

**BASIC MATHEMATICAL CONCEPTS PRACTICED IN NACHHIRING RAI
COMMUNITY**

**A
THESIS
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Chapter-I

INTRODUCTION

Background of the Study

The term 'mathematic' is etymologically derived from an ancient Greek word "mathancin", which means "to learn". Mathematics and life are related to each other like a relation between nail and muscle in a human body. It seems that mathematics is originated with the origin of human civilization. Mathematics is the backbone of civilization. Mathematics is the mirror of civilization and it is directly associated with human life (Thapa, 2011, p.1).

Mathematics subject has significant impacts on people's daily life activities. Every people use mathematics to solve the problems in their daily activities. The development of mathematics was simultaneous with the social development of human civilization. "Mathematics is used throughout the whole world as an essential tool in many fields, including natural science, engineering, medicine and the social science"(Bell, 2008).

The concept of numbers and the process of counting developed so long before the time of recorded history. Counts could also be maintained by making collection of pebbles or pieces of stones, by cutting notches in pieces of wood and by tying knots in a string. Then the word "tally" was used against the number of objects in a small graph. Early mathematics can be said to have originated in certain areas of the ancient orient primarily as a practical science to assist in agricultural and engineering pursuits (Eves, 1983).

From the above views of different writers, we can say that mathematics is created from different cultures. Every people use mathematics knowingly or unknowingly in their daily lives.

Development of mathematical concepts is a major achievement of human civilization, astrology, structural design, voyages etc. across unknown land and oceans. The measurement system of economic planning and transition, which need the use of, developed mathematical concepts and reasoning. Developments in this field had started in early periods of history in China, India and the Mediterranean.

Mathematics may be considered a special kind of language developed to convey quality, shape, position etc. and their interrelationship and its use is determined by rules of logic-the logic that emanates from the law of nature (CERRID, 1990).

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

When researchers investigate knowledge possessed by members of distinct cultural groups, they may be able to find unique mathematical ideas, characteristics, procedures, and practices that we consider ethno-mathematics, which is used to express the relationship between culture and mathematics. In this regard, the term 'ethno' describes characteristics related to the cultural identity of a group such as language, codes, values, jargon, beliefs, food and dress, habits, and physical traits while the term 'mathematics' express a broad view of mathematics, which includes

ciphering, arithmetic, classifying, ordering, inferring, and modeling (D'Ambrsio, 2001).

According to Lama (2016) human beings can't be separated by mathematics because it helps the individual to understand and interpret quantitative and qualitative aspects of concept. It has been developed for fulfilling the daily life problems of men like counting, calculating and remembering. It is believed that the mathematics and the development of human civilization goes together. Mathematics was introduced later in the formal education system; it has been developed simultaneously with the development of society. Mathematics is not only the theories and problems of formal education system, but also it has been practicing in the contemporary society with their own ideas and belief systems.

In Nepal, there are several ethnic groups with their own typical traditions and practices. The different ethnic groups have their own basic mathematical concepts. The Rai people of Nepal are also one of the ethnic groups in which they use their own basic mathematical knowledge, concept and processes in their daily life activities knowingly or unknowingly. Therefore, as a member of Nachhiring Rai community, I have seen ethno-mathematical knowledge's used in our social activities such as estimating time, games, musical instruments, domestic materials and activities and geometrical figure in cultural dress and ornaments. We have own our language, symbol and concepts in mathematics. So that, I am highly interested to identify the basic mathematical concept practiced by Nachhiring Rai community.

Introduction to the Nachhiring Rai Community

The word 'Rai' is used to signify single ethnic group in literature by the government and administration are in everyday speech according to local and tradition originally there are 10 Kiranti [Rai] groups. (Brook morris, 1928, p. 238)

Nachhiring Rai people are kiranti/Khambu tribe the Rai people have been classified as a separate subgroup. On the basis of language Nachhiring Rai is one of them (Giri, 2010, p.18). The Nachhiring Rai people are one of the major hilly communities of eastern part of Nepal. Although, they are widely distributed in the middle and western zones of Nepal, the dense settlement of Nachhiring Rai is found in Khotang.

According to National Population and Housing Census 2011, there are 620,004 ethnic Rai's in Nepal which is 2.3% of the total population. Within this number, 70.89 % declared themselves as practicing the traditional Kirati religion and 25% declared themselves as Hindu and rest of the Rai people declared themselves as a Christian. The Rai people are divided into different sub-groups, including the Nachhiring, Hangkhim, Bantawa, Sotang, Chamling, Sampang, Yayokhya, Dumi, Jerung, Kulung, Khaling, Dilpali, Shamsuhaang, Lohorung, Mewahang, Rekhali, Thulung, Tamla, Tilung, Wahaling, Wambule, Parali, Yamphu, Jero, Puma, Syangbo, Sunuwar, Dewas, etc. Out of them, this study is mainly concerned with the basic mathematical concept practiced by Nachhiring Rai community.

Statement of the Problem

Nepal is a multi-lingual, multicultural, multi-religious country with 2.6 billion populations of 125 ethnic groups and their 123 mother languages (National population Census, 2011). Beside these people have different social, economical, cultural and religious background with their own language rule and regulation.

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

has its own way of measuring, calculating and doing basic mathematical processes. Hence, the cultural diversity and the equity of learning opportunity have been considered as one of the problems in mathematics (Thapa, 2011).

This study is concerned with the study of mathematical knowledge and concepts used by Nachhiring Rai people in Khotang district. People use mathematical ideas and knowledge in their daily activities and individual practices in their cultural and social environment through experience and interaction with social elements.

Every culture has its own measuring, calculating and doing basic mathematical processes. Nachhiring Rai people in Khotang are one of the disadvantaged groups. Their cultural activities are different from other cultures. So, it is important to know that mathematical concepts, process and endeavor of this ethnic group of Nepal. No studies have been conducted dealing with ethno mathematics of Nachhiring Rai community of Khotang district. Therefore, I intended to study the basic mathematical concepts and process used by Nachhiring Rai community.

This study is not done for the solution of any kind of serious problem but its main purpose is to find the ethno mathematical concepts and ideas and knowledge of Nachhiring Rai people in their culture.

Therefore this study has intended to answer the following research questions:

-) What are the ethno-mathematical practices in Nachhiring Rai community?
-) What is the traditional counting system in Nachhiring Rai community?
-) How do Nachhiring Rai people perform the four fundamental operation in their real life?
-) How do Nachhiring Rai people use their measurement system?

Objective of the study

The main objectives of this study is to investigate the basic mathematical concept locally practiced by Nachhiring Rai people. To meet this objective the following specific objectives are prepared.

-) To find the measurement system practiced by Nachhiring Rai community.
-) To find the counting system adopted and practiced by Nachhiring Rai community.
-) To identify the ways of the four basic mathematical operations practiced by Nachhiring Rai.

Significance of the Study

This study reflects the indigenous mathematical knowledge and skills. This study would help the mathematics teacher, researcher, educators, students, and their parents who are interested to understand the artifact of culture of Nachhhiring Rai. This study focused on what are the basic mathematical concepts practiced by Nachhiring Rai community and how they connect their understanding to formal education system. In this regards, the significance of this study is listed below.

-) This study explore the ethno-mathematical practices in Nachhiring Rai community, which is valuable for further researchers to explain the knowledge of the mathematics of Nachhiring Rai community.
-) This study would be helpful to know the nature of counting system and algorithm of four basic mathematical operations practiced by Nachhiring Rai.
-) It would be helpful for the teacher to link or connect the day-to-day classroom practices with a mathematics of Nachhiring Rai community which increases the student is understanding.

-) It would contribute in ethno-mathematics by helping to promote mathematical knowledge and skill of the Nachhiring Rai community.
-) It helps to show the different types of local practices used by Nachhiring Rai community in their daily life activities through mathematics.
-) This study helps to make the content of mathematics in primary level, if primary education is given in their own mother tongue.
-) This result of this study would be helpful for policy maker, curriculum designer to consider Ethno-mathematics mother tongue curriculum.

Delimitation of the Study

This study is a case study of Nachhiring Rai community. This study deals with basic mathematical concept practiced by Nachhiring Rai. Any study cannot overcome the problems of all the fields. Each of them have some limitations. Hence this study have the following limitations.

-) This study is based on ethno-mathematical concepts in Nachhiring Rai Community of khotang district.
-) Only Aiselukharka Gaupalika -1 wadasku of khotang district is taken as the field of this study.
-) Only ten selected respondents with their mathematical practices reflected in this study.
-) This study is related to find the concepts of ethno-mathematics practiced by Nachhiring Rai community in their cultural artifacts only.

Definitional of Key Term

Some terms related to this study are defined and explained with contextual understanding as follows.

Mathematical Concept.In my study, mathematical concept refers to the day to practice adopted by Nachhiring Rai people in counting, calculating, measuring and the four fundamental operations.

Ethnic Group.In this study ethnic group means a type of group contained within the national boundaries defined by race, religion or national origin.

Community. Community is everybody, adults and children, social and non social persons, living in a certain territory where all share a mode of life, but not all are conscious of its organization or purpose.

Nachhiring Rai. The Nachhiring Rai are indigenous ethno linguistic group of Nepal. They have their own distinct languages and cultures.

Practices.The functions adopted by Nachhiring Rai in counting, measuring and fundamental operations.

Chapter-II

REVIEW OF RELATED LITERATURE

In this chapter I reviewed the related studies to construct the platform for standing to the research of the subject which gives the theoretical support for the study. There are two types of literature review i.e. Empirical and Theoretical. There are some researches related to mathematics, but no studies have been done on basic mathematical concept practiced by Nachhiring Rai Community. I reviewed some literatures similar to my study.

Empirical Literature

CERID (1990) studied on "Elementary process of learning mathematical concepts and process of Rasuwa, Tamang. The purpose of that study was to identify the basic mathematical concepts used by Tamang adult with no formal mathematics education, to identify traditional Tamang method of mathematical operation and to find out the implication of Tamang process and tone up to the present learning situation. The project work has also shown that the Tamangs have their own system of measuring counting and their own mathematical processes and geometrical concepts. The study has also shown that the situation of children into the formal system. But it did not study the effect of ethnic mathematics practices in the classroom settings.

Wynn (1992) did study on "Children's acquisition of the number words and the counting system." The research based on how and when children come to understand the way in which counting determines numerosity and learn the meaning of the number words. Seven month longitudinal study of 2 and 3 year olds shows that, very early on, children already know that the counting words each refer to a distinct, unique numerosity, though they do not yet know to which numerosity each word refers. It is possible that children learnt this in part from the syntax of the number

words. Despite this early knowledge, however, it takes children a long time to learn how the counting system represents numerosity.

Similarly, Karki (2008) conducted a research on "Basic mathematical concepts practiced by Hayu community." The main objectives of this study to explore the counting system of Hayu community and to find out the rules of the four basic fundamental mathematical operations, measurement system used in Hayu community. He had used qualitative research design with ethnography approach. He had selected 10 people from Dadi VDC with purposive sampling. He used observation, in-depth interview, photograph, for data collection. He found that Hayu people have not their own script but they have their own language and names for numbers one to one hundred. Hayu people solve their problems of addition and subtraction based on 20 and they used fingers unit like kuret, bitta and hat. They used kosh to measure long distance.

Chaudhary (2014) studies on "Concept of mathematics among Dangaura Tharu" the objective of study was to identify the acquired mathematical concepts, counting system and measurement system of Dangaura Tharu and to find out the geometrical knowledge practiced by Dangaura Tharu people in their traditional equipment. It is the qualitative research design. He used ethnography methodology to collect the data and to analyze the collected data the researcher used Vygotsky's social constructivist theory and Piaget's cognitive constructivist theory. It was found that Dangaura Tharu community has been using many mathematical concepts in their daily activities without taking any formal mathematical education, although they considered as backward cast, they had the concept of count, addition, subtraction and some geometrical concept such as a circle, cylinder, cone, parallel line, plane, similarity, congruent, etc. They learnt this concept without taking any formal

education but from their culture and society. They learnt through their adult, their daily working experience and social interaction.

Acharya (2015) studied on the topic "Indigenous geometrical knowledge of Tamang community from their cultural practices." The purposes of this study was to explore ethno mathematical practices of geometry in the Tamang people and linking these practices in the primary level of our formal education. He used qualitative inquiry with purposive sampling method. Sample size for the study was not fix. So, for the study the researcher discussed with many other people such as Tamang leaders, professional people, teachers, farmers, senior and adults. An observation and interview schedule were the main tools for his study. He concluded that sketch or design of cultural dress, blouse as curve lines, cultural foods timsuraalum as triangle, a surface of Jantar as quadrangular and Mathi, cheptehar base of kulagi, damphu and two-sided drum of bonbos and lamas as circle. From the musical instrument damphu, we can encourage students to draw circles. From the nanglo we can teach the students quadrants, parallel lines, perpendiculars lines and circular shapes.

Similarly, Lama (2016) did a research on "Geometrical knowledge practiced in Tamang community." The main purpose of this study was to explore the ethno-mathematical practices of geometry in Tamang community. He had used qualitative research design with ethnography approach. He selected 18 Tamang people from Lurpung village. He has found that the geographical knowledge is strongly embedded in socio-cultural activities of the Tamang community and Tamang people measured length and breadth by using their hands and fingers like as: Ammal, Kuret, Bitta, Pit, Haat which are the measuring units of length and breadth and the kosh is the measuring right units of distance.

Moreover, about the ethno-mathematical practices adopted by Sherpa community, Sherpa (2018) studied on the topic "mathematical concept and socio-cultural practices in Sherpa community base 10 and base 20 numeration system have been practiced in Sherpa community for counting process. Sherpa people don't have their own script. However, they have been following the Tibetan script. They measured length and breaths by using hands and fingers. Tha, thure are the measuring units of length and breath. Moreover, the kosh is the measuring right units and distance. The units of volume measurement are Chimti, muthi, chauthi, mana, kuruwa, pathi and muri. The units of weight measurement are chhatak, pau, Bisauli, Bhami, Aathpol, kg etc. He used qualitative ethnographic research design. He used interview and observation for data collection methods. His research was based on Sherpa community at beni V.D.C. with ten case sample.

From the above discussions of the related literature, a lot of studies have been carried out around the world in this field and many ethno-mathematical practices have been conducting in various places. The researcher found that no researches have been done on basic mathematical concept practiced by Nachhiring Rai community in Khotang district. The review of above literatures motivated the researcher to study the basic mathematical concept practiced by Nachhiring Rai. Therefore the ethno-mathematical study in different ethnic groups and review of literature will help for theoretical framework construction.

Theoretical Review

There are various learning theories related to this study such as Behaviorists, Cognitivists, Constructivists, ethno-mathematics and ethnography. In this chapter, I have reviewed some theories related to my study. There are various theories about

learning mathematics, ethno –mathematics, constructivism and ethnography with reviews, which are presented below.

Constructivism

Generally, "construction is the reality of something from ideas, opinion and knowledge (Oxford dictionary). Historically, constructivism was started and theorized by Jean Jack Rousseau, John Dewey and Jean Piaget with the names of developmentalist exponents with the meaning similar to construction. Constructivism means kinds of consideration about themes and built up strong mental plan, so people have their own construction of mathematical objects in a mathematical community. Jean Jack Rousseau, John Dewey and Jean Piaget are related to the philosophy of naturalism, progressivism and cognitivism respectively. Constructivist Glaser field stated, " Knowledge is the result of an individual subjective's constructive activity, not a commodity that somehow resides outside the knower and can be covered or instilled by diligent perception or linguistic communication".

People have their own beliefs and experiences. They construct new ideas from what they see, listen and perceive. They do not always use the teaching method but use their own strategies to solve their problem on their own surroundings. Some mathematical concepts are acquired by him/her before she/he sets foot in school.

Constructivism is a movement that extends beyond the belief of the cognitive. It considers the engagement of learners in meaningful experiences as the essence of learning. Constructivist emphasizes that learners create their own interpretation of the world of information. The constructivists argue that students situate the learning's experience with their own experiences and that the goal of instruction is not to teach information but to create situations, so that students can interpret information for their own understanding. The role of instruction is not to dispense facts but to provide

students with ways to assemble knowledge. The constructivist believes that learning occurs most effectively when students are engaged in authentic tasks that relate to meaningful contexts. The ultimate measure of learning is, therefore, based on the ability of the students to facilitate thinking in real life. (Upadhyay, 2007, p.89).

In constructivism there is no any knowledge that exists of the person, there is no objective reality. Knowledge must be actively constructed by learners as they are already "knowing beings" who bring previous knowledge and experience to any learning events (Acharya, 2015).

Knowledge is actively constructed by learners, learners reflect on their physical and mental actions with learner come to integrate new knowledge into their existing mathematical schema and learners come to construct a more robust understanding of mathematical concepts and processes through the process of negotiation, explanation, and justification (Vygotsky, L. S. (1978).

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

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

Vygotskian Theory (Social constructivism). L.S Vygotsky was famous scholar who emphasized on the social constructivism, the researcher has been used Vygotsky's theory for this study that every knowledge is socially constructed and children learn when they get contact with outer environment either verbally or observantly Vygotsky's theory is one of them that regards social interaction between peers and adults as important aspect in creating meaning making sense and conveying culture within the shared context (Majhi, 2012).

This shows that social construction belief on the multiple constructions of the world. To understand and apply models of instruction that are rooted in the perspectives of social constructivists, it is important to know the premises that under them. In this regards,

Kim, B. (2001) argued that:

"Historical developments inherited by the learner as a member of a particular culture. Symbol systems, such as language, logic, and mathematical systems, are learned throughout the learner's life. These symbol systems dictate how and what is learned. The nature of the learner's social interaction with knowledgeable members of the society is important. Without social interaction with more knowledgeable others, it is impossible to acquire the social meaning of important symbol systems and learn how to use them. Young children develop their thinking abilities by interacting with adults"

Vygotsky's general genetic law of cultural development states: Any function in the child's cultural development appears twice of no two planes. First, it appears on a social plane, and then on the psychological plane. First it appears between people as an inter-psychological category, and then within the child as an inter-psychological category Social relations of relations among people genetically underline all higher

functions and their relationships. The natural, lower, biologically based, psychological functions are transformed into higher mental processes as a result of intrapsychic functions undergoing interiorization wherein they are wedded to the lower functions and transform them into the higher intrapsychic functions. In other words, the higher psychological functions were first external, social, involving interpersonal relations before becoming internal psychological processes (Vygotsky, 1989).

“Sociogenesis”, Vygotsky affirmed, “is the key to higher behavior”. All that is internal in the higher functions was of necessity external at some point; it was social, a relation that was between two people, before it became an individual function. This idea achieved its fullest expression in Vygotsky’s general genetic law of cultural development. Vygotsky expressed the law as follows: All higher mental functions make their appearance in the course of child development twice: first, in collective activity, social activity, i.e. as interpsychic functions, second in individual activity, as internal properties of the child’s thinking, i.e. as intrapsychic functions (Vygotsky, L. S., 1934).

For Vygotsky, the knowledge of children is expressed in children's egocentric language as cognitive and which is internalized by the growing of the age, the language is originally and primarily social. About the child thinking process, Vygotsky feel that synchronically about unfamiliar situation or objects. Vygotsky emphasizes on interaction.

From the above discussed theory, it is concluded that constructivism emphasizes the important of the knowledge, belief and skills of an individual bring to the experiences of learning. People construct new ideas from what they see, listen and perceive. They do not always use the taught method but use their own strategies and experience to solve their problem on their own surrounding. Some mathematical

concepts are acquired by his/her before she/he sets foot in school. Similarly, Vygotsky is constructivism theory emphasizes on society. This theory is based on social phenomenon. People take the knowledge from their social practices and they internalize the skills. The main concern of the Vygotskian social constructivism theory is knowledge, human practice, society and culture.

From the above discussion theories would guide me on what and how Nachhiring Rai people do and think about mathematical construction in their daily works. People have their own beliefs and experiences. They construct new ideas from what they see, listen and perceive. History of mathematics argues that the mathematical practice began from the society and social activities. So, I think these two theories constructivism and Vygotsky's social constructivism will help me to analyze the Nachhiring Rai's traditional and local mathematical thinking and their mathematical behavior in their society and day to day works.

Conceptual Framework of the Study

Conceptual framework described through the literature studies facilitated to attain research objectives, get the answer of the research questions and carry out the research work as a whole smoothly (Acharya, 2015). This theoretical framework was already used for qualitative research such as "A study on ethno-mathematical concepts practiced by Tharu community in morang district" for this research I have used same conceptual framework.

Conceptual Framework for the Study

Source: Karki (2017)

This framework is mainly based on constructivism theory and social constructivism theory as well as ethnography study as research methodology. Based on this framework, I collected data by the help of in depth interview and participant observation. At the same time, I took photos, audios and video records. Then I analyzed and interpreted the collected data. Mathematical knowledge practices in the Nachhiring Rai community would help to implement mother tongue-based education in school level by making aware the community. The following is the framework for this research.

In the above figure Nachhiring Rai Mathematical knowledge practices is the main issue in this study. This framework is linking between school mathematical knowledge and basic mathematical knowledge practices in Nachhiring Rai community.

Chapter-III

METHODS AND PROCEDURES

Methodology is a very significant part of research. This chapter deals with research design, methods procedures, study site, sample of the study, tools of data collection, data collection procedure, data analysis and interpretation.

Design of the Study

Qualitative research design is a research method used extensively by scientists and researchers studying human behavior, opinions, themes and motivations. My research design belongs to ethnography because it helps me for systematic and scientific study of socio-culture of the Nachhiring Rai community. Therefore, ethnography research methodology is applied to do my research. This study is conducted on the basis of field work, observation and interview.

"Qualitative research is multi method in focus, involving an interpretative, naturalistic approach to its subject matter" (Creswell, 2004). This means, it helps me to reach natural and socio-cultural activities of the Nachhiring Rai community, where it is concerned with people's belief, lives experience, context of particular time.

Ethnography is a research method central to knowing the world from the standpoint of its social relations. It is a qualitative research method predicated on the diversity of culture at home (wherever that may be) and abroad. Ethnography involves hands-on, on-the-scene learning and it is relevant wherever people are relevant.

Study Site

Rai people are mainly found in eastern districts of Nepal like; Khotang, Bhojpur, Solukhumbu, Sankhuwasabha, etc. Among them, Khotang district is also known as the local residence of Nachhiring Rai people. Thus, I am also quite familiar

with the local culture and tradition of Nachhiring Rai community as a member of that community.

The population of the study is taken from the Aiselukharka Gaupalika -1 wadasku of Khotang district. This research is qualitative research. I have used purposive sampling for my study. I have chosen ten Nachhiring Rai people who were very familiar and well known about Rai culture from the same village. This study was based on qualitative research. So the sample size of this study was ten Nachhiring Rai people with purposeful samples and then respondents were also chosen by the purpose sampling.

Tools for Data Collection

Tools are very important to collect needed information's for the research. In this research, I have adopted interview, observation and photographs as different tools to answer the research questions, which are described below.

Observation guideline

I have used participant observations to get the in-depth information from the research field. First, I met the people who were familiar with that study area. I observed their life style, work, conversation, houses, land, measuring system and the other mathematical activities. These activities helped me to identify the mathematical concepts of Nachhiring Rai people. Therefore, I have used the participant observation tool.

Interview guideline

Interview is a two way interaction between interviewer and interviewee in which interviewer creates situations that can attract the attention of respondents for a enough period of time in asking questions and answering the questions which interviewee puts his/her understanding and meaning (Karki, 2017).

Interview is the process of data collection from face to face mode with interaction. I have used interview as an important tool to collect the data in this study. I prepared open ended interview guideline question on the basis of daily life activities of Nachhiring Rai people. I met the Nachhiring Rai people individually, then I informed them about the objectives of taking interview and made good relationship with them. Then I interviewed with selected respondents on the basis of interview guidelines. The interview was conducted on a pleasant conversation.

Photographs

Photographs is another important tool for data collection. I have taken some photographs which represent of their activities done in real life situation to add the validation of this study.

Reliability and Validity

Reliability and validity are important aspects of selecting a survey instrument. Reliability refers to the extent that the instrument yields the same results over multiple trials. Validity refers to the extent that the instrument measures what it was designed to measure. In research, there are three ways to approach validity and they include content validity, construct validity, and criterion-related validity. I compared with our formal education curriculum and standard unit of mathematics for the validity and reliability.

Data Collection Procedure

First, I went in my village Aiselukharka Gaupalika-1 with tools (interview guidelines, observation guidelines, etc.) and created close rapport building and discussed with Nachhiring Rai Farmers, Senior, house maker carpenters and educators. I also visited their houses, occupation places for details information. Specially, the data was collected in naturalistic situation by participant observation

and in depth interview so, that made me easy because that was my own village. I discussed with the Nachhiring Rai farmers, Nachhiring Rai leaders, Nachhiring Rai senior adults, and Nachhiring Rai senior educated person. There were five respondents in my village. I directly told my purpose of research to them because that was my own village. First, I took interview with farmer. After that I took interview with senior educator and housewife. Similarly, I visited four villages for the of khotang district. Sometimes I did work with them in the field and that time I asked them how to make these objects then they told me the construction process, and I recorded their voices what they told. At that time, I took photos and videos. In course of visiting the villages at and first I introduced myself and I did not tell my purposes but I told to them its my interest to find the mathematical knowledge of Nachhiring Rai community. I visited their work fields, houses, farms, schools, worshipping and celebrating festivals for the information's. At that time, I took photos with voