

**BASIC MATHEMATICAL CONCEPT PRACTICED BY SHERPA COMMUNITY**

**A**

**THESIS BY**

**ANANTA KUMAR PHUYAL**

**IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE**

**OF MASTER OF EDUCATION**

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.....

Prof. Dr. Bed Raj Acharya, Head



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### LETTER OF APPROVAL

A thesis by Ananta Kumar Phuyal entitled “**Basic Mathematical Concept Practiced by Sherpa Community**” has been approved for the partial fulfillment of the requirements for Degree of Master of Mathematics Education.

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### RECOMMENDATION FOR ACCEPTANCE

This is to certify that **Mr. Ananta Kumar Phuyal**, has completed his thesis entitled “**Basic Mathematical Concept Practiced by Sherpa 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-voce.

.....

Lok Nath Bhattarai

Supervisor

Date: 15 January, 2021

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## **DEDICATION**

Dedicated to my Family

## DECLARATION

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

Date.....

.....

Ananta Kumar Phuyal

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.....

Ananta Kumar Phuyal



## ABSTRACT

This study focused on the identification of mathematical concept and numeral system practiced by Sherpa community. The design of the study is qualitative nature and the approach of the study is ethnographic. The Soludhudhkunda municipality wads no 1, Solukhumbu district is taken as the field of the research and ten Sherpa people (1 teacher 1 student and 8 illiterate people) were selected by the snowball sampling method. This study concerned on the numeral system, measurement system, and geometrical concepts practiced by Sherpa community. The tools adapted for the collection of data are interview, observation and photographs. Sherpa people mostly use their own counting system of Numerations which is practiced from long period of time. Their numeration system is based on 20. They did simple mathematical operations orally but large number of problems could not be solved by illiterate persons. Sherpa people used different measurement system such as bitta, inch and hatt for length measurement, kosh for long distance measurement, tulo for weight measurement etc. On the other hands, they have no any concept of geometry but they prefer to construct and use geometrical objects to make their life easy. Thus, there is the knowledge gap between traditional and modern approach of measurement system and geometrical concept but similar practices are found still among the illiterate groups.

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## Chapter I

### INTRODUCTION

#### Background of the Study

The concept of number and numerals, from early developments in mathematics are together an important basis for quantification of things in measurement, comparison, location of relative position etc. We can see how number concepts were developed. The need to convey precise information about objects urged people to developed numbers. Number recording needs counters; fingers and toes are clearly the handiest of all counters. Therefore, a counting system based on fingers (10) and fingers and toes (10+ 10) were developed in many parts of the world. The invention of symbols helped to develop mathematical processes, which utilize positional representation of numbers and operation of numbers. This made math process – addition subtraction, multiplication and division.

The early numerical and decimal systems developed by the Hindus have formed a basis for the math processes in common use today. The Brahmi numerals for the earliest were Hindu invention and the devnagari numerals were a later development. Today people have developed several forms of number counting: some of base 2, some of base 5, some of base 10, some of based 20 and so on. Most people count 10 and 100. Some ancient counting systems have already becomes absolute and some others that have survived in their partial use in new ones. For examples, the French, “quantrevigngetdix” means “four twenties and ten”. The precious British momentary system of “20 shillings = 1 pound” was based on 20 (CERID, 1990:4)

People have been using mathematics from the very beginning of human civilization. It is believed that mathematics was originated along with the origin of man. Human beings themselves created mathematics in the need for application to

counting a measuring in relation to both of quantities as well as spatial objects.

Mathematics usually develops according to the needs of human being.

The term mathematics has been interpreted & explained in various ways. It is the numerical & calculation part of man's life & knowledge. It helps the man to give exact interpretation to his/her ideas & conclusions. It deals with quantitative facts & relationships as well as with problems involving space & form. It enables the man to study various phenomena in space & establish various relationships between them. It explains that this since is a by-product of our empirical knowledge (Upadhaya, 2010).

A common approach is for an anthropologist with extensive knowledge of mathematics to spend large amounts of time within a given population, learning how to do the mathematical work that local people do. In this sense, “ethno” refers to an identifiable cultural group (not a race or ethnicity) (D’Ambrosio 1985; 2006), such that even professional mathematicians could be seen as producing a form of ethno mathematics (Borba 1990; Powell & Frankenstein 1997).

Anthropologists who study mathematics have documented that all people do mathematics, but also a variety of forms are practiced in different cultures. In fact, many believe that humans developed mathematics in order to describe the world around us and help us to solve everyday problems. Viewing mathematics as a tool to describe the natural environment explains how very different people on different parts of the globe throughout history could create a universal mathematics. Yet differences between cultures may have led to different forms being practiced. Researchers in ethno mathematics argue that the kinds of mathematics developed are partially influenced by the peoples who create them (D’Ambrosio 2006).

Much of the ethno mathematics research that is readily available highlights the games that are played in many African cultures and how those games draw upon mathematical principles familiar to Western mathematics (Zaslavsky 1998; Crane 1982).

However, the researcher wanted to know whether they used the geometrical concept knowingly or unknowingly if they know the mathematical concept. The concept of number and the process of counting system has been development with the time. In the most primitive time, human had some number sense of them recognizing more and less when some objects were added or taken from small group simple counting becomes imperative with the gradual development of human civilization and society. In the previous time the way of keeping a count was done by simple tally method by using the principle of one to one correspondence, for example in keeping a want on sheep, one finger per sheep would be turned under. The collection of pebbles/sticks/stones or pieces of wood were used in maintaining the counts. The perhaps later an assortment of vocal sour was developed of a word tally against the number of objects in a small group. Finally, with refinement of writing, an assortment of symbols was derived to stand for these numbers.

### **Introduction of Sherpa**

The Sherpa's are a tribe of Tibetan origin. They mainly live in the Khumbu and Solukhumbu regions of Nepal. Sherpa's inhabit the valleys of the DudhKosi and Roiwaling Rivers west of Solukhumbu, and they are also found in the LantangHelambu region. Kathmandu has a sizable Sherpa population; Terai region also has small numbers of Sherpa's populations. They are also present in the Indian state of Sikkim and the bill towns of Darjeeling and Kalimpong. The dress of Sherpa is similar to that worn by Tibetans. They wear a long inner shirt over a pant-like

garment, both made out of wool. Yeti is a unique element in Sherpa folklore. They belong to the Nyingmapa sect of Buddhism. In addition to Buddha and the Buddhist divinities, the Sherpa also have believed in various gods and demons that are believed to inhabit every mountain, cave, and forest. For example, the Sherpa's call Mount Everest Choniolungma and worship it as the "Mother of the World." The monastery or gompa is an important aspect of Sherpa religion. The important festivals of the Sherpa's are Losar, Dumje, and Mani Rimdu, Losar.

The language of the Sherpa is called Sherpa or Sherpali. The Sherpa use the Tibetan script for writing. They use Nepali in their dealings with other peoples. They have many mathematical concepts and process, which are own mathematics. Although primary schools are available in Sherpa communities, few Sherpa have not any formal schooling. The literacy rates are low, as their parental expectations for their children.

### **Statement of the Problem**

The researcher has studied many article thesis journals to find something new as well as something gap during this studied. The researcher has motivated to do research in Sherpa community for this the researcher has studied many empirical studies which was conducted in different community .The researcher has vary curiosity to know about Sherpa community that how people of Sherpa community count the number use, numerals and the mathematical concept specially geometrical concept use in preparing domestic material in daily life. The people of Sherpa community used many geometrical idea of mathematics to make many necessary things like chair, Gumba, etc. Also, they use mathematical concept knowingly or unknowingly. Either they study formally or by practically. If they used such type of



geometrical concept in their daily life during to construct making domestic materials, then, the researcher wanted to improve their understanding and concept of mathematical idea in their daily life. For this above purpose, the researcher has selected this topic in title “Basic mathematical concept and numerals system practiced by Sherpa community”.

The researcher selected this topic because this is easy for him to take data easily as Sherpa community people were situated near the school where he was teaching. The researcher went to the every place of Sherpa community, where mathematical concept or geometrical concept were used. The researcher had also curiosity to know their traditional script cultural mathematics, traditional mathematical counting system, measuring system. The researcher wanted to search such mathematical knowledge, which was internally in their mind, but they could not express properly, so the researcher tried to express their internal (latent) idea of mathematics in the world. Hence, this study intended to answer the following research questions.

