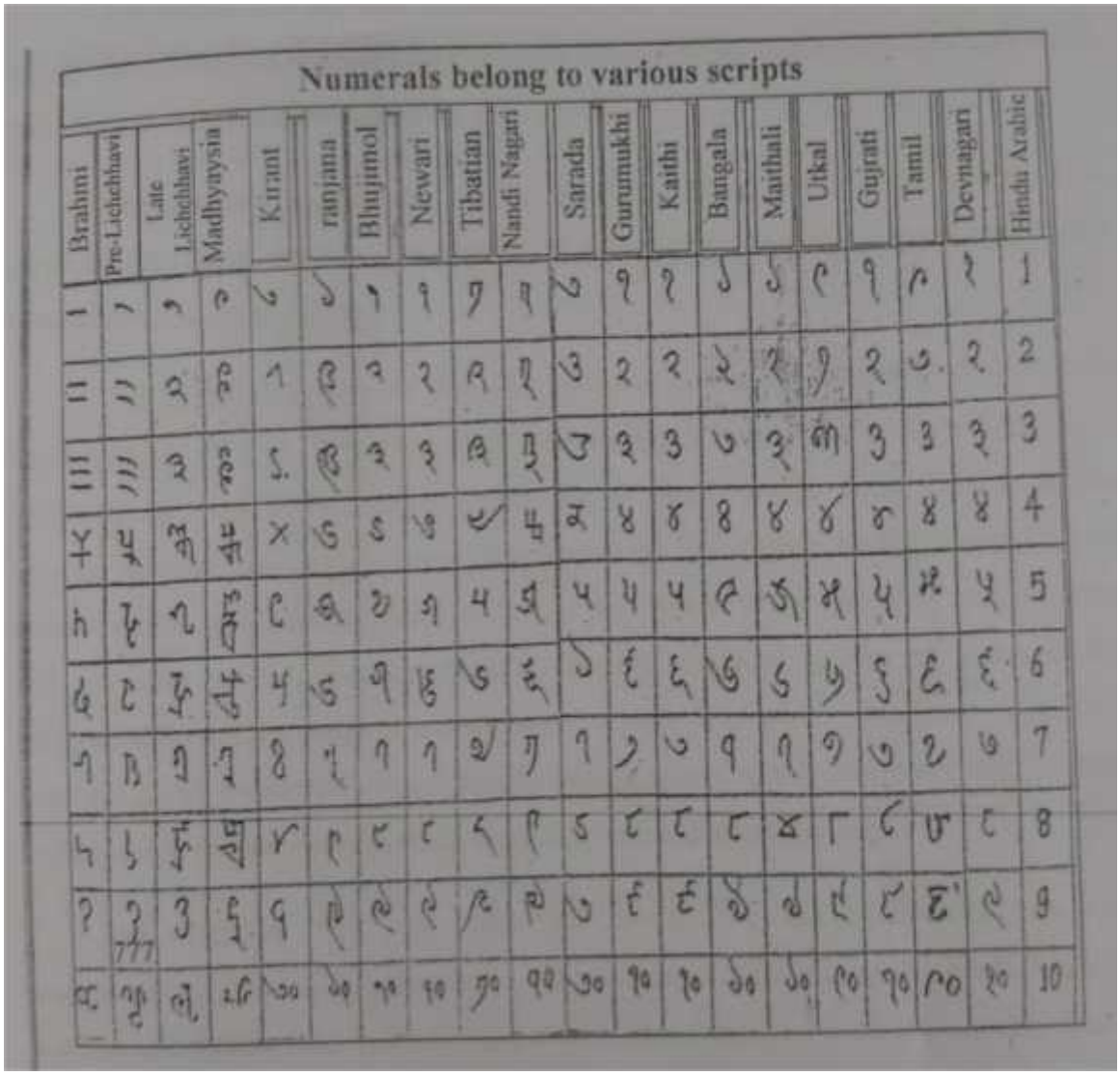


	Symbol
Bantawa Rai	᱐ ᱑ ᱒ ᱓ ᱔ ᱕ ᱖ ᱗ ᱘ ᱙ ᱑᱐
Nepali	९ २ ३ ४ ५ ६ ७ ८ ९ १०
Bantawa Rai	᱑᱐ ᱒᱐ ᱓᱐ ᱔᱐ ᱕᱐ ᱖᱐ ᱗᱐
Nepali	१० २० ३० ४० ५० ६० ७०
Bantawa Rai	᱙᱐ ᱑᱐᱐
Nepali	९० १००

Appendix-3


Pre Licchhavi
Licchhavi
Malla and Shah Period
Bharam
Pre Licchhavi
Post Licchhavi
Kiran
Ranjana
Bhujimo
Newari
Maithili
Tibetan
Nandinagari
Devanagari

Appendix-4



Numerals belong to various scripts

Brahmi	Pre-Lichchhavi	Late Lichchhavi	Madhyayasia	Kirant	ranjana	Bhujimol	Newari	Tibatian	Nandi Nagari	Sarada	Gurumukhi	Kaithi	Bangala	Maithali	Utkal	Gujrati	Tamil	Devnagari	Hindu Arabic
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
11	11	2	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
111	111	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
+<	4	4	4	X	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Appendix-5