

Chapter I

INTRODUCTION

Background of the Study

The term mathematics has been interpreted and explained in various ways. Mathematics is the science of number and space (Oxford Dictionary, 2005). Mathematics is intimately involved in every moment of human's life. It is the science of numbers and their operation, interrelation and combination of space configuration and their structure measurement etc. It has played an important role in the development of science and technology. Mathematics is both an art as well as science. Pure mathematics lies at its heart. Pure mathematics explores the boundary of mathematics and pure reason. It has been described as that part of mathematical activity that is done without explicit or immediate consideration of direct application. Another branch of mathematics is applied mathematics and it is concerned with the study of physical, biological and sociological world.

Mathematics is essential for understanding every discipline, Without knowledge of mathematics, it is very difficult for better understanding of the other disciplines like economics, physics, chemistry and so on. Accepting the need and implication of mathematics as human lives. Mathematicians seek and use patterns to formulate new conjectures by mathematical proof. When mathematical structures are good models of real phenomena, then mathematical reasoning can provide insight or predictions about nature. Through the use of abstraction and logic, mathematics developed from counting, calculation, measurement and the systematic study of the shapes and motions of physical objects. Practical mathematics has been a human activity from as far back as written records exist.

Galileo Galilei (1564-1642) said *"The universe cannot be read until we have learned the language and become familiar with the characters in which it is written. It is written in mathematical language and letters are triangles, circles and the other*

geometrical figures without which means it is humanly impossible to comprehend a single world, without these one is wandering about in a dark labyrinth.

David Hilbert said, “*we are not speaking here of arbitrariness in any sense. Mathematics is not like a game whose tasks are determined by arbitrarily stipulated rule. Rather it is a conceptual system possessing internal necessity that can only be so and by no means otherwise*”[Retrieved from <https://en.m.wikipedia.org>]

Regarding the origin and development of mathematics, H. Preston (Adhikari, 2002 p.3) has expressed his view that mathematics was developed from the need of organized society of people. For instance the primitive tribes living by hunting and collecting the natural harvest of forest and field, they needed rudimentary knowledge of counting to communicate numbers to the tribes. This may be the number of animals in a hand or the numbers of people in a hostile tribe. Also needed were the measure of size, strength, distance and time, however crudely formulated they might be certain primitive awareness of similarities of the shapes must be present in effort to duplicate arrow heads and implements and it is also important to have means of describing location involving both concepts which later developed into mathematics. From the above discussion very simple evidence about the origin of mathematics was according to the need of human being in the process of civilization and has been essential component of human civilization. So the history of mathematics is a part of history of human civilization.

The mathematical sciences have changed significantly during the past few decades. The most obvious change is the enormous growth of mathematics. Even the latest scientific and technological developments have proved mathematics as a powerful tool for any scientific achievements. The history of mathematics is as old as the human civilization.

The history of mathematics in Nepal is based on Astronomy, Arithmetics and geometry. It was created from experiences and interactions with an environment (In 3rd-10th). This period propose as the ancient period on the basis of the first written mathematical documents found at Asoka pillar in Lumbini. 1/8 is found in Lumbini on Asoka pillar. This gives the concept of division by 8 and conversely multiple of 8. The different symbols were used to denote numbers. They practiced mathematics in different bases systems like base 10 and 20. They also used the word ‘Wisati’(20).

In practice in ancient period (Lichhavi) people would use different word for measurement system like Monika to denote the quantity of paddy land that covered by the seed of one Manika. In the practice in Tharu community one mana means four pathi (one-tin) mana, pathi. Similarly in lichhavi period they used Kharika for the quantity of paddy land having one Muri seed to be used. Drandika means the paddy land which used to be one dron seed of rice. The word 1 li= $\frac{1}{3}$ miles, $\frac{25}{11}$ miles=1 Kosha. These examples indicate the Nepalese own measurement systems. The period after 10th century is proposed as the medieval period in the context of Nepal for mathematics practices. Dharmapati, Bardhane, Balbhadra Joshi, Chakrapani Aryal, Laxipati pande etc were contributed for developments of mathematics in Nepal. Mostly they contributed in jyoutisha arithmetic. They calculated calendars and it is based in planetary motion that is astronomy.

In the context of Nepal we consider 18th century and onward as the modern time line for mathematics practice. Formal mathematics education was influenced by mathematics practices neighboring countries scholars. So some individuals as mathematics teachers were hired from India. But indigenious mathematics were practiced each and every communities as local mathematics. In this period Nepali scholars wrote several mathematics books. E.g Vyatka chandrika, Vichitra Ganita, Ankendu Shekhara, aksharanka Shiksha, Gorkha Bijaganita etc. Practice of mathematics has been rapidly developed. Awareness in history of mathematics and classical developments and research in this fields which focused mainly mathematics in Nepal. Searching of mathematics in Nepal in curriculum masters and bachelor's degree). It is the achievement in mathematics curriculum reformation. A research team of Research centre for innovation and development (CERID 1990) conducted a study of elementary process of learning mathematical concepts in Nepal (NCHRTM-2017). Nowadays many researchers have researched in various fields of mathematics.

The concept of number and process of counting developed so long before the time of recorded history that matter of this development is largely conjectured. It is known that at the present time there are savage tribes that make very little use of numbers and interestingly enough the tribesmen have few assets on the other hand, the demands of modern civilization for methods as well as precisely with numerous aspects of social affairs are so, great that a simple numbers in the groups as long as

they are small. For example, such a word as 'pair' means two, 'hand' means five and head means one. In Tibet the word 'wing' means two when such expressions are as such as has been devised (CERID, 1990).

Mathematics is symbolized and structured as system. The invention of symbols helped to develop math process, which utilize positional representation of numbering and operation of numbers. This made math processes such as addition, subtraction, multiplication and division simple enough for common use. Today people have devised several forms (bases) of number counting. Some based on 2, some on 10, some on 20 and so on. Some ancient counting system have already becomes obsolete and some others that have survived and gradually being replaced by new system (Bhusal, 2010).

We live in a global world. The economy is global, production is becoming increasingly global, communication systems are interconnected, and major political decisions are taken unilaterally. But people continue to speak different languages, adhere to different religions, eat and dress differently. Such diversity is normally seen and indicates that schools should respect different cultures, but schools expect students to learn the same mathematics developed by great mathematicians that legitimation, arguing that otherwise students can hardly operate in the modern world. Mathematics is behavior science, also influenced by cultural rule. This view has been supported by many current historians and philosophers of mathematics. Hence different languages, dresses, foods and religions have made existence of different cultures. Culture influences the activities of people. consequently mathematical ideas (measurement, counting, classification, modeling etc.) may have different way in every culture which leads that different nature of mathematical process is known as the term “Ethno mathematics” or, “ethnic groups mathematics”(Paudel, 2012).

The term ethno mathematics is used to express the relationship between culture and mathematics. The term requires a dynamic interpretation because it describes concepts that are themselves neither rigid nor singular namely, ethno and mathematics (D’Ambrasio, 1987). The term ethno describes “all of the ingredients that make up the cultural identity of a group, language, codes, values, jargon, belief, food and dress, habits and physical traits”. Mathematics expresses a broad view of

mathematics which includes ciphering, arithmetic, classifying, ordering, inferring and modelling. (Pp 2-3)

D'Ambrosio (1990) defined ethnomatics in the following way:-

The prefix ethno is today accepted a very broad term that refers to the social cultural context and therefore includes language, jargon and codes of behavior, myths and symbols. The derivation of mathema is difficult, but tends to mean to explain, to know, to understand, and to do activities such as ciphering, measuring, classifying, inferring, and modeling. The suffix tics is derived from techne and has the same root as technique (Devkota, 2014).

Rosa and Orey (2003) stated that *the mathema develops the tics within the context of ethnos because it consists of daily problems people face, larger problems of humanity and endeavors of humans to create a meaning full world.*

Geraldo pompu, Jr gives the definition of ethnomatics in the following lines:
Ethno mathematics refers to any form of cultural knowledge or social activity. Characteristics of a social and or cultural group, that can be recognized by other groups such as "western" anthropologists, but not necessarily by the group of origin, as mathematical knowledge or mathematical activity.
 [Retrieved from <https://www.educationword.com>].

Ethno mathematics is the study of mathematics which takes into consideration the culture in which mathematics arises. i.e it is the study of relationship between human societies with mathematics(UNESCO, 1989).

It can be concluded that Ethno mathematics lies at the confluence of mathematics and cultural anthropology. At one level, it might be called maths in the environment maths in the community. At another related level, it's the way that specific cultural groups go about the task of ciphering and counting, measuring, classifying, ordering inferring and modeling (Gilmer, 1989 p. 105).

Different ethnic tribes have their own mathematics in the culture. In most Brazilian tribes, we can find some knowledge on geometry in body painting, handcrafts and in the building of their huts. Concepts such as parallelism

perpendiculars are found in body painting and are incorporated into the language. For “tapirapes” from matogrosso, the parallelism ‘axapayway’ and the perpendicularism ‘axapankway’. The circle and the sphere mean the perfect shape for the most Brazilian tribes as it did for the Greeks. Many of the geometrical concepts can be found in different culture. The Tshokwe people of southern African’s Bantu culture have used graph theory principles in sand drawing. In Africa, circular house are grouped in circular compounds, such as arrangement maximized living space, affords protection and minimized required building materials. (Zaslavsk, 1973)

The development of methods used in measurement has been closely associated with as oral history or unwritten history. The growth of number system. In order to carry on trade crude system of weights and measures were devised in the beginning. Measurement is essentially a process of making comparisons.

Qualitative research designs are systematic designs. In this designs emphasis gathering data on naturally occurring phenomena. Most of these data are in the form of words rather than numbers, and in general the researcher must search and explore with a variety of methods until a deep understanding is achieved. Qualitative designs can initially be classified as interactive or non-interactive and then further delineated within each of these major types (Shrestha, 2070 p-39). There are 4 types of qualitative research (phenomenology, ethnography, grounded theory, narrative inquiry). This research is ethnography basis.

An ethnography is a description and interpretation of cultural or social group or system. Although there is considerable disagreement about the meaning of the culture, the focus is on learner patterns of actions, language, beliefs, rituals and ways of life. As a process, ethnography involves prolonged fieldwork, typically employing observation and casual interviews with participants of a shared group activity and collecting group artifacts. A documentary style is employed, focusing on the mundance details of everyday life and revealing the observation skills of the inquirer. The collective informant’s point of view is painstakingly produced through extensive, closely edited quotations to convey that what is presented is not the field worker’s view but authentic and representative remarks of the participants. The final product is a comprehensive, holistic, narrative description and interpretation that integrates all aspects of group life and illustrates its complexity (Shrestha, 2070 Pp-114).

Newars are mainly settled in Kathmandu valley. They have mongolian features and their own language and script, Newari believed to have its origin from Tibeto Burmas. Hinduism and Buddhism are their main religions. They have complex social systems and practices are comprised of many castes. Trade and farming are their main occupations.

There are many mathematics notation in people of different cultures that written history has hidden, frozen or stolen. So that oral history is becoming much important to study ethno mathematics (Grades, 1985). Nowadays many researcher have devoted to search the ethno mathematics ideas and structures that ethnic group has oral history or unwritten history.

Statement of the Problems

Nepal is rich in diversity, religious, cultural, linguistic and ethnic. Every ethnic groups has their own religious, social and cultural beliefs, their cultural activities have own types of important role in the national culture. Newar is the historical inhabitants of the Kathmandu valley and its surrounding areas in Nepal and they create its historic heritage and civilization. Newar is one of the advantaged ethnic groups. Their cultural activities are different from the other castes.

Ethno mathematics is used to express the relationship between culture and mathematics. The term requires a dynamic interpretation because it describes concepts that are themselves neither rigid nor singular namely ethno and mathematics (D'Ambrosio, 1987). The term ethno describes all of the ingredients that make up the cultural identity of a group language, codes, values beliefs, food and dress, habits and physical traits whereas Mathematics expresses a broad view of mathematics which includes ci-hering, arithmetic, classifying, ordering, inferring and modeling.

It is necessary to know the mathematical concepts and processes of ethnic groups of Nepal for the betterment of mathematical knowledge in people for county's development. The changes in the society or community affect their cultural system in the course development. It consequently directs to develop different units of the system. But there still remains the use of traditional method in Newar community, counting and measurement process. No studies have been conducted dealing with ethno mathematics of any kind in Pokhara. Therefore the researcher intended to study

the basic mathematical concepts and process of Newar community. In this context, the study has focused on the following questions:-

- What is the counting system of Newar community?
- How do they perform the four basic fundamental operations (addition, subtraction, multiplication and division) in their real life?
- What are the measurement systems practiced in Newar community?

Objectives of the Study

By the considering the above statement of the problem the following were the objectives of this study:-

- To explore the counting system of Newar community.
- To find out the ways of the four basic fundamental operations practiced by Newar people.
- To identify the measurement systems used in Newar community.

Justification of the Study

Human civilization is the result due to the development of human consciousness. The process of civilization began from ancient stage. The history of human civilization is combination of construction and destruction of human activities. Now a days the trend to study about the art, architecture, culture, archeological excavation and historical events of country or a certain place is increased. Such types of studies, investigation and research are related to different aspects of human being or settlement. This studies in these fields helps to identify and explore the level of ethno mathematical studies of Newar community based on concept and process of basic mathematics.

Nepal has adopted a policy of free and universalization of primary education. NEC (1992) has recommended that primary education can be given in mother tongue. The subject math has been accepted as an important compulsory subject since grade one. No place is given in the curriculum to have ethnic maths. However, the new curriculum has opened a new policy to have local curriculum. If primary education is given in the mother tongue, what should be the content of mathematical in primary level? This study is the study of indigenous counting and measuring system of Newar

community. The nature of mathematics if explored systematically can be used in curriculum. This study in this direction will be culturally very important.

Every human settlement has its own culture and customs and there is still another aspect of human development called ethno mathematics. Generally every ethnic group has its own script, counting and measurement system which help them for their prosperity for the development. The significance of this study can be listed as follows:-

- This study will add a new dimension in the field of ethno mathematics.
- This study will help to identify the basic concept of counting, to explore the four basic operations and the measurement system practiced in Newar community.
- The result of this study will be helpful for policy maker, curriculum designer to consider ethno mathematics in curriculum.

Delimitation of the Study

There are many ethnic groups in Nepal with their own culture, life style, dressing tradition and mathematical system and the study can be done in many aspect of the community. This study tries to explore out what mathematics and measurement system the Newar community use at present. This does not give a complete account and formalization of mathematics. It tries to explain in the form that practiced as a part of their culture.

The study was carried out about mathematical ideas, counting and measurement systems of advantage community with a small number of respondents. The limitations of the study are as follows:-

- This study is limited to Newar community from Pokhara metropolitan city ward no 1(Bagar).
- This study is concerned with only the mathematical concepts of counting (number counting, grouping and recording system), measurement (length, distance, volume and weight) system and four basic operations of whole numbers.
- It was limited to 26 Newar people for responding Pokhara metropolitan city ward no 1.

Definition of Term

Newar. Newar is one of the advantage ethnic group of Nepal.

Measurement system. In this study measurement system refers to the technique of measurement which includes length/distance, area, volume and weight.

Ethno mathematics. It is study of mathematics along with its inter-relationship to the culture.

Ethnic groups. It refers to a specific group of people having common, culture, tradition and language.

Mathematical concept. In this study mathematical concept refers to the basic concept of number of four basic fundamental operation.

Formal/ modern system. There is standard mathematical system accepted by all the nations in the world. Such a system is including in their national level curriculum our country has also adopted such universal and standard mathematical system which is known as formal modern system.

Traditional system. The system of mathematical calculation which is different from the formal system in concept, structure, process etc reflects the typical (mathematical) system of Newar people is called traditional system.

Literate. Literate means being able at least to read and write general Nepali and perform fundamental mathematical operations in daily life.

Illiterate. Illiterate are those (persons) who cannot be included in the minimum definition of literate.

Chapter II

LITERATURE REVIEW

The related studies construct the platform for standing to the research and periphery of subject matter, which gives the theoretical support for the study. Reviewing related literature help researchers to limit their research question and to clarify and define the researchers in a better position to interpret the significance of their own results. The researcher is going to research on basic mathematical concept, counting, measurement and basic four operations of mathematics used by Newar community. By reading many different studies, we will begin to gain an impression about the important aspects of the topic, identify data sources that other researchers have used, identify and become familiar with the style of writing that is used – particularly within the ethnos of the area that we are researching, identify ideas for further consideration and create our own reading and critiquing strategy.