- How did Sherpa community people use numerals in their daily life practices?
- How did the Sherpa people use geometrical concept in making domestic materials?

### **Objectives of the Study**

The objectives of the study were as follows:

- To explore numerals and counting system practiced by Sherpa community.
- To find out the geometrical concepts used in making domestic materials by Sherpa peoples.

## **Significance of the Study**

Generally, every ethnic group has its own script and counting system, which helps them for their prosperity for the further development. The ethnic mathematics was one of the important aspects of every ethnic group. This study was aimed to identify and explore the mathematical concept and practice in Sherpa community. The result of this study would equally helpful for mathematics education, mathematics teacher, mathematician and other people who were interested to understand the artifacts of culture of Sherpa community to numeral and basic concepts.

- This study would be helpful to the nature of counting system and algorithm of basic mathematical operation practiced by Sherpa.
- The study would be helpful to identified measurement system of Sherpa community.
- This study helps policy maker and curriculum planners to consider ethno-mathematics in textbook as well as curriculum.
- This study helps mathematics educator, mathematician and mathematics teacher and for learner to understand the facts of culture of Sherpa community that how they used mathematical concept.
- The study helps to add the new dimension in knowledge in the field of cultural mathematics. It helps to explore the script and numerals practiced by Sherpa community.

## **Delimitation of the Study**

There were many communities in Nepal with own mathematical system. The study was conducted on Sherpa community of ward No. 1 at Dudhkunda Municipality in Solukhumbu district only. This study was focused only on the mathematical ideas, concept and skill used in Sherpa community in their real life. The researcher was

limited to find the numerals counting system and measurement system of Sherpa community. The study was limited on exploring the geometrical concept practiced by Sherpa community while they used that concept in making their domestic materials.

### **Definition of Key Terms**

**Mathematical Concepts.** Mathematical concepts in this study refers to the basic concept of number and its fundamental operation along with, length, distance, area volume, weight as well as how to get mathematical idea practiced by their own culture.

**Sherpa Community.** Sherpa Community in this study is defined as the adults and children, social and non- social persons, living on the Dudhkunda- 1, of Solukhumbu.

**Sherpa.** Sherpa refers to an indigenous ethnic group of Nepal.

**Counting.** Counting is “the use of systematic way to compare and ordered the discrete phenomena. It may involve tallying, or using objects or string to record, or special number words or names.”

**Numeral System.** A numeral system (or system of numeration) is a writing system for expression number that is, a mathematical notation for representing number of a given set, using digit or other symbol in a consistent manner. In this study numerals practiced by Sherpa community.

## **Chapter II**

### **REVIEW OF RELATED LITERATURES**

A review of the related Literature is the source for the further study. It provides the strong knowledge about the related topic. Research is the orderly investigation of a subject matter for the purpose of adding knowledge (Khanal, 2016, p. 3). The review of related literature involves the systematic identification, location and analysis of documents containing information related to the research problem (Khanal, 2016).

#### **Empirical Literature**

Empirical review deals with the review of the books, thesis, journals, articles, policy documents and so on. This topic deals about the research carried out in related field. There are some national as well as international thesis and articles related to my study are included in this section.

Knijnik (2004) studied on Mathematics education and the Brazilian landless movement: three different mathematics in the context of the struggle for social justice. This paper aims to discuss issues related to mathematics education and social justice in our Empire times taking as an empirical base for the discussion the work developed by the author in the last 16 years with the Brazilian Landless Movement. The paper analyzes this peasant social movement, focusing on the political role it is assuming in what Hardt and Negri (2001) called Empire and more specifically, the educational work it is improving in the country.

It also presents the theoretical background that informs the author's ethno-mathematical thinking based on a Post-Modern perspective in its connections with Post-Structuralism theorizations, more specifically, those associated with the work of

Michel Foucault. Moreover, using the work of the “Second Wittgenstein” (which corresponds to his book “Philosophical Investigations”) three different mathematics: are shown: a mathematics produced by a form of life associated to MST peasants, another one produced by a form of life of the urban sawmill men and a third, produced by a form of life found in the Western Eurocentric school, even considering that all of them have family resemblances.

Similarly, Dunbar (2008) studied on finding their way: a critical ethnography of five of African American women educators’ early experiences to develop into culturally relevant pedagogues. The purpose of this qualitative study was to explore the nature of the diversity preparation of five African American women and their teaching experiences following the completion of their teacher education training. The critical ethnographic case studies that developed were theoretically framed in Culturally Relevant Pedagogy developed by Black Feminist Thought (Collins, 1990), and Womanism (Phillips, 2006).

Data were collected from classroom observations, individual and group interviews. Using a system of open coding (Strauss & Corbin, 1998), data analysis resulted in the emergence of three overarching themes: a) the formal diversity preparation offered by the university, b) the women’s individual perspectives of cultural relevance, and c) the ways in which the women incorporated their perspectives into their classroom practices.

The experiences that young women encountered significantly influenced their understandings of culture and its impact on learning for diverse student populations. The results of this study suggest the need for teacher educators to reconsider how TEPs are structured to better prepare minority Pre-service teachers in the future to teach culturally diverse students.

Likewise, UNESCO (2008) studied on “Developing Culturally Contextualized Mathematics Resource Materials: Capturing Local Practices of Tamang and Gopali Communities” The main objective of this project was to develop culturally contextualized mathematics curriculum resource materials for the lower secondary schools of Nepal in order to foster a culturally pluralistic society. Specifically, the project focused on the practices of women and economically disadvantaged ethnic communities (Tamang and Gopali) of Hilly regions of Nepal, preparing curriculum resource materials for students, teachers and awareness materials for parents.

In order to achieve the main objective, the project adopted a two-phase procedural strategy in order to develop the culturally contextualized materials for teachers and students and support materials for parents. The development phase comprised the activities of conceptualizing the project, carrying out the fieldwork, planning the fieldwork involved identifying fieldwork sites, selecting and orienting field researchers and field supervisors, and preparing methods and modes of data collection and reporting. The field researchers and field supervisors visited two Tamang and Gopali communities for a period of 4 weeks. Informal interview, observation, and field notes were the main data collection tools applied in this study. This data was supplemented by use of cameras to record still photographs and videos.

A unique conceptual model, the Mandala Model, was developed in order to facilitate the writing of the curriculum support materials based on the outcomes of the fieldwork. The curriculum resource materials were trialed in a school with 12 teachers, 47 students and 7 parents who showed very positive attitudes toward the teaching and learning activities associated with the curriculum materials. Teachers who were present in the validation seminar were found to be positive toward the curriculum support materials.

In this regards, Rai (2011) studied on “Mathematical concept and process practiced by Dumirai at Khotang District.” The main objectives of this study was to find out counting system the four basis fundamental mathematical operation practiced in Dumirai community. This is a qualitative research he used ethnography. He used pursuing sampling method for selecting five ward out of nine ward in Khotang district the main tools of this study are interview and observation the finding of this study are: The people of Dumirai community use ‘Grouping by 20’ in there counting system as well as in four fundamental mathematical operation they use the concept of addition more in measuring system.

Dumirai people solved the problems about simple lengths measured by hand and fingers. The units of length are Aamal, Kuret, Bitta, kachhi and Haat. Dumirai used haat for area measurement of construction new house. They measured their land area in terms of ploughing time and in terms of consuming seeds. In conclusion, that many people of Dumirai community use there on traditional counting system as well as measurement system younger and literate Dumirai’s are becoming aware of formal system of mathematical processes and measurement system.

Adhikari (2012) studied on “Basic mathematical concept and process of Dhanuk community.” The main purpose of this study was to find out the counting system measurement system and the basic mathematical operation used by Dhanuk community. He used ethnography design because this study is qualitative nature. The tools of his study are in depth interview and participation observation. He selected Bhatauliya, Ankar, Ramgopalpur and PadaulVDC’s of Mathottari district by using purposive sampling method. He selected 8/8 male and 8/8 female form sample VDC and the selection was purposive. He took data from sample people by going their community using face-to-face interview and he observed the mathematical activities

done through Dhanuk community. He went in the field repeatedly to observe mathematical concepts and for mathematical mathematics counting system as well as the measure system used by Dhanuk community. The findings of this study are: Dhanuk's community people are using a group of twenty, it means they are using one twenty, two twenties, and three twenties etc. e.g.

$$80 \div 4$$

$$(20 + 20 + 20 + 20) \div (1 + 1 + 1 + 1)$$

The people of Dhanuk community use grouping by twenty in all four operations of mathematics in Dhanuk community.

$$1 \text{ kanma} = 10 \text{ kanai}$$

$$1 \text{ kanai} = 16 \text{ Ranail}$$

$$1 \text{ Haat} = \text{paune } 2 \text{ kanma}$$

$$9 \text{ Haat} = 1 \text{ Laga (Approx 13.5 feet)}$$

$$1 \text{ Laga} \times 1 \text{ Laga} = 1 \text{ Dhur}$$

$$20 \text{ Dhur} = 1 \text{ Katha}$$

$$20 \text{ Katha} = 1 \text{ Bigha}$$

$$1 \text{ Kanama} = 50 \text{ gram}$$

$$\text{Paka } 1 \text{ man} = 40 \text{ kg; Kacha } 1 \text{ man} = 32 \text{ kg}$$

He concluded that the people of Dhauka community generally used Thuti, Bitta and Haat to measure the length and unit of distance is Kosh but they used to measure land length by 'Lagi.' They use sherpasari, to measure weight.

Nyaupane (2012) conducted a thesis on "Basic mathematical concepts and numerical system used by Magar community." The objective of the study was to find the counting system, four fundamental operations and measurement system practiced in Magar community. He used snowball-sampling method for sample of her study. He chose Shree Krishna Ganndaki VDC of Syangja district he used observation,



interview, photograph as tools for data collection. This study is qualitative nature and he used ethnography, He categorized the mathematical concept into circle, cylinder, straight line, parallel lines, perpendicular, plane, cone, congruence, and similarity obtained from data by major community.

He also described the mathematical concept from Magar's community while, looking, playing forming use. Finding of this study are: The numeration system of Magar is based on multiple of twenty e.g. one twenty, two twenty, three twenty Magar community had the concept of number scale circle, cylinder, straight line parallel line, perpendicular, plane, cone, congruence and similarly, these mathematical concepts we found as ethnography in their daily life. He concluded that the Magar community are using mathematical concept without taking any formal mathematics education. They acquired concept through their culture, their adult and their working experience.

Limbu (2013) studied on "Basic mathematical concept practiced by Limbu community." The main objective of this study to identify the numerals and basic concept of math practiced by Limbu community and to explore the geometrical concept used by them while making domestic goods. This is qualitative research so he used ethnography design for this study. He focused on naturalistic inquiring interviews and direct observation for the data collection. He also used photography to collect the data. He used secondary data from different journals, books and related polished documents. He used purposive sampling method.

He took for the study purpose among them three person are more than 60 year old, two persons are 40 to 60 year for this he used snowball sampling method and using this method, he got the person'. The main finding of this study are: The Limbu community count's by using grouping 20. They write number of 6x, G, 0, Y 65 = 14, 60,953. They used their own script like hope zero lacha = aak ..... Fangshi = nau.

They used pau, sher, aathpol, bisauil, dharni, ganda, hamali, bodi etc. for measuring unit of goods. He concluded that they used their own traditional script numerals and mathematical ideas. The Limbbu communities have their own script numbers of notation which was developed by the king Sirijangha (in 9th century) and rediscovered by the second Sirijangha which is called Kiranti script.

Similarly, Lamichhane (2016) studied on “Mathematics concepts practiced in Kumal community.” The main objective of this study was to find out the counting system, the ways of basic/fundamental operations and measurement system used in Kumal community. This is a qualitative research he used interpretive, naturalistic inquiry method in this study. The tools of this study are in-depth interview, observation, field note, and photograph. He selected Kalika Municipality as study area purposively in Chitwan district where many Kumal community’s people are situated. The above 50 years age people were only selected who was directly involved his/her traditional culture. She selected 12 members among them six were male and six were female purposively. He categorized mathematical process and measurement system from collected data and he used coding method to analyze the versions of respondents. The findings of this study are:

KattiNakhaiHakau	-	Zero
EkaHakau	-	one thing
Dui Hakau	-	two things
Teen Hakau	-	three things

Addition:

$$\begin{aligned}
 127 &= 6 \times 20 + 7 \\
 - 64 &= 3 \times 20 + 4 \\
 \hline
 &= 3 \times 20 + (7 - 4)
 \end{aligned}$$

$$= 3 \times 20 + 3$$

13 Roani = 1 Biga

16 Aana = 1 Ropani

16 Dam = 1 Aana

1 Kuruwa = 2 Mana

8 Mana = 1 Pathi

20 Pathi = 1 Muri

14 Pathi = 40 kg

He has concluded that the counting, system, measurement system and for fundamental operations Kumal community's people use "grouping of 20:" They used traditional units for measurement unit liku, Haat, Dharni, Aana, Ropani, Tub, Pathi, Bitta, Kunet etc.

Karki (2017) conducted a thesis entitled Basic mathematical concepts practiced by Hyu community. The objective of the study was to explore the counting system to find out the rules of four basic fundamental operation and measurement system practiced in Hayu community. She used purposive sampling designing for sample of her study. She chose DadigaranseVDC of Hayu community in Sindhuli among them she selected one teacher. One student and eight adult 1-layu people as a sample of this study.

She used participation observation and in-depth interview tools for data collection her study is based on qualitative nature and used ethnography approach. She visited work plane, house farm schools of Hayu community for collection the data she took photos and made field note while collecting the data collection she used coding method for analyzing the data she also analyzed the data from interview by using coding and decoding method as well as help of audio rerecording field note and

observation form. The finding of this study are: Hayu people have their own name of number 1 to 100 :Kolu for 1 naung for 2, chhiung for 3, bliungnar for 4 kolu got konkali for 5, kolugatmukonkali for 6, kolugotmu, non konkali for 7 kolugotmuchhiung for 8, koluigotgotmu bluing for 9 naunggotkolu khan man angtonauptokolu for 10 and so on to 100. In conclusion Hayu community's people use their own language for counting the number. They use concept of multiple of twenty (one twenty, two twenty) for addition subtraction, multiplication and division this idea of four operations for only simple problem but for the complex problem they solved unknowingly.

### **Theoretical Review**

The theoretical review of literatures guides and integrates the research study. It is the plate form of the research program. The conceptual and theoretical literature is reported on in order to demonstrate our understanding of the evolution and state of the field (Khanal, 2016).

In this chapter, the researcher introduces the theoretical discussion, which is relevant for the interpretation of the findings of the study. There are various theories related to children's leaning and development. They are classical conditioning, operant conditioning, gestalt theory, social constructivism, radical constructivism and so on. For the study, only the constructivist theory and Vygotskian theory of social construction has been used for the interpretation of finding of the study. They are described as follows:

### **Social Constructivism**

Vygotsky (1978) was founds scholar who emphasizes on the social constructivism. Social constructivism is a theory among several theories on constructivism. The researcher has been used Vygotsk's theory for this study that

knowledge is socially constructed and children learn when they get contact with outer environment either verbally or observantly. Vygotskian theory is one of them that regard social interaction between peers and adult as important aspects in creating meaning, making sense and conveying cultural within the shared context.

Vygotsky stresses the child learns something first on the social level, then later on the individual levels. It means children develop their skills through playing or increasing with peers and other adults. This means that social level takes first for initiation of the learning. The individual's child then internalizes the skill. In the words of Vygotsky, through such inter-psychological process at the individual's levels e.g. emotional and cognitive structure. Therefore, internalization is the process by which the inter-psychological so not a simple transfer from external activities to performed cognitive structures. The learning is thus facilitated through speech, social interaction and cooperative activities.

Vygotskian theoretical discussion reveals the psychological perspective and describes about insides of the individuals. In other word, it is more focused on the individual behaviors relation to society Vygotsky's theory of ZPD (Zone of proximal development) was helpful for me to build theoretical frame to understand the behaviour of Sherpa peoples as outside of the classroom. I have drawn the idea from ZPD that human behaviour is determined in the form of language, culture, situation, communication and social factors have influence in the human behaviors.

Vygotsk describes a theory that "Zone of Proximal Development (ZPD). "In this theory, the children need some mediators like parents, teacher and adult or peer to uplift his/her knowledge, from the knowledge that already existed with him/her. The children's construction of knowledge is not from only individual but also the

surroundings context and the interaction with more knowledge of others. Schhiitzi (2002) describes Vygotskian zone of the proximal development. He says it is the difference between the child capacities to solve problems on his/her capacity to solve them with assistance. In other words the actual development level refers to all functions and activities that a child can perform independently. On the other hand the ZPD includes all the function and activities that child or a learner can perform only with the assistant or some scaffolding presses providing non-instructive intervention could be an adult such as parents' teacher and care taker.

Vygotsky stresses that the child construct the knowledge from maturation and culture. Here the eternal culture knowledge is internalized with the help of community so the psychological function in these children originated in interaction with outer or interpersonally and only later become interpersonal.

Vygotsky states child is social which is present right from the beginning as he/she arrives into the complete words of social relationship and culture. The culture itself has an historical development. Vygotsky state that child development is organic growth and maturation is known as natural line. Psychological function is known as cultural important. Both these processes of development meet at certain point mediated by speech and cultural forces of development are equally important. He believes on the role of the cultural in development of child, which is transmitted to them by parent's adults or peers. For Vygotsky, the knowledge of children is expressed in children's egocentric language as cognitive and, which is internalized by the primarily social.

### **Constructivism**

Simply, constructivism means a kind of consideration about themes and builds up a string mental plan so different individual have their own construction about

existing phenomenon. Learning mathematics requires construction not passive reception and to know mathematics requires constructive work with mathematics object in a mathematical community.

Constructivism is a philosophy of learning founded on the premise that by reflecting our experience, we construct our own understanding of the world. We learn in each of us, generates our own “rules” and mental which we use to make sense of our experiences. Learning therefore, is singly the process of adjusting our mental models to accommodate new experience.

A major theme in the theoretical framework of Bruner is that learners construct new ideas or concepts based upon their current/prior knowledge. The learner selects and transforms information, construct hypothesis and makes decision replaying and cognitive structure to do cognitive structure (i.e. scheme mental models) provides meaning and organization to experience and allows the individual to “go beyond the information giving.”

It is obvious that people make their own meaning from their own beliefs, construct new ideas from what they observe listen and perceive. They do not always use the previous method to solve the problem; they use their own strategies too. Z. P. Dienes communicated that children should learn by “physical action and mental reflection” through their own experience. Constructivism assume that learners construct their own knowledge on the basis of interaction with their environment, in this context Piaget writes “Knowledge is not passively received rather knowledge is actively created by student. Mathematical idea is made by learner not found like a pebble or accepted from other like a gift.”

Concerning the psychological aspect Piaget stresses on the key work “Action” through which he advocates that knowledge is gained. He said that the essential way

of knowledge the word is not directly through our senses, but primarily through our action. Action is understood as being all behavior by which we cause a change in the world around us or by which we change our situation in relation to the world.

Psychologist Piaget, J. Bruner and Dines provide three different postulates about construction of knowledge. They are as follows:

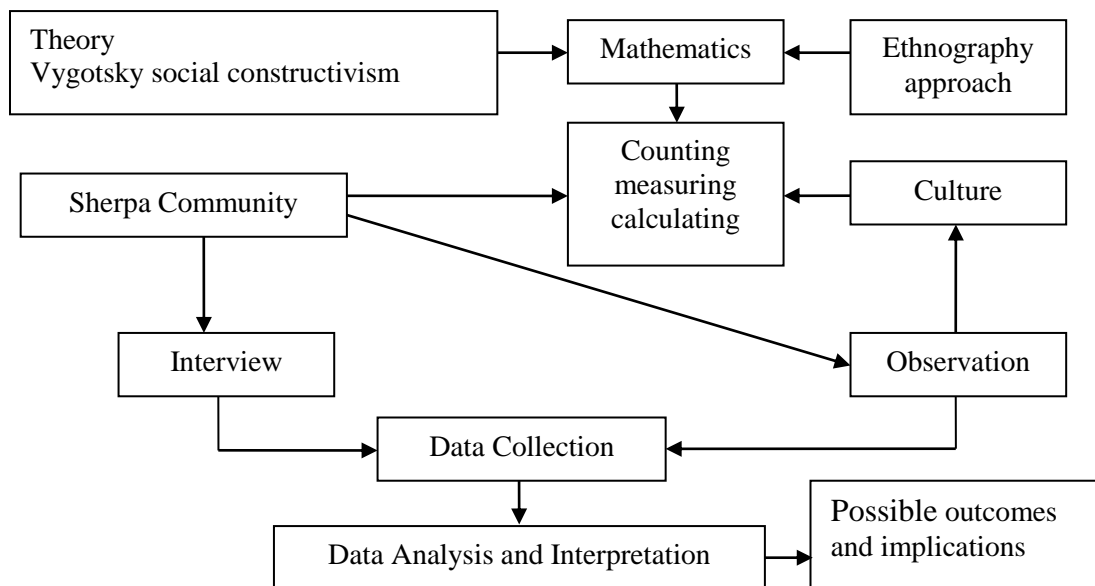
- Knowledge is physically constructed by learners who are involved in active learning.
- Knowledge is symbolically constructed by learners who are making their own representation of action.
- Knowledge is socially constructed by learners who convey their meaning making to other.

Constructivism is a theory among many, basically a theory based on observation and specific study about how people learn. It says that people construct their own understanding and knowledge of the world, through experiencing things and reflecting on those experiences.

### **Conceptual Framework of the Study**

By reviewing above theory and related literature, the following conceptual framework was developed by the researcher.





This framework shows that the ethno mathematical knowledge of Sherpa community was practiced from their cultural prospective. The conceptual base of this research depends upon the social constructivism focuses on importance of the culture and constructing knowledge practiced based on understanding. This research is systematic, qualitative procedure used to generate a theory that explains conceptual level process and interaction.

Mathematics was originated along with the human civilization. Human beings themselves created mathematics in the field for application for counting and measuring in relation to both of quantities as well as special objectives. Mathematics, culture and community are inter-related; mathematics is developed in the culture. There can be found counting measuring and calculating which the parts of mathematics are: These activities can be found by observation and interview. In the above figure Sherpa mathematical practiced is the main issue in this study depicted. Then it shows what my research design is, tools for data collection theory, which is bended in the study has shown clearly in the above framework.

## **Chapter III**

### **METHODS AND PROCEDURES**

Research methodology is a way to systematically solve the research problem. It may be understood as a science of studying how research is done scientifically (Kothari, 1990). It describes the design of procedure which is to be carried out to achieve the objectives of the study.

Research methodology is a science, which determined how to complete the research systematically. Research is systematic method of finding right solution for the problem whereas research methodology refers to the various sequential steps to adopt by a researcher is studying a problem with certain objectives in view. In other words, research methodology refers to the various methods of practices applied by the researcher in the entire aspect of the study.

#### **Design of the Study**

Ethnographic study design was used in this study. The data collected by the research was analyzed qualitatively. Qualitative research can be regarded as ‘naturalistic inquiry’ in a sense that it is conducted in natural setting by trying to avoid any intentional manipulation and distortion of the environment of the informants by the research (Tames, W. Stigler and Michelly Perry, 1998). The final written report or presentation included the voices of participant, the reflexivity of the researcher and a complex description and interpretation of the problem and it extended the literature or signals a call for action (Creswell, 2007).

#### **Site selection**

The researcher used snowball sampling method for selection of respondents for this study. This study was conducted in Sherpa community of Solukhumbudistrict.

Sherpa people were leaving in many villages of Solukhumbu district. Among them only Dudhkunda Municipality ward no. 1 was selected as study area. So, Taksindu of Dudhkunda was area of this study. I would take those people who were directly involved in their traditional culture. I selected 10 people purposively for in-depth interview from sample people among them 5 were male 5 were female.

### **Tools of the Study**

There were many tools to collect the information in qualitative data. Among them I use in-depth interview schedule and observation form as data collection tools.

### **Interview Schedule**

Interview is an informal technique, which has been used as field instrument for the research. The interview was used to collect the general information of the research area and their issues. To fulfill the objectives of the study, I conducted interview with 5 male and 5 female sherpas. The interview was also conducted with one teacher and one student of Gumba School.

### **Observation form**

Observation technique was also applied for learning about the mathematical practices physical infrastructure influence of the practice in their day to day life. This technique helps to find the additional descriptive information before during and after the data collection. The researcher observed their house construction, handwork construction, customs, playing, culture, festivals, measurement system, counting system and their daily activities.

### **Validity and Reliability of Tools**

The validity and reliability of the tools were determined by cross matching methods and ethnographic consideration. i.e. they are determined by asking the same questions to the sample people again and again.

### **Data Collection Procedure**

I was very familiar with Sherpa community people. So, I could easily participate in their culture. Hence, as I participant observer, I collect the primary data, from school, Gumba, their cultural activities homemade materials, historical temple etc. I also collected the data from audio recording and photo graphs; I collected data from their cultural function/program. Also, the field notes were used while collecting data from field. The interview with all the participants was taken after their permission. I also collect the information by using tools thought field visit. I observed their cultural phenomena and made field note.

### **Data Analysis and Interpretation Process**

The collected data from interview and observation form different tools was firstly categorized and organized according to the objective of the study for the exploration of measurement system. Then, collected data were analyzed by the help of different theories review in the literature review section. The collected information was analyzed by applying triangulation approach. Before making the final summary for every concept the researcher observed repeatedly. The detail data analysis procedure includes the audio recording, making code, making theme, applying thematic analysis approach and triangulate the information to make valid result.

## Chapter IV

### ANALYSIS AND INTERPRETATION OF DATA

This chapter explains about ethnographic study related to the number concept and geometrical knowledge practiced in Sherpa community. This chapter also includes analysis and Interpretation of data collected from the field of observations, interviews and photographs. It is an ethnographic study related to number concept and the Geometrical knowledge practiced by Sherpa community. The researcher has divided this chapter into three parts. The first part described the number concept used by Sherpa community. Second part explains about the measurement system, measurement of weight and length/ distance. Third part deals about the use of Geometrical concept in Sherpa community in their cultural materials activities.

#### **Number concept and counting system**

The concept of mathematics begins with the concept of counting in the ancient period. Mathematics is an important discipline to all human because they use it to solve their daily life problem. The researcher asked the question to Sherpa people about the idea of numbers counting system of Sherpa people. Their numeration system is base ten or decimal. Sherpa people mostly use their native counting system which is practiced from long period of time. They (Old illiterate people) use formal counting system up to 10. Sherpa counting as below:

Zero for 0, chyik for 1, ngyi for 2, sum for 3, Jyi for 4, nga for 5, tuk for 6, din for 7, gye for 8, gu for 9, chyuthamba for 10, gyathamba for 100. The other counting system of Sherpa people are given in appendix (1).

The Sherpa community has their own counting system of numbers. Numeration system and pronunciation is same as their own system but little bit different than in

Devnagarik system. It concluded that their system is similar to Hind Arabic number counting system but they used only different script.

### **Basic operation practiced**

The process of basic operation used by Sherpa people is oral and their mental process. Every person has different idea in the process of counting, addition, subtraction, multiplication and division. But in particular, the basic idea is same for the different groups and places. This study deals with the mathematical operation belongs to the addition, subtraction, multiplication and division. These fundamental operations of addition, subtraction, multiplication and division were presented repeatedly as following.

### **Addition**

Addition is a mathematical operation that represent combining collections of objects together into a large collection. It has signified by the plus sign (+) for example  $5+ 5$ . Mostly Sherpa did not feel necessary to count more than 10. Some of them counted 20, 30, 40,..... up to 100. So they expressed any number on the group of tens or twenties. To add two numbers they put set of group of tens or twenty.

An elderly persons solved the questions of problem what is the number at together between fifty tens and two (fifty two) and three tens and nine (thirty nine)? (The questions was asked by providing apple grains of the group of 52 and 39) as follows.

He first expanded both numbers, in the group of twenty and remainder the number represent as first two twenty and twelve, second one twenty and ninety .He put together group at twenties in one side and set of remainder in another side. Then Mathematical expression is

$$52 = 2 \times 20 + 12$$

$$\begin{aligned} \frac{+ 39}{91} &= \frac{1 \times 20 + 19}{3 \times 20 + (20 \times 1 + 11)} \\ &= 3 \times 20 + (20 \times 1 + 11) \\ &= 60 + (20 + 11) \\ &= 60 + (20 + 11) \\ &= 4 \times 20 + 11 \\ &= 80 + 11 \\ &= 91 \end{aligned}$$

It is showed that before addition between any two numbers they expressed the number in the form 10's, 20's, 50's and 100's. Most of them expressed the operation of addition in the form of 20's. At first they added between the group of twenties and then remainder.

### **Subtraction**

Subtraction is a more difficult concept than addition as they decomposed number in to different group of number (decomposing process) Like 10, 20, 40, 60, or 100 etc. The decomposing process is a set of grouping for the solution of the problem of subtraction.

They have no any concept of negative number. They have to donate positive number only. In subtraction process elder Sherpa people are unknown with formula system of subtraction as they understand the subtraction as remove some number of things from set of the whole things. Most of the people solved the subtraction problems by grouping method .Some children going to School and who have completed the primary level education solved subtraction problem easily. But most of illiterate people solved subtraction problem as the following ways. If you have 3

bisa(bis) and seven apples i.e 67 (apples) if you have 30 apples damaged then how many apples are remaining for you? As 67 is equal to three 20's and 7 once and 45 is equal two 20's and 5 ones. The process of subtraction they apply was as follows.

$$\begin{aligned}
 67 &= 3 \times 20 + 7 \\
 \frac{- 45}{22} &= \frac{2 \times 20 + 5}{1 \times 20 + 2} \\
 &= 1 \times 20 + 2 \\
 &= 20 + 2 \\
 &= 22
 \end{aligned}$$

It is showed that before subtraction between any two numbers they expressed the number in the form of 20's, 50's and 100's. Most of them expressed the operation of subtraction in the form of 20's. At first they subtracted between the group of twenties and then remainder. Thus decomposition rules were different in the old age and literate people (young age)

The old age group remained totally on traditional way so the method of subtraction seems changeable because of their contact with other community. In this above method are expressed as:

$$\begin{aligned}
 85 &= (4 \times 20) + 5 \\
 \frac{- 69}{11} &= \frac{(3 \times 20) + 9}{(1 \times 20) + 4} \\
 &= 20 + 4 \\
 &= 24
 \end{aligned}$$

Which is wrong answer from this example researcher concluded that the remainder of first number should be greater than the remainder of second number to subtraction problem write and easily.



## Multiplication

Multiplication is known as repeated addition. Many people use multiplication operation knowing or unknowingly. They use repeated grouping process. Sherpa computed the multiplication problem as addition. They put together the same type of group in one place and counted. If just took more time compared with addition in the question of if there are 16/16 potatoes in four places how many potatoes would there have in total? Solve as 16 means one ten and six. Four place one ten makes six ten.

Mathematically it can be represented by

$$16 \times 4 = (1 \times 10 + 6) \times 4$$

$$64 = (10 \times 4) + (6 \times 4)$$

$$64 = (10 \times 4) + (10 + 10) + 4$$

$$64 = (10 \times 4) + 20 + 4$$

$$64 = (40 + 20) + 4$$

$$64 = 60 + 4$$

$$64 = 64$$

Without feeling any difficulty they solved problem like  $5 \times 3$ . It is quite different by solving literate people. They solved it orally as four 10 equal 40 and another four 6 equals 1 bisa and four equal 24. Now 3 bisa equal 60 and adding 4 which is equal 64. Thus it indicated that ability and skill to solve the problem of multiplication was different according to individual's mathematical ideas and knowledge. Based 10 multiplicative as well as based 20 grouping system was the easy expression for multiplication. They solved multiplication problems by addition method and took long time to solve a short problem. So they are unable to multiply larger numbers. Some younger who has complete basic education can solve problem using multiplication rule and process like it.

## **Division**

Division is the repetition of subtraction. According to Sherpa people division is the process of making physical objects into different pieces and distributes these pieces to each person. Sherpa people use the concept of division for dividing volume, counting number and money. Division of volume is carried out by using pot. They measure things in pot and divided among them .If things are less than the measurement the pot, they divided randomly. In case of number likes dividing apple potato etc, the express divided number in the form of 10's and 20's they divided number in the remainders and made result. For greater number, they used group of 100 and group of 500. They had never made greater number practices except the money problem. Sometimes they made mistakes while in division. It is quite difficult task. While to solve the problem 60 is equally divided for 3 persons, how will each get? First of all she divided the number 60 into 20's group in 3 unequal parts. Then he added one equal part and said that 20's distributed for each 3 person. Thus its mathematical expression is

$$60 \div 3$$

$$20 + 20 + 20 \div 1 + 1 + 1$$

From the above example researcher conclude that division is different and takes long time they use such types of example in their daily life.

## **Measurement of Length and Distance**

Sherpa have their own measurement system in SoluDudhkunda Municipality-  
1 They still use their traditional measurement system. The unit of measurement of long and short thing is different the short they are measured in terms of width of finger but two short things they can measure the thing that are less than 1 inch they use the units as .They measure the shortest length is shorma (Inch). They use BIIta to

measure the shorter length. Generally, Bittais the distance between tip of the thumb and tip of the middle finger when stretched optimum. They use Thu kang (Haat in nepali) to measure longer distance.

Generally the measurement units to measure are hand and Bitta. The convert the above units of length the above units of length as follows:

Eight inch = one kuret

One kuret + two inch = one Bitta

One bitta + two inch = one pit

One pit + eight inch = two Bitta = one Haat

The units of length likes kuret, Bitta,Haat are practiced by Sherpa for the construction of house and many other domestic purposes.

### **Volume measurement**

In Sherpa community, measurement is mainly used to measure paddy, daru potato etc. The volume of grain or water is usually required while having and asking for a family and for trading of cereal and liquid materials. Sample person said that units of volume measurement widely used are manna, pathikuruwa,muri etc. The measurement of volume is used in daily life.

Volume measure is mainly used to measure ghee, milk, wine (raksi) paddy, corn wheat, cereals etc. They used mana and pathi, they also used kuruwa for measurement. Mana is a unit of volume of both solid thing and liquid thing but the amount is different for two things.

The conservation system of volume as shown below:

Two chakanchi= two and half muthi =one chauthai

Two chauthai =two pala =one mana (ten muthi)

Two mana =one kuruwa

Four kuruwa= one pathi

Twenty pathi =one muri

In Sherpa community different practices of measurement such as muthi, mana,kuruwa, pathi etc. for the measurement of grains, kerosene, milk, vegetable oils, ghee etc.

### **Weight measurement**

In the research period, I observed that weight measurement system was limited for trading of butter, Xurpi, Dry cheese, yak wool meat only but also nowadays they are not using their traditional measure system. The Sherpa measurement weight system is much influenced by modern measurement system. The most important tools used in Sherpa community for measuring weight were Tulo sample person has a grocery but she hasn't used Tulo. I asked about tulo that he said our father and grandfather used but present we use Taraju. The most of the people use Tulo in ancient period as a measuring instrument to measure the mass and weight. But now a day many people are attracted to the professional farming and they sell the goods in the neighboring markets so they use standard unit of measurement. They have been using the conservation of weights as showing below:

9 Phul=1 Darni

2Bisauni=1 Dharn

1 Bisauni=2 Aathpol

1 Aathpol=1 shers

Sherpa community also uses the weighing units such as Phul,Bisauni,Dharn, Aathpol, shersetc four the measurement of meat.

## Geometrical concept

The following geometrical concepts practiced by Sherpa community were observed and analyzed in this research.

### Concept of circle

Ting and Dhampure are the most popular cultural musical instruments belonging to the indigenous Sherpa community. Sherpa people use damphu in every event, such as weddings, funerals, special occasions, rituals and festivals where importantly, they express happiness. I found that clear concept of circle was assumed in Sherpa community. I asked the question about circle with same person do you know about circle? He replied as didn't know about circle but he used the concept of circle to make of Damphu. It is found that Sherpa community using the concept of circle with diameter even though they don't know the meaning of circle. From the figure given below are cultural and musical instrument in Sherpa community.



Center of circle

Circumference of circle

**Figure 1:**Ting**Figure 2:**Damphu

Ting and Damphu both are in circular shaped. In Ting we can beautiful pattern

of different shaped circle. These objects can be used to teach the concepts of circle in the school level in geometry class so that the student can understand easily.

### **Concept of triangle**

This is the Gumba area (figure below). We can see different geometrical entities in the gumba and house. That is the geometry of wall, roof, window etc. The wall is made of clay bricks and it is rectangular in shape. The roof has a slope at an angle with the horizontal line or surface.



**Figure 3:** Gumba and House

This shows a great cultural application of geometry in Sherpa community. Student can explore angles patterns and shape at the different part of the gumba and house together with their measurement. This way we can engage students in the discovery of geometrical application in the line of people in rural areas.

### **Concept of cylinder**

It was found that Sherpa communities were using concept of cylinder in their daily activity. As for example Mani of Sherpa community is the best example of cylinder. Mani is the cultural material widely used in the Gumba and many other statues made by Sherpa community. But the people of Sherpa community didn't know

the meaning of cylinder. I asked how do you make the Mani golo (cylinder) ? Their answer was personal practice taught him to make like cylinder. Following figure is concept of cylinder in this community mostly.



**Figure 4: Mani**

So that if we use this object as a teaching object in class room while teaching the concept of cylinder then the student can understand easily at the school level.

### **Concept of Rectangle**

Rectangle being the most common shape forms a part of our day to day life. Actually they don't know the concept of rectangle but they use the mechanism of rectangle while constructing their house. I asked question Why to make rectangle shape house? His answer was that personal practice, easy to construct and little bit it is earth quick resistant.



**Figure 5: House**

Therefore, by using this object we can teach rectangle as well as many mathematical geometrylike parallel line, perpendicular line, right angle and straight line.

### **Concept of congruence**

Through the observation and interview, researcher found that Sherpa community have the concept of congruence but they haven't meaning of congruence and congruent materials but they say it utrai – utrai. This concept found when the sample population was using equal Jhampta. Researcher asked them why they use congruence Jhampta. They answered, they use the congruence Jhampta to produce sharp sound by striking one Jhampta over another Jhampta.



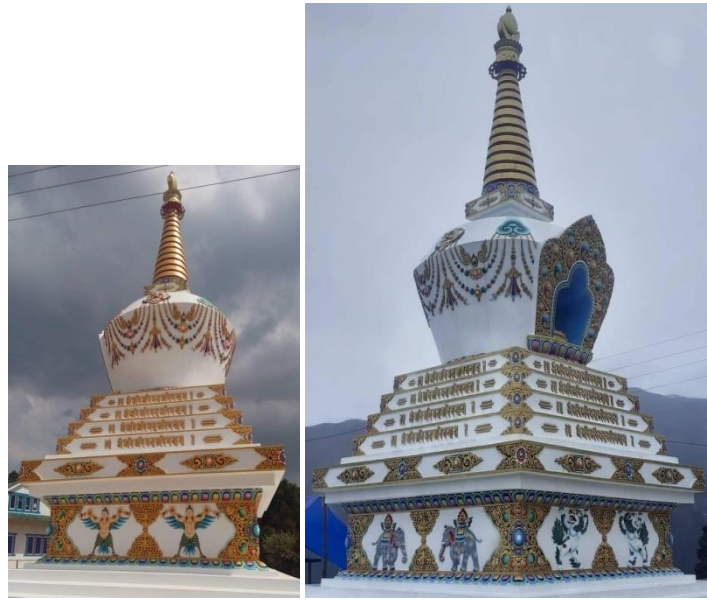
**Figure 6: Jhampta**

Hence, these objects provide the clear concept of congruency at the school level to teach geometry.

### **Concept of similarity**

Through the observation researcher found that Sherpa community used the concept of similarity they called it Mildojuldo, same, if seen in the circle, plane, cylinder plane. Illiterate Sherpa people simply understand the similarity as resemblance of one object with the other.





**Figure 7:**Bauda

It is found that Sherpa community prepared the similar objects but they don't know the mathematical meaning of similarity. These objects can be used to teach the concepts of circle in the school level in geometry class so that the student can understand easily.

## Chapter V

### FINDINGS, CONCLUSION AND IMPLICATIONS

Mathematics is considered as social creation dealing with how mathematical concepts and knowledge are developed and how to use mathematics in daily life in the Sherpa community. The main purpose of the researcher is to study the basic mathematical concepts and number systems practiced by the Sherpa community. That is identifying the counting system, four mathematical operations and geometrical concepts in the domestic context of the Sherpa community. For this purpose, the researcher visited the Sherpa community and respondents were selected as elderly persons from each Dudhkunda Municipality by snowball sampling. Then, the researcher observed their work for preparing different artifacts, the counting system, basic four fundamental operations and their geometrical system.

The researcher explored mathematical concepts and processes in this community through face-to-face interviews and observations - observations and interviews and photographs were used. The researcher acted as an observer and found different types of mathematical terms and concepts in the Sherpa community. Concepts of algebra, angles, cylinders, congruence, etc. were explored on the basis of their information and field visits. The researcher conducted interviews with 10 Sherpa community members, one teacher and one student. On the basis of their information and field data, the researcher has listed the following findings.

#### **Counting system**

Sherpa people do not have their own script but they have been following the Tibetan script and they have their own language. Sherpa people have their own names for numbers:

Zero for 0, chyik for 1, ngyi for 2, sum for 3, Jyi for 4, nga for 5, tuk for 6, din for 7, gye for 8, gu for 9, chyuthamba for 10, gyathamba for 100. The other counting system of Sherpa people are given in appendix (1).

### **Basic Four Fundamental operations**

Some educated Sherpa people use formal way of addition and subtraction but rest of the people is using alternative ways. They add and subtract just opposite to that of formal way. That means in formal way they add and subtract digit from right to left (from unit to tens, hundreds, thousands places respectively) but Sherpa people solve the addition and subtraction for base on 10 or 20. Base 10 and base 20 numeration system have been practiced in Sherpa community for counting purpose. Most of elder and illiterate use base 20 (bisa) as the traditional system of counting and younger and literate use base 10 numeration system from the influence of educational and interaction with other community.

Thus, they did simple mathematical operation orally but large numbers problems could not be solved by illiterate person. They have not specific numerals so the recording system is not clear. But now days these activities have remained only in elder person. And literate Sherpa know numerals of Nepali to represent numbers. Sherpa have no their own script. But they have been following the Tibetan script. The researcher has their found their specific symbols to represent the numbers from 0 to 10 only. They did simple mathematical operations orally but large numbers problems could not be solved by illiterate persons. They have not specific numerals so the recording system is not clear. But now days these activities have remained only in elder persons.

## **Measurement**

Sherpa people measure different things in their culture in different ways. For examples hands and fingers are used to measure length. The units of length are bitta, inch and hatt. They use kosh to measure long distance. The volume is measured with different types of pots. The units of volume are manna, kuruwa, pathi and muri. The weight is traditionally measured by Tulo. The units of weight are phul,darni, bisauni, aathpolandshers.

## **Geometrical concept**

The geometrical concept is also practiced by Sherpa people knowingly or unknowingly. They have no any concept of geometry but they prefer to construct and use geometrical objects to make their life easy. For examples circle, cylinder, rectangle etc.

## **Conclusions**

The present study of Sherpa community has found has their own system counting, basic fundamental operations and measurement system. Most of the old Sherpa people solve addition and subtraction problem by grouping methods. They generally make the group of ten and twenty. They sometimes make the grouping of 5, 50,100, 500 and 1000 according to the nature of numbers. Most of them solve multiplication problem by respectively addition method. So they took long time to solve multiplication problems. They also use grouping method to solve division problems. The system was locally developed in the past, when there was no need of standardizing measurement unit and no pressing needs of the use of numerals. They felt upon these systems as appropriate for their daily life needs. So the system seem to be of practical utility in their life .The Sherpa use their own system of counting and

measurement as well as mathematical process for their normal day to day activities. People learned this system in their own communities through normal activities. The system were simple enough to learn and for practical utility. Sherpa people need to learn formal school mathematical system. It is conclude that Sherpa people use Geometrical objects that they mostly prefer to construct such as: Ting, damphu, jhampta, baudha, etc. with different shapes such as conical, circular, rectangular and rhombus. This practice can be integrated in our formal education system. Therefore, they have to explore at their level to modern mathematical concept and processes. So, this research facilitates to understanding modern mathematics in the school level mathematics curriculum.

### **Educational implications**

This study was conducted with short period of time, small numbers of respondents and limited area. Therefore, the finding of this research may not cover the entries aspects of mathematics and Sherpa ethnic group. There local and traditional knowledge consists in their artifacts involve more mathematical concepts. It is clear that nearly every aspect of Sherpa daily work / practice in cooperated the use of mathematics. The followings are the implication of this study:

- All ethnic groups have to do this research because the study of counting system, four mathematical operation measurement systems in Geometrical concept is indispensable for each ethnic group.
- This study helps to find teaching material available in the local community and easy to teach the student of local community that makes the teaching process more effective.

- This study also give general idea about on how the children of Sherpa community learn mathematics specially geometry parts in classroom and link it with daily life activity.

Thus, the research in the field of the indigenous culture and their ways of doing, learning and teaching can facilitate to understand their ways and implement to the formal schooling .This research will be useful for curriculum planner, text book writers, teachers and policymakers to develop their professional development. The study conducted in a few days so an intensive research can be done also for extended period.

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## APPENDICES

### Appendix – I

English	नेपाली	संख्या	देवनागरीमा	In Roman
One (1)	एक (१)	एकै १	chyik	चीक
Two (2)	दुई (२)	गर्नेथा २	ngyi	इयी
Three (3)	तीन (३)	गणुथा ३	sum	सुम
Four (4)	चार (४)	चौ ८	jyi	ज्यी
Five (5)	पाँच (५)	ह्या ५	ngá	ङ
Six (6)	छ (६)	डुग ६	túk	टुक
Seven (7)	सात (७)	सुवा ७	din	दीन
Eight (8)	आठ (८)	बकुटा ८	gye	ये
Nine (9)	नौ (९)	दगा ९	gu	गु
Ten (10)	दस (१०)	सुबुधारा १०	chyuthamba	च्युथम्बा
Eleven (11)	एघार (११)	सुबुधारे ११	chyuchyik	च्युचीक
Twelve (12)	बाह्र (१२)	सुबुधारेथा १२	chyungyi	च्युइयी
Thirteen (13)	तेह्र (१३)	सुबुधारेथा १३	chyuksum	च्युक्सुम
Fourteen (14)	चौध (१४)	सुबुचौ १८	chyupjyi	च्युप्यी
Fifteen (15)	पन्ध्र (१५)	सुह्या १५	chyenga	च्योङा
Sixteen (16)	सोह्र (१६)	सुहुग १६	chyutuk	च्युटुक
Seventeen (17)	सत्र (१७)	सुहुसुवा १७	chyupdin	च्युपदीन

Eighteen (18)	अठार (१८)	सुहुसुवा १८	chyapgya	च्योपया
Nineteen (19)	उन्नाइस (१९)	सुहुदगा १९	chyutku	च्युटकु
Twenty (20)	बीस (२०)	गर्नेथाम्हा २०	ngyichyu	इयीशयु
Twenty-one (21)	एक्काइस (२१)	गर्नेथाम्हासुहुग २१	ngyichyu chachyik	इयीशयु चचीक
Twenty-two (22)	बाइस (२२)	गर्नेथाम्हासुहुगर्नेथा २२	ngyichyu cha ngyi	इयीशयु चइयी
Twenty-three (23)	तेइस (२३)	गर्नेथाम्हासुहुगणुथा २३	ngyichyu cha sum	इयीशयु चसुम
Twenty-four (24)	चौबीस (२४)	गर्नेथाम्हासुहुचौ २४	ngyichyu cha jyi	इयीशयु चज्यी
Twenty-five (25)	पच्चीस (२५)	गर्नेथाम्हासुहुह्या २५	ngyichyu cha ngá	इयीशयु चङा
Twenty-six (26)	छवीस (२६)	गर्नेथाम्हासुहुडुग २६	ngyichyu cha túk	इयीशयु चटुक
Twenty-seven (27)	सत्ताइस (२७)	गर्नेथाम्हासुहुसुवा २७	ngyichyu cha din	इयीशयु चदीन
Twenty-eight (28)	अठ्ठाइस (२८)	गर्नेथाम्हासुहुसुवा २८	ngyichyu cha gya	इयीशयु चया
Twenty-nine (29)	उनत्तीस (२९)	गर्नेथाम्हासुहुदगा २९	ngyichyu cha gu	इयीशयु चगु
Thirty (30)	तीस (३०)	गणुथाम्हा ३०	sumchyu	सुम्च्यु
Thirty-one (31)	एकतीस (३१)	गणुथाम्हासुहुगर्नेथा ३१	sumchyu so chyik	सुम्च्यु सोचीक
Thirty-two (32)	बतीस (३२)	गणुथाम्हासुहुगर्नेथा ३२	sumchyu so ngyi	सुम्च्यु सोइयी
Thirty-three (33)	तेतीस (३३)	गणुथाम्हासुहुगणुथा ३३	sumchyu so sum	सुम्च्यु सोसुम
Thirty-four (34)	चौतीस (३४)	गणुथाम्हासुहुचौ ३४	sumchyu so jyi	सुम्च्यु सोज्यी
Thirty-five (35)	पैंतीस (३५)	गणुथाम्हासुहुह्या ३५	sumchyu so ngá	सुम्च्यु सोङा

Thirty-six (36)	छत्तीस (३६)	षष्ठ्यसहस्रैपुन ३६	sumchyu so tuk	सुमच्यु सोटुक
Thirty-seven (37)	सैंतीस (३७)	षष्ठ्यसहस्रैपुन ३७	sumchyu so din	सुमच्यु सोदीन
Thirty-eight (38)	अठतीस (३८)	षष्ठ्यसहस्रैपुन ३८	sumchyu so gya	सुमच्यु सोग्या
Thirty-nine (39)	उनन्वालीस (३९)	षष्ठ्यसहस्रैपुन ३९	sumchyu so gu	सुमच्यु सोगु
Forty (40)	चालीस (४०)	षष्पि ४०	shipchyu	शयीच्यु
Forty-one (41)	एकचालीस (४१)	षष्पिपुनैपुन ४१	shipchye she chyik	शयीच्यु शेच्यीक
Forty-two (42)	बयालीस (४२)	षष्पिपुनैपुन ४२	shipchye she ngyi	शयीच्यु शेङ्गी
Forty-three (43)	त्रिचालीस (४३)	षष्पिपुनैपुन ४३	shipchye she sum	शयीच्यु शेसुम
Forty-four (44)	चबालीस (४४)	षष्पिपुनैपुन ४४	shipchye she jyi	शयीच्यु शेज्यी
Forty-five (45)	पैंतालीस (४५)	षष्पिपुनैपुन ४५	shipchye she ngá	शयीच्यु शेङ्गा
Forty-six (46)	छयालीस (४६)	षष्पिपुनैपुन ४६	shipchye she tuk	शयीच्यु शेटुक
Forty-seven (47)	सटचालीस (४७)	षष्पिपुनैपुन ४७	shipchye she din	शयीच्यु शेदीन
Forty-eight (48)	अठचालीस (४८)	षष्पिपुनैपुन ४८	shipchye she gye	शयीच्यु शेग्ये
Forty-nine (49)	उनन्वाचास (४९)	षष्पिपुनैपुन ४९	shipchye she gu	शयीच्यु शेगु
Fifty (50)	पचास (५०)	षष्पि ५०	ngapchyu	ङ्गपच्यु
Fifty-one (51)	एकाउन (५१)	षष्पिपुनैपुन ५१	ngápchyu ngá chyik	ङ्गपच्यु ङ्गाच्यीक
Fifty-two (52)	बाउन (५२)	षष्पिपुनैपुन ५२	ngápchyu ngá ngyi	ङ्गपच्यु ङ्गाङ्गी
Fifty-three (53)	त्रिपन (५३)	षष्पिपुनैपुन ५३	ngápchyu ngá sum	ङ्गपच्यु ङ्गासुम

Fifty-four (54)	चौउन (५४)	षष्पिपुनैपुन ५४	ngápchyu ngá jyi	ङ्गपच्यु ङ्गाज्यी
Fifty-five (55)	पचान्न (५५)	षष्पिपुनैपुन ५५	ngápchyu ngá ngá	ङ्गपच्यु ङ्गाङ्गा
Fifty-six (56)	छपान्न (५६)	षष्पिपुनैपुन ५६	ngápchyu ngá tuk	ङ्गपच्यु ङ्गाटुक
Fifty-seven (57)	सन्ताउन (५७)	षष्पिपुनैपुन ५७	ngápchyu ngá din	ङ्गपच्यु ङ्गादीन
Fifty-eight (58)	अन्ठाउन (५८)	षष्पिपुनैपुन ५८	ngápchyu ngá gya	ङ्गपच्यु ङ्गाग्या
Fifty-nine (59)	उनन्साठी (५९)	षष्पिपुनैपुन ५९	ngápchyu ngá gu	ङ्गपच्यु ङ्गागु
Sixty (60)	साठी (६०)	षष्पि ६०	tukchyu	टुकच्यु
Sixty-one (61)	एकसाठी (६१)	षष्पिपुनैपुन ६१	tukchyu re chyik	टुकच्यु रेच्यीक
Sixty-two (62)	बैसाठी (६२)	षष्पिपुनैपुन ६२	tukchyu re ngyi	टुकच्यु रेङ्गी
Sixty-three (63)	त्रिसाठी (६३)	षष्पिपुनैपुन ६३	tukchyu re sum	टुकच्यु रेसुम
Sixty-four (64)	चौसाठी (६४)	षष्पिपुनैपुन ६४	tukchyu re jyi	टुकच्यु रेज्यी
Sixty-five (65)	पैंसाठी (६५)	षष्पिपुनैपुन ६५	tukchyu re ngá	टुकच्यु रेङ्गा
Sixty-six (66)	छैसाठी (६६)	षष्पिपुनैपुन ६६	tukchyu re tuk	टुकच्यु रेटुक
Sixty-seven (67)	सटसाठी (६७)	षष्पिपुनैपुन ६७	tukchyu re din	टुकच्यु रेदीन
Sixty-eight (68)	अठसाठी (६८)	षष्पिपुनैपुन ६८	tukchyu re gya	टुकच्यु रेग्या
Sixty-nine (69)	उनन्सत्तरी (६९)	षष्पिपुनैपुन ६९	tukchyu re gu	टुकच्यु रेगु
Seventy (70)	सत्तरी (७०)	षष्पि ७०	dinchyu	दीन्च्यु
Seventy-one (71)	एकात्तर (७१)	षष्पिपुनैपुन ७१	dinchyu ton chyik	दीन्च्यु तौन्च्यीक



## Appendix -2

### Interview Guidelines

Date of interview:

Name:

VDC:

Age:

Ward no:

Occupation:

Village:

1. How many numbers can you count?
2. How many numbers can you count in your language?
3. How do you count if you need to count more than that number?
4. Which language do you feel easy to count?
5. Can you say the ten thousand, fifty thousand, fifty thousand and one lakh in your own language?
6. How do you count money?
7. What is the addition of 9 apples and 7 apples
8. Name of the domestic goods in Sherpa language?
9. Name of the cultural good in sherpa language?
10. How many members are there in your family?
11. What are your measuring devices in your community?
12. How do you measure milk oil, ghee, potatoes, apple etc in your community?

### **Observation Guideline**

To find the answer of the researcher questions, researcher observed the Sherpa culture, daily life activities and other related issues concerning mathematical knowledge generation at the same time. Researcher was able to find out observation regarding the questions such as How Sherpa people count the number how they added, subtraction, multiplication and division and how they measure different things.