So, I have collected some books, journal and articles, researches which are related to ethno mathematics and mathematical concept and process. By deeply studying these resources, I am going to review the related literature as follows:-

Empirical Review

CERID (1990) studied on "the elementary process of learning mathematical concepts and process of RasuwaTamangs". The purpose of the study is to study the basic mathematical concept used by Tamang adults with no formal mathematical education, to identify traditional Tamang method of mathematics operation, and to find out the implication of Tamang process and tone up the present learning situation. This project work has shown that Tamangs have systems of measurement counting and their own mathematical process and geometrical concepts are based on the shapes and structure patterns of object existing around. He also found that counting and mathematical process are manifest mostly in money-accounting. They measured length of an object with hand and fingers and volumes with wooden pots. The Tamang system of numeration and mathematics in Rasuwa is influenced by Devanagari- Nepali based system i.e base 20. This study has also showed the situation

of children into the formal system, but it didn't study the effect of ethno mathematical practices in the classroom settings.

Shrestha (2003) studied the measurement system in Newar civilization with the objectives to identify the numeral systems and its trends to gradual development. His research is based on primary and secondary data, consisting of the study of profiles conducting with resources persons and the study of related journals, books, microfilms etc. Secondary data were collected from several libraries, museum and personal collection. He found that all the numerals of Newar civilization were found as developed from the Brahmin the ciphered numeral system was used during the Lichchhavi period, and the symbol zero was introduced during the dark age of mathematics development. This study has not showed the present mathematics practices in real life of Newar.

Kadel (2005) has studied on "The basic mathematical concepts and process of Cheapang community. The purpose of this study is to explore the numeration system, measurement system of Cheapang community and concluded that,

- The numeration system of Cheapang is base 20.
- Cheapangs have their own mathematical process which is a simple cumulative process.
- Cheapangs have their own traditional measurement uses physical object of the environment in the practical situation.

Pantha (2007) has studied on the topic "Basic mathematical concepts and process practiced by Darai of Tanahun District." and conclude that:

- The numeration system of Darai is a system of base 10.
- Darais have their own maths process that is a simple cumulative process.
- They have their own traditional system of measurement for lengths they measured with hand. Similarly the area is measured with ploughing time or grain yielded from the land, volume is measured with Mana, Pathi, Muri etc and weight is measured with Tulo.

Dhakal (2008) has studied on "basic mathematical concept and process of Raji Ethnic Group." The purpose of the study was to study the counting system of Raji ethnic groups, to find the way of the four basic mathematical operations practiced by

Raji Ethnic group. She concludes that the ethnic group have been base 10 (younger/literate people) and base 20 (traditional people) practiced their community they have not their own symbols for native names of numbers. Their own counting system, measurement system and operating system, now a days literate and younger also use Hindu–Arabic counting system and they use short cut method to solve mathematical problem.

Bhusal (2010) has studied on "A study on the use of geometrical concept by Darai community (An ethno mathematics study of Chitwan district). The purpose of the study is to explore the geometrical concepts used by Darai community. He conclude that,

- While constructing any objects, they make a conceptual vision of concerning objects.
- The circular shaped objects are mostly preferred. So that it covers more area.
- They are not able to differentiate among geometrical objects having different shapes.
- Some younger and literate persons are becoming aware of formal geometrical concepts.
- They are able to tell the shape of each parts of some machinery equipments, but not able to tell the name of some machinery equipments, which they told the name of whole object.

Paudel (2012) studied on an ethno mathematical study on Gurung community based on concept and process of basic mathematics in Kaski district. His study is concerned with exploring the existence of mathematical concepts and processes used by Gurung community. The main purpose of the study is to explore the counting system, to find out the way of doing four fundamental operations in mathematics more ever uses of such operations in Gurung community. His research is descriptive in nature because of its survey in ethnographic basic. His study is based on two phases. In first phase, he was selected 21 persons as respondents from different groups, and in the second phase he has carried out to collect data, i. e interview and observation. Answers given by respondents are recorded on note copy and analyzed in descriptive way. He concludes that,

- The numeration system of Gurung is base 10 and 20 both.
- Gurungs have their own maths process that is a simple commutation process. Numbers are decomposed in different groups of numbers for carrying out subtractions and division.
- They have their own traditional system of measurement. Length is measured with hand and fingers, area is measured with production of seed of grains which is measured in Mana, Kuruwa etc.
- The fractional practices of measurement in Gurung community are done by using physical objects of the environment in the practical situations.

Rai (2015) has studied on development of numerical scripts in Rai ethnic group. The purpose of the study is to investigate the development of numerical system of Rai ethnic group and he concludes that,

- The script of Kiranti (Rai) is influenced by Brahmi script so the numerals are also influenced by Brahmi numerals.
- Kiranti (Rai) have their own numeral system. They have been using the numeral system from medieval age in different forms.
- World numerals were widely used before the proper use of numerals.
- Decimal scale with position number system was adopted.
- All Rai people have adopted same scripts in writing but varies in their pronunciation.

Karki (2017) studied on basic mathematical concept practiced by Danuwar community. The purpose of the study is to identify the counting, measurement system practiced by Danuwar community and explore the geometrical concepts used for making domestic goods. He conducted the study on the basis of ethnographic approach. Thus it is descriptive in nature. Researcher has selected Duhauli municipality of Sindhuli district. He concludes that,

- Base 10 and base 20 numeration system.
- Danuwar communities have their own systems of counting and measurement system as well as their own mathematical process.

- In Danuwar community, lengths are measured with hand and fingers. The units of length are: Auri, Kuret, Bitta and Haat. They use kosh to measure long distance.
- Danuwar community has their own geometrical knowledge.

They have used different concepts for making the domestic tools such as a circle, rectangle, rhombus, similarity, congruence, parallel line etc.

Ethno mathematics is a new emerging field of mathematics in this decade. There are so many investigations carried out around the world in this field and many ethno mathematical practices have been conducting in various places like in Brazil, Ghana, Papua New Guinea, Spain and so on (Paudel, 2012). Nepal is multicultural country where many cultural systems are found. But in this field, no attempts have been made as discussed on this context and the review of above literatures helped researcher to understand that there is a Newar community whose mathematical concepts and processes have not studied yet. Therefore, on this field researcher undertake the study.

Research Gap

The gap also consider the missing piece or pieces in the research literature is the area that has not been explored or is under explored. This could be a population or sample (size, type, location etc). Research method, data collection and or analysis or other research variables or conditions. In another words, it indicates a finding from a research in which a key question has not been answered. It shows you have a deep understanding of the status of the body of knowledge in your chosen field and finally it shows that you have conducted a research which fulfills that gap in the literature.

CERID (1990) had researched on the elementary process of learning mathematical concepts and process of Rasuwa Tamangs which aim to study the basic mathematical concept used by Tamang adults with no formal mathematical education. Shrestha (2003) had studied on measurement in Newar civilization with the objectives to find the numeral system and its trends to gradual development. Kadel (2005) had studied on the basic mathematical concept and process of Cheapang community.

Pantha (2007) had conducted a research on the topic basic mathematical concepts and process practiced by Darai of Tanau district. Dhakal (2008) had researched on basic

mathematical concept and process of Raji ethnic group. Bhusal (2010) had researched on a study on the geometrical concept by Darai community (an ethno mathematical study). Paudel (2012) made a research on an ethno mathematical study on Gurung community based on concept and process of basic mathematics. Shiddi (2015) had researched on development of numerical scripts in Rai ethnic group. Karki (2017) had studied on basic mathematical concept practiced by Danuwar community. No studies have been conducted dealing with cultural mathematics (i.e. Ethno mathematics) of any kind of Newar community in Pokhara. Therefore, the researcher has intended to study the basic mathematical concepts and processes of Newar community in Pokhara.

Theoretical Construction

This section deals with the theoretical supports of the study. There are many theories developed by different psychological and scientists related to child development and process of learning. Out of several learning theories, some are developed by cognitive, some are behaviorists, some are humanism and some are constructivist. All theories has vital role in learning but this study is based on a society. So the researcher used ethnography approach.

Conceptual Framework

A conceptual Framework represents the researcher's synthesis of literature on how to explain a phenomenon. It maps out the actions required in the course of the study given his previous knowledge of other researcher's point of view and his observations on the subject of research. [Retrived from

<https://simplyeducate.me/2015/01/05/conceptual-framework-guide/>]

Analyzing various literatures in ethnographic basis, I have developed a conceptual framework for the study which is given below:-

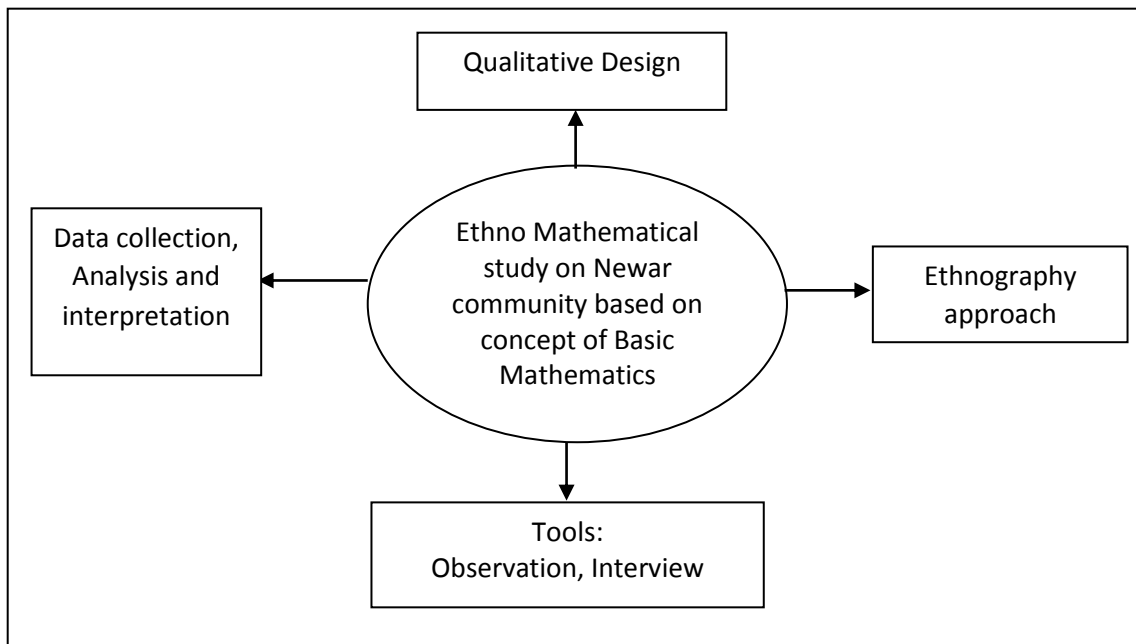


Figure 2.1: Conceptual Framework

The conceptual framework, which I mentioned in above is the important part of this study. An Ethno mathematical study on Newar community based on concept of basic mathematics was topic of this study. I have applied the qualitative research design and ethnography approach for carrying out this study. This study has centered to explore the counting system, to find out the ways of the four basic fundamental operations and to identify the measurement system used in Newar community. The research design of my study was qualitative and ethnography approach. Data collection, analysis and interpretation process has done by the help of different theories.

Chapter III

METHODOLOGY

Research methodology is a science, which determines how to complete the research systematically. The design of this study is a qualitative. Qualitative research is multi methods in focus, involving an interpretive, naturalistic approach to its subject matter. Qualitative research involves the studies used and collection of a variety of empirical materials, case study, personal experience, life story, interview, observation, historical, international and visual texts that describe routine and problematic moments and meaning in individual lives (Denzing & Lineon, 1994) are its tool for data collection.

It is conducted on an ethnographic basis. Thus it is a descriptive type. Researcher used observation and interview as method for searching the concepts and process of mathematics in Newar community.

This chapter delineates the design of the plan and procedure of study. That determine how the research becomes complete and systematic. The method applied in this study has been discussed in the following:-

Research design, sources of data, site selection, sample of the study, tools, method for data collection, data analysis procedure.

Research Design

A research design is a systematic approach that a researcher uses to conduct a scientific study. It is the overall synchronization of identified components and data resulting in a plausible outcome. To conclusively come up with an authentic and accurate result. The research design should follow a strategic methodology in line with the type of research.

The design of the study is qualitative. Qualitative research is a process of naturalistic inquiry that seeks in-depth understanding of social phenomena within their natural setting. It focuses on the “why” rather than “what” of social phenomena and relies on the direct experiences of human being as meaning-making agents in

their everyday lives. The three major focus areas are individuals, societies and cultures, and language and communication. Although there are many methods of inquiry in qualitative research, the common assumptions are that knowledge is subjective rather than objective and that the researcher learns from the participants in order to understand the meaning of their lives.

This study is the ethnographic basis. Ethnographic research is the most in-depth observational method that studies people in their naturally occurring environment. This research design aims to understand the cultures, challenges, motivations, and setting that occur. So it is an ethno-mathematical study on the concept and process of mathematics on the Newar community. This ethnography is based on qualitative research as well as descriptive in nature.

Ontology

Ontology is the philosophical study of the nature of being, becoming, existence or reality as well as the basic categories of being and their relations. Traditionally listed as a part of the major branch of philosophy known as metaphysics. Ontology deals with questions concerning what entities exist or can be said to exist, and how such entities can be grouped, related within a hierarchy and subdivided according to similarities and differences. Reality is subjective and multiple as seen by participants in the study (Hui- 2013). So ontological assumptions are concerned with what we believe constitutes the social reality as a branch of philosophy. In relation to my research project, there is no single reality and it always changes according to context and situation that is reality will differ according to assumption.

Epistemology

Epistemology is the study of knowledge acquisition. It involves an awareness of certain aspects of reality and it seeks to discover what is known and how it is known. Considered as a branch of philosophy which addresses cognitive science. More over epistemology explains why our minds relate to reality and how these relationships are either valid or invalid. It is needed in order to distinguish between the truth and falsehood as we obtain knowledge from the world us (Cline Austin-2018). Epistemology is the study of the nature and scope of the knowledge and

justified belief. It is analyzed the nature of knowledge and how it relates to similar notion such as truth, belief and justification.

So, in my research I have tried to develop my epistemological through observation and interview so that I have generated knowledge through interactions between me as a researcher to Newar people.

Axiology

Axiology is the study of value. i.e what makes good things good and bad things bad. Axiology is a branch of philosophy that studies, judgements about the value. Axiology primarily refers to the aims of the research. This branch of the research philosophy attempts to clarify if you are trying to explain or predict the world, or are you only seeking to understand. (Lee, N & Lings I, 2008).

"Axiology is related with values and ethnics. Axiology refers to truth, worth, values and ethics. It studies how people think and determine the value of different things". (Pratistha, 2011). For my qualitative research, no value is right or wrong, rather value is context based so that it differs from individual to individual, according to the human behavior and how they apply in different situations.

Description of Study Area

Pokhara is metropolitan city in Nepal, which serves as the capital city of Gandaki Pardesh. It is the country's largest and second largest in terms of area and population respectively. The city also serves as the headquarters of Kaski district. Pokhara is located 200 kilometres (120 miles) west of the capital, Kathmandu. The altitude varies from 827 meters (2713 feet) in the southern part to 1,740 metres (5,710 feet) in the north. Pokhara district is full of people with multi-language, multi-religion, and multi-cultures. According to the census 2011, total population of Pokhara metropolitan is 4, 92,098, 2.2% of total population speak Newari as their first language. This city is the common places of different castes such as, Brahmin, Gurung, Chhetri, Newar, Khas Nepali, Magar etc. People from different districts are migrated here and mark a blend of different cultures. So here, we can observe various cultures, religions and languages. Newar is also one of them who migrated from various regions. Retrieved from (2015) pokharamun.gov.np.

Site Selection

Ethnographic research often starts with choosing a field site. Ethnographic fieldwork typically begins with participant observation, which is later complemented by other data. (eg interview and documents). Thus the researcher chose purposively Pokhara Metropolitan City ward no 1 (Bagar). Those area is the popular for Newar ethnic group in Pokhara Metropolitan City. The researcher gets mixed (different) casts in this area, however lots of Newar people will also find. Therefore it is suitable for the researcher to collect the data as good responses.

Selection of key Respondents

Key respondents are important source of acquiring data. They are those who know their culture and a great deal about the study subject. The researcher personally visited the study area, met a social worker and explained him about the purpose of visiting of the area. By the help of the social worker, the researcher selected key respondents in two phases. The researcher had selected 20 persons of different age groups, 4 persons from old age (above 60 years), 8 from middle age (40-60), 8 from young age (20-40) years in the first phase. The researcher selected only the persons to participate in every activity of their cultural role and knew a great deal which were expected under study. After collecting responses in the first phase from the selected only six persons, two from old age, two from middle age and two from young-age. The six key respondents were selected for in-depth interview.

Sample of the Study

This is the qualitative inquiry, so the sample size in this study won't fix. According to Anderson "there will not rules for sample size in qualitative inquiry. (Anderson 2001, p 123). Therefore the sample size of this inquiry depends upon the researcher what s/he wants to know what the purpose of inquiry was, what can be credibility of the study and what can be done with available time and resources. For this study purpose the researchers had prepared the individual people records of Newar people. The researcher had taken 20 persons of different age groups, 4 persons from old age , 8 from middle age (40-60 years), 8 from young age (20-40) years.

Data Collection Tools of the Study

Data collection is the process of gathering and measuring information on targeted variables in an established system, which then enables one to answer relevant questions and evaluate outcomes. The goal for all data collection is to capture quality evidence that allows analysis to lead to the formulation of convincing and or edible answers to the questions that have been posed. There are different methods for collecting primary and secondary data. The researcher collected secondary data from different journals, articles, books and other published and unpublished documents. The data collection tools are different on the basis of the nature of the study and design of the research, so to achieve the data researcher used for researches to get data as described below:

Observation

There are different number of techniques to gather information. Observation is one of them. Observation is a process in which more than one person's observe what is occurring in some situation. Observation concerns the recording of what is being observed. It is the most useful tool for data collection in any kind of research.

Researcher got information about the social worker of the study area by visiting and conversing with the people familiar with that place and people. It was done so because the researcher was familiar with the culture of Newar. Researcher informed the senior person of that Newar community about the purpose of the study and visiting that community. The researcher took some information about the environment, culture and customs profession, economic condition of that community by the help of senior persons. Researcher observed their life style, work, conversation, daily activities, customs and other interesting activities. After overall activities, researcher identified their daily activities. Researcher separated those mathematical activities on the basis of their daily activities. Researcher separated those mathematical activities she noted down in her note copy. Some of those activities were noted down as they were found. She utilized those field notes in her analysis and interpretation of the research work. The researcher spent two weeks for getting information about the daily activities.

Interview

Many types of interviews, the researcher applied open –interviewed guide line approach. The researcher prepared interview guidelines (open-interviewed questions) on the basis of the suggestions from supervisor and the study of research book, theories, (related to the subject) research document and books related to Newar. Interview was taken individually with literate, young, old and illiterate Newar people because of culture are conserved by them. The interview guideline was changed on the basis of the interviewee’s responses, local situations and observation. Moreover, she strengthened the bond of relationship with the interviewees with the help of the social worker. After informing them the objectives of taking interview, researcher interviewed with the selected respondents on the basis of interviewee’s guidelines. (See appendix). The researcher spent one week for interviewing of the first phase. The purpose of the first phase interview was to find out the actual mathematical activities done by them in real life and to select the better respondents. The researcher spent three days for in depth interview in second phase. In depth interview was taken with six persons. The interview was natural because the interviewer (researcher) took their interview wherever she found them. The information got from the interview was written in the note copy and used in the analysis and interpretation of the study.

Data Analysis Procedure

After data collection using various means observation, and interview. Then researcher analyzed these data using descriptive method. Description is the main method of analysis and interpretation of the data. So descriptive method is used for analysis concept and process of basic mathematics on Newar community.

Data Handling Process

Data were collected with the help of observation and interview. Newar people were requested for saying their counting, measurement and fundamental operations practiced in their community. Descriptive method is used analysis techniques of this research. Data are obtained from observations and interview.

Quality Standard: It is always mandatory to maintain quality standards while conducting educational research. Thus I as a researcher try to formulate quality

standards of my research project letting others to judge the quality of my work on the basis of it. This section of my research project attempts to address the quality standards that I use to generate and represent my data. I conduct my research through descriptive paradigm which can be enumerated as bellow:-

Trustworthiness

To maintain the trustworthiness, i had listened social worker voice and established myself deeply immersed in research process. I explore data by conducting interviews of social worker (Newar people). It is more related the ethics in the context of research. So the matter of trustworthiness applies between the researcher and participants. “Trustworthiness” of the research can be achieved through credibility, transferability, dependability and conformability.

Credibility

Credibility refers to the extent to which a research account is believable and appropriate with particular reference to the level of agreement between participants and the researcher. Credibility is defined as the quality or power of inspiring belief. To establish credibility in my research, I have tried to spend as much time as the observation needed and engaged with different people with their work. I have taken interviews of the Newar people a prolonged engaged in observations. After getting information I wrote notes, I asked similar types of questions to others people and tried to find real practices from those information.

Transferability

Transferability for a qualitative research means the degree of similarities between researcher and the readers .To maintain the transferability in my research, I have made rich description of what participants said during the interviews and what I found during observation.

Dependability

According to the Cambridge English dictionary “Dependability is the quality of being able to be trusted and being very likely to do what people expect”. For

maintaining dependability in my research, I had participated in observation and i had not participated in interviews with any pre-assumptions and belief. I had focused upon exploring their real views and actual data.

Conformability

Conformability is the last criterion of trustworthiness that a qualitative researcher must establish. This criterion has to do with the level of confidence that the research study's findings are based on the participants narratives and words rather than potential researcher biases (statistics solutions, 2017). For maintaining conformability of my research, I had collected data in natural setting of data to maintain the quality of data gathered.

Chapter IV

BRIEF INTRODUCTION OF NEWAR COMMUNITY

Nepal is multiethnic, multilingual, multi-religious and multicultural country. Various principalities of our country are declared by various ethnic groups along with their respective languages, religions and cultures. According to the census 2011, there are 125 caste/ethnic groups in Nepal. Among those groups, Newar is also famous caste which is believed to be Tibeto Burmons.

The common identity of Newar was formed in the Kathmandu valley. One of the advantages ethnic group of Nepal. Newar is the indigenous group of Kathmandu valley that used to make almost the entire population of the valley before the Shah invasion in 1968. Newars are mainly traders. With a purpose to trade, they are scattered across the country. According to the census of 2011 there are 13, 21,933 Newars (4.99% of the Nepal's total populations) of which 8, 60,000 speak Newari language. [Census 2011, Retrived from <https://www.nepal.unfpa.org>].

Despite the small percentage numerically, they contribute significantly in the history, art, architecture and business activities in the country. They are into the business and government services, business being their main profession. They have negligible representations in the army and polices services. There are both Buddhist and Hindu Newars. Like elsewhere in the country, Religious syncretism is blended into the culture and tradition (Bajracharya, 2011).

The Newars are regarded as original inhabitants of the Kathmandu valley, but their origins are shrouded in mystery. They speak a Tibeto-Burmese language, which indicates they originated in the east but their physical features range from distinctively Mongoloid, again suggesting to east, to indo-Aryan, which of course points to India. The Newar golden age peaked in the 17th century when the valley consisted of small city-states, and Nepal was a vitally important trading link between Tibet and the north Indian plains. The history of Newar correlates to the history of Kathmandu valley (or Nepala Mandala) prior to the establishment of the modern state of Nepal.

Newar caste system is the system by which Newars, the historical inhabitants of Kathmandu valley, are divided into groups on the basis of vedic varna model and divided according to their hereditary occupations. The Newar caste structure

resembles more closely that of North India and Madheshis than that of 'Khas Parbatiyas' in that all four varna (Brahmin, Kshatriya, vaishya and shudra) and untouchables are represented. The social structure of Newars is unique as it is the last remaining example of a pre- Islamic North India civilisation in which Buddhist elements enjoy equal status with the Brahmanic elements. There are many castes in Newari like Shrestha, Joshi, Pardhan, Rajbhandari, Maharjan, Bajracharya, Mulami, Aamatya etc.

The Newars are rich in culture and religion and the best examples are the numerous jstras, pujas and social ceremonies they manage to conduct even in today's fast life. Some of the festivals and ceremonies conducted by the festivals and ceremonies conducted by Newar community are Ihi or Bel Bibaha, Mha puja, Bisketjatra, Ghuhupunhi, Gaijatra, Yanyapunhi (Indrajatra), Holipunhi, Machhendra Nathjatra, Swanya punhi etc. Among the Newar community, an interesting ancient tradition, known as 'Ihi or Bel Biha, requires that a young girl often 7 or 8 years old, be married to a certain tree called 'Bel tree' or to its green fruit called 'Bel'. The tree and the fruit symbolizes a deity called 'Hiranya Garbha'. Among the deities, Hiranya Garbha' is one of the immortals. Thus marriage with 'Hiranya Garbha' is considered to be everlasting.

'Nepal bhasa' is classified as among the sino-Tibeton languages but it has greatly derived much of its grammar words and lexicon from the influences of southern indo Aryan language like Sanskrit, Prakrit and Maithali. Newars are bound together by a common language and culture. Their common language is Nepal Bhasa or the linguistic progenitor of that language. Nepal Bhasa script is a group of scripts that developed from the Brahmi script and are based primarily to write Nepal and among the different scripts Ranjana, bhujinmol and prochalit are most common scripts. Newars speak their own language, 'Newari' better known as Nepal Bhasa which belongs to tibeto-Burman family of language. It has its own scripts and has no linguistic connection to Nepali, Hindi or Sanskrit. The Newari script, the 'Ranjanalipi' is exceptional. The Newari literature is also very rich.

Besides their richness on cultural heritage and festivals, the Newars are impeccable artists and architects. The Kathmandu valley with all its temples and

palaces compares no less to Florence in Italy. The Newars, of course, remained pivotal in the arts and architecture found in the valley.

Newari foods are very delicious and famous all over the world. The food items served to the guests during festivals and feasts have own symbolic significance. Newari meals classify three main categories:- Daily meals (ja), Snack (baji) and feasts (bhoje). Sari (hakupatasi), chholo, makashi, Ear-Rings, jhaphu and muga mala are the Newari girl's clothing and dhaura suruwal black design, black cap and patuka are the boy's dress.

Chapter V

DATA ANALYSIS AND INTERPRETATION

This chapter is devoted to analyze and interpret the data from the field of observation and interview. Newar is one caste among other castes of Nepal. They have their own identity, culture, tradition, norms, script and values. They are varied according to the variation of geography in Nepal. Language is different from district to district such deviation makes the effects in a society. Generally the variation of language and objective effects are trying to be shown and analyzed here.

How was development of math's in Newar society? How was it used in ancient Newar society? How was the numeration system? How was the solution of daily mathematical problems? How did they measure the quantity? The above problems and their solutions are addressed by this study.

Though direct questionnaire, interview and observation with many different group were done. It is different from each other's place in their pronunciation. For example, for one parbatali pronounced 'chhau', syangjali 'chhaun' but kaskali people said 'chhi'. Some others differently pronounced letter are shown here.

Table no. 1

Different pronunciation among Newar community

Use in Kaski	Use in Parbat	Use in Syangja	Number
Chhi/ Chha (छि/छ)	Chhau (छऊ)	Chhanu(छंड)	1
Ni (नि)	Ngau(ङऊ)	Ngeu(ङेउ)	2
Swon (स्व)	Shaau(सऊ)	Shou(सोउ)	3
Pyaa (प्या)	Sheu(सेऊ)	peu(पेउ)	4
Nga (ङा)	Ngau(ङऊ)	Ngau (डाउ)	5
Khu (खु)	Khu (खु)	Khuu(खुउ)	6
Nhasa/Nhe (न्हस/न्हे)	Nehu(नेहु)	Nheu(न्हेउ)	7
Chyaa(च्या)	Shehu(सेहु)	Chayaau(च्याऊँ)	8
Gu (गु)	Gu(गु)	Gunu(गुउ)	9
Jhi(झि)	Jhau(झऊ)	Jhinu (झिउ)	10

Though it is different in pronunciation but there is not such distinct in core. This chapter has been divided into three sub sections. First section deals with counting system, second with math's process and third with measurement system of Newar community.

Counting System

Number Concept and Counting System.

Newar people mostly use their native counting system. But the young who are educated they use formal counting system. Their numeration system is based on 10 which is similar but they have their native name up to counting 10. They use 'Zero' but name is like as Nepali language 'sunya'.

Table no. 2

Name of number in Newars

In Newar	In English	In nepali
Sunya (शुन्य)	Zero	Sunya
Chhi(छि)	One	Eka
Ni (नि)	Two	Due
Swon(स्व)	Three	Teen
Pyaa(प्या)	Four	Char
Nga (ङा)	five	Panch
Khu (खु)	Six	Chha
Nhasa (न्हस)	Seven	Saat
Chyaa (च्या)	Eight	Aath
Gu (गु)	Nine	Nau
Jhi (झि)	Ten	Das

To count above 10, these can be found little different. While counting these numbers they count 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 200, 500, 1000 and 100000. But to count other number they follow same as the Hindu Arabic number. The change of time, the numeration system is changing day by day. The effect of Hindu Arabic system is followed to adapt in Newar language. Young and literate

Newar people don't know their counting system more than 10 which is a good example of modernization. Even youth and literate are not conscious to use their own language. Jhinchha, jhinni, jhinswon respectively is used for eleven, twelve and thirteen. It is revealing by various organizations nowadays also.

But several Newar people who donot have border knowledge in language they count the number differently for eleven, one tens and one ones, two tens and two ones for twenty two and so on. In their own system it is used as 'jhinchha' for eleven, jhinni for twelve and so on from table:

Table no. 3

Number	In Newar language	In nepali
11	Jhinchha(भिन्छ)	Eghara
12	Jhinni(भिन्नि)	Barha
13	Jhinswon(भिन्स्व)	Terha
14	Jhinpya(भिन्प्या)	Chaudha
15	jhinyaa(भिन्प्या)	Pandra
16	Jhinkhu(भिन्कु)	Sorha
17	Jhinnahasna(भिन्हस)	Satra
18	Jhinchyaa(भिन्च्या)	Athara
19	Jhingu(भिन्गु)	Unnais
20	Nee(नी)	Bis

Other familiar based numbers are shown in the following table:

Table no. 4

Number	In Newar language	In Nepali
10	Jhi(भि)	Das
20	Nee(नी)	Bis
30	Swee(सुइ)	Tis
40	Pee(पी)	Chalis
50	Nyaya(इये)	pachas
60	Khuee(खू)	sathi
70	Nhayeya(न्हयेय्)	Sattari
80	Chaeyeya(च्येय्)	Asi
90	Guee(गुइ)	Nabbe
100	Sachchhi(सच्छि)	Saya
200	Nisaa (निसः)	Dui saya
500	Ngyesaa	Panchsaya
1000	Dowaachhi (व्दःछि)	Hajar
10000	Jhidaw (भिव्दः)	Das Hajar
50000	Ngyedawaa (इये व्दः)	PachasHajar
10000	Lakha (लख)	Lakh

Though regular 10 base numbers are used normally as shown in above table. Like ‘Pee’ for Forty, Khue for sixty, Sachchhi for hundred. Numeration system and pronunciation are same as their own system but little bit different than in Devnagarik system. for example, in Newar numeration system Five tens and one onces (Nyayachha) for fifty one. In Hindu Arabic numeration directly ‘pachas’ is pronounced for fifty. Although it is not exactly as Arabic system but in core, it is not far from the Hindu Arabic system. The above table is also the description of some regular numeration system in Newar numeral system.

Grouping System

Hindu Arabic number system is a base to grouping system with decimal place value. So it has a positional grouping system which is considered to be a calculating

machine because it makes column arithmetic simple through positional notation and use of zero as place zero.

The number system of Newar is base 10 but they don't use zero on number. A part from the group of ten they use other groups of numbers are 20, 30, 40, 50, 60, 70, 80, 90, 100. But for one lakh they use 'Chhi lakh' like as Hindu Arabic system.

In research researcher found that only the old generation use base 10 on counting, grouping, interpreting any data. But the literate and younger people of Newar didn't use grouping as used by old generation. They used groups of 10, groups of 20, groups of 100 and group of thousand also.

Recording System

In the view of some people, Newar had their written language, it was related to Nepali Bhasa. They used Devnagari on writing. Now a day's most people (literate, illerate, younger, older) use Nepali and English to express their views.

All mathematical work is done by orally. Thus their recording system is same for all, in their community because they don't have any symbol to represent particular number. Smaller amount recording memory. For long period record, they used copy. Those recording system are used on the activities for money borrowing or lending to each other or, selling or purchasing goods. This is a formal system not only for Newar people, but most of other ethnic people.

Basic Operations

An operation, in mathematics is an action that is carried out to accomplish a given task. The arithmetic operations are addition (+), subtraction (-), multiplication (\times), and division (\div). The process of basic operation used by Newar people is oral and their mental processes are discussed below:-

Addition

Mostly Newar do not feel necessary to count more than 10. Some of them counted 20, 30, 40,.... up to 100. After 10 they express any number on the group of tens and remainder. Almost Ninety five percentage of Newar people in the study area are literate. They solve the problem using formal system and use calculator which is the effect of modernization. I asked the question sample of 86 year old illiterate

person, “what is the number at together between four tens and five ones (fourty five) and three tens and eight ones (thirty eight)?

He first expanded both numbers in a group of tens and reminder, the number represented as first as four tens and five one, second three tens and eight. Then he put together groups tens in one side and sets of remainder in another side. Groups of four and three makes 7 tens and five and eight ones. He divided five and eight ones in one tens and 3 ones. So, the total is eight tens and three ones. Then the mathematical expression is:

$$\begin{aligned}
 &45 = 4 \times 10 + 5 \\
 + &38 = 3 \times 10 + 8 \\
 \hline
 &= 7 \times 10 + (5 + 8) \\
 &= 7 \times 10 + 1 \times 10 + 3 \\
 &= (7 + 1) \times 10 + 3 \\
 &= 8 \times 10 + 3 \\
 &= 80 + 3 \\
 &= 83
 \end{aligned}$$

This is researcher’s mathematical representation. It is also a formal system which is used by illiterate person.

Subtraction

Subtraction is felt more difficult than addition by the people. Although people can subtract it take them more time than addition. Almost ninety five percentages people are literate in the study area. The process of subtraction is not different in their community. They use formal system and use calculator to subtract.

In a sample 86 years old man, I asked the question on “suppose you have nine tens and eight ones (98) apples if you give seven tens and four ones (74) of your’s on how many apples are reaming with you?” He said, “As ninety 98 equal to nine tens and eight one and 74 equal to seven tens and four ones. From nine tens subtract 7 tens left two tens and eight ones subtract four ones left four ones. i.e. 24

The researcher mathematical representation is as follows:-

$$\begin{aligned}
 98 &= 9 \times 10 + 8 \\
 -74 &= 7 \times 10 + 4 \\
 \hline
 &= (9-7) \times 10 + (8-4) \\
 &= 2 \times 10 + 4 \\
 &= 20 + 4 \\
 &= 24
 \end{aligned}$$

Multiplication

Multiplication is the short form of addition. It has repeated grouping process. Illiterate people computed the multiplication problem as addition. They put together the same type of groups in one place and counted.

It just took more time compared with addition in the question of “if there are 25/25 cow in four places how many cows would there have in total?” Solved as 25 is equal to two tens and five ones four place, two tens makes eight tens and five ones make two tens. Now the total cow would ten tens. i.e. 100

In mathematically, it can be represented like,

$$\begin{aligned}
 25 \times 4 &= 25 + 25 + 25 + 25 \\
 &= (2 \times 10) + 5 + (2 \times 10) + 5 + (2 \times 10) + 5 + (2 \times 10) + 5 \\
 &= (2+2+2+2) \times 10 + (5+5+5+5) \\
 &= (8 \times 10) + (2 \times 10) \\
 &= (8+2) \times 10 \\
 &= 10 \times 10 \\
 &= 100
 \end{aligned}$$

They solved the problems like 2×2 without feeling any difficulty. It is quite different by solving literate people. They solved it orally as ‘twos 45’ is 90 and others. Thus it indicate that ability skills to solve the problem of multiplication is different according to individual’s mathematical ideas and knowledge. Base 10 multiplicative grouping system is the easy expression for multiplication.

Division System

Basically base 10 is based to divide any numbers. They express dividend number in the form of 10s. If the expression of 10s couldn't be divided in groups of tens. After following this process, they divided the remainders and made result. Young and literate people, for smaller number are calculated mentally. For greater number they used calculator.

While solving the problem 45 equally divided for 5 persons, how will each get? The illiterate 86 years old man said "45 is equal to four tens and five ones, from four tens each gets 8/8 and leave 5. 5 each gets 1/1. Finally each gets 8+1=9. They had never made greater number practices except the money problem. Sometimes they made mistakes while in division. It is quite difficult task.

In mathematically, it can be represented like,

$$\begin{aligned}
 45 \div 5 &= (4 \times 10 + 5) \div 5 \\
 &= (4 \times 10) \div 5 + (5 \div 5) \\
 &= 40 \div 5 + 1 \\
 &= 8 + 1 \\
 &= 9
 \end{aligned}$$

Measurement System

Weight Measurement

In the research area, researcher found that weight measurement system was mainly limited to trading of ghee, milk and meat. But nowadays they are not using traditional measurement system. In Newar measurement weight system is much influenced by modern measurement system. The most important tools used in Newar community for measuring weight were tulo. Sample 86 years old age person has a grocery but he didn't use tulo. The researcher asked about tulo that he said our father and grandfather used but present we use Taraju (balance). Tulo which is made of iron bar has fixed blob of mass on one side. The other side's carry a nanglo (a bamboo plate) tighter by ropes. The suspension could be shifted at different measure marks on the iron bar to balance the weight. It is considered that 'phulis' which is shown by iron bar determines weight. Nowa days most of Newar people are slowly changing their

measurement units and have started to use modern measurement units: like gram, kilogram. To measure the weight of any types of objects and cut meat of pig, goat they use their measurement units Dharni and Bisauli.

General conversion of weight,

1 dharni= 2 bisauli (2.5 kg approx)

1 bisauli= 1.25 kg

Measurement of Length and Distance

New generation use modern system of measurement tools to measure length and distance. But old people use their traditional measurement system to measure the distance and length units are Amla (umal), Bitta and Haat. If they have to measure the very short length of anything they use fingers (Amla). For short measurement of the distance between the tips of the thumb to the tip of middle finger they use bitta. Their measurement units is Haat and it is measure distance between the elbow and the tip of their middle finger. They also use kuret for measure short distance. Length conversions is presented below:-

9 Amla - 1Kuret

10 Amla - 1 Bitta

2 Bitta - 1 haat

At the time of construction, breadth and height are measured in haat more than 95 percent of them know about 'inch' and 'foot'. Younger and literate persons know about centimeter and meter. Thus many people are aware of new units of length measurement in foot and inch.

In case of measuring distance, half of the Newar people in the study didn't know how far it is only literate person knew it. Even they used to indicate distance by comparing the distance up to other known place.

They divided 24 hours of ek din and ek rat. They divide different part of day and night as follows:-

Morning = Sutha

Noon = Tin nhiney

Afternoon	= Nhiney
Evening	= Sanila
Night	= Bahani
Mid night	= Chanhey
Also called,	
Yesterday	= Mhiga
Today	= Thaun
Tomorrow	= Kanhey
Parsi	= Kansa

Area Measurement

Newar people, when they construct buildings/house, they estimate area of land by stretching the rope to the required shape. Ropes of fixed measurement of length and breaths with hand are made which are used to measure required length of the ground. Now days the Newar people use phitta, ruler etc.

Now a days, all Newar people use of measuring area in Bigha, Kattha, Ropani and Dhur are used which is a basic unit of metric system. Area conversions is presented below:-

1 Bigha	- 20Kattha (72,900 sqft)
1 Kattha	- 20Dhur (3,645 sqft)
1 Dhur	- 182.25sqft
1 Ropani	- 16Aana (5,476 sqft)
1 Aana	- 342.25sqft

Volume Measurement

In Newar community measurement is mainly used to measure cereals. 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 Chimti, Muthi, Mana, Muri etc. The measurement of volume is used in daily life.

Now a days many people of Newar community use Liter, Mili liter, Bottle and Glass to measure the volume of liquid materials. The familiar units conversions are presented below:-

2 Dhewa - 1 Mung (panchmuthi)

2 Mungs - 1 mana

8 Manas - 1 Pathi

20 Pathis - 1 Muri

In tradition, Mana is the measurement of volume held on the basis daily use pots. Pathis are measured in Dakar (a bamboo baskets) and Muris are measured in Bhakari. The less amount than 'dhewa' is measured as 'chimti'.

Chapter VI

FINDINGS, CONCLUSIONS AND IMPLICATIONS

After making analysis and interpretation of data in chapter v, this chapter has been devoted to finding, conclusion and recommendation for further study. The first section of this chapter presents the findings of the research, the second section presents the conclusion of the study and the last section presents the implication based on the findings of the study. Major findings, conclusion and implication of the study have been considered in sequence under sub headings.

Findings of the Study

The following result has been depicted after the analysis of collected data.

- The numeration system of Newar is base 10.
- They have only ten number name in their native language. For the greater numbers above ten they have followed as Nepali 'Devnagarik' system
- Except the group of base 10, they used other groupings as 50, 100, 200, 500 and 1000. But individually it is varied also.
- In the Newar groups in Bagar have their own system of counting and measurement system.
- Though the written documents about the numeration based on Newar language is not found easily but somewhere else it is found.
- In case of operation of mathematical process addition and multiplication are easier than subtraction and division.
- For the addition of two numbers or quantities they make groups of 10s and the counting by commutation process.
- While doing subtraction they decompose groups of number like 10.
- Problems of multiplication are done as repetitive addition technique.
- They follow the subtraction method for division process or decompose process is used for division.
- Traditionally length were measured with 'hand' and 'finger'. The unit of length were 'Amla, Bitta and Haat'. But now a days the educated/ modern people use 'fit, inch, meter and kilometer'.

- Volume was calculated according to the production of grains. The units of volume are: chimti, mutthi, mana, pathi and muri. But now a days standard means are adopted.
- Tulo was main traditional material of weighting but nowadays, the educated/modern people use Taraju. General units of the weight measure are ‘Dharni’ and ‘Bisauli’ etc.
- Younger and literate people are becoming aware of formal system of mathematical concept and process. They can solve mathematical problems by direct and short cut method also.

Conclusions

There are various ethnic groups in Nepal which have their own traditional mathematical system. Some ethnic groups with mathematical ideas have still remained undiscovered. The concept of using mathematical knowledge in real application is varied among the castes or different tribes. Among them, in Newar they have also different ways of using mathematical knowledge. The system were locally developed in the past. Even these systems are very simple and not abstract in nature. So they use their own systems of counting and measurement and math’s processes for their normal day to day activities. Thus, these systems seem to be of practical utility in their life.

Raising rapid development of technology has made people learn modern math’s concept and processes. So most of the Newar people left their counting, measurement and mathematical operations. Most of Newar people are educated. It is better to introduce ethno mathematics of Newar in school levels curriculum. There are many ways to link with formal mathematics education. Thus, the government, curriculum planners, book authors and teachers should be aware and give emphasis on Newar community’s mathematics which is unknowingly practiced in daily activities. Even though this study conducted taking short period of time, small number of respondents and limited area. Therefore the findings of this study may not cover all aspects of mathematics of Newar community like geometrical concepts. It can contribute towards local school math’s curriculum of Newar.

Implications of the Study

This study is done within a short period of time, small number of respondents and limited area. Since this study is limited in several aspects, the findings of this may have covered in limited area. So considering this limitation and on the basis of the present study, the following implications have been made:-

- To add a new dimension in the field of ethno- Mathematics.
- To explore the many culturally diverse ways in which Mathematics education can be made more meaningful for and inclusive of the lives of students world wide.
- School may be applied practical knowledge in socio – cultural activities which can promote their previous experience.
- It is helpful for teachers, students, researchers, educationist, policy makers and curriculum designers.
- It supports for understand ethno Mathematics of different ethnic groups.

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APPENDIX 1
Number counting in Newar language

English	Nepali	Newar
One	Ek	Chhi
Two	Dui	Ni
Three	Teen	Swon
Four	Char	Pya
Five	Panch	Nga
Six	Chha	Khu
Seven	Saat	Nhasa
Eight	Aath	Chyaa
Nine	Nau	Gu
Ten	Das	Jhi
Eleven	Eghara	Jhinchha
Twelve	Barha	Jhinni
Thirteen	Terha	Jhinswon
Fourteen	Chaudha	Jhinpya
Fifteen	Pandra	jhinNha
Sixteen	Sorha	Jhinkhu
Seventeen	Satra	Jhinnahasna
Eighteen	Athara	Jhinchyaa
Nineteen	Unnais	Jhingu
Twenty	Bis	Nee
Twenty one	Ekais	Neechhi
Twenty two	Bais	Neeni
Twenty three	Teis	Neeswon
Twenty four	Chaubis	Neepya
Twenty five	Pachis	Neenga
Twenty six	Chhabis	Neekhu
Twenty seven	Sattais	Neenhe
Twenty eight	Athtis	Neechyaa

Twenty nine	Unantis	Neegu
Thirty	Tis	Swee
Thirty one	Ektis	Sweechha
Thirty two	Battis	Sweeni
Thirty three	Tettis	Sweeswon
Thirty four	Chauntis	Sweepya
Thirty five	Paintis	Sweenya
Thirty six	Chhais	Sweekhu
Thirty seven	Saintis	Sweenhe
Thirty eight	Athtis	Sweechyaa
Thirty nine	Unchalis	Sweegu
Forty	Chalis	Pee
Forty one	Ekchalis	Peechha
Forty two	Bayalis	Peeni
Forty three	Tirchalis	Peeswon
Forty four	Chauwalis	Peepya
Forty five	paintalis	Peenyaa
Forty six	Chhayalis	Peekhu
Forty seven	Satcalis	Peenhe
Forty eight	Athcalis	Peechyaa
Forty nine	unachas	Peegu
Fifty	pachas	Ngheye
Fifty one	Ekanunna	Ngheychha
Fifty two	Baunna	Ngheyeni
Fifty three	Tripanna	Ngheyeswon
Fifty four	Chauvanna	Ngheyepya
Fifty five	Pachpanna	Ngheyenyaa
Fifty six	Chhapanna	Ngheyekhu
Fifty seven	Santaunna	Ngheyehasa
Fifty eight	Anthaunna	Ngheychyaa
Fifty nine	Unsathi	Ngheyegu
Sixty	Sathi	Khuee

Sixty one	Eksatthi	Khueechha
Sixty two	Baisatthi	Khueeni
Sixty three	Trisatthi	Khueeswon
Sixty four	Chausatthi	Khueepya
Sixty five	Painsatthi	Khueenyaa
Sixty six	Chhaisatthi	Khueekhu
Sixty seven	Satsatthi	Khueenhe
Sixty eight	Athsatthi	Khueechyaa
Sixty nine	Unasattari	Khueegu
Seventy	Sattari	Nhayeya
Seventy one	Ekhattar	Nhayeyachha
Seventy two	Bahattar	Nhayeyani
Seventy three	Trihattar	Nhayeyaswon
Seventy four	Chauhattar	Nhayeyapya
Seventy five	Pachattar	Nhayeyanyaa
Seventy six	Chhahattar	Nhayeyakhu
Seventy seven	Sathattar	Nhayeyanghasa
Seventy eight	Athhattar	Nhayeyachyaa
Seventy nine	Unasi	Nhayeyagu
Eighty	Asi	Chaeyeya
Eighty one	Eksi	Chaeyeyachha
Eighty two	Bayasi	Chaeyeyani
Eighty three	Tirasi	Chaeyeyaswon
Eighty four	Chaurasi	Chaeyeyapya
Eighty five	Pachasi	Chaeyeyanyaa
Eighty six	Chhayasi	Chaeyeyakhu
Eighty seven	Satasi	Chaeyeyanhasa
Eighty eight	Athasi	Chaeyeyachyaa
Eighty nine	Unannabbe	Chaeyeyagu
Ninety	Nabbe	Gwee
Ninety one	Ekanabbe	Gweechha
Ninety two	Bayanabbe	Gweeni

Ninety three	Triyanabbe	Gweeswon
Ninety four	Chauranabbe	Gweepya
Ninety five	Panchanabbe	Gweenyaa
Ninety six	Chhayanabbe	Gweekhu
Ninety seven	Santanabbe	Gweenhe
Ninety eight	Anthanabbe	Gweechyaa
Ninety nine	Unansaya	Gweegu
Hundred	Saya	Sachchhi

APPENDIX 2

QUESTIONNAIRE

- How many members are there in your family?
- How many numbers can you count in your language?
- Can you say the numbers like as ten thousand, fifty thousand and one lakh in your own language?
- How do you count money?
- How do you measure daily time in your community?
- How can you add two digits numbers like $45+38$?
- How can you add three digits numbers like $112+214$?
- What is remaining amount if you give Rs 74 from RS 98?
- You have 114 apples, If you give 104 apples to your son how many apples remains with you?
- If 25/25 goats are kept in eight places, how many goats would have their in total?
- If you spend Rs 81 for 9 pencils? How much costs for each pencil?
- What is the way to calculate mathematical operations by literate?
- How is the length and breadth fixed while constructing buildings/houses?
- What measure is used to estimate short length?
- How do you express long distance between two places?
- How can you measure the volume of liquid materials?
- How much land do you have? How do you measure it's production?
- How can you weight cereals?
- Do you know any other method of measurement used by literate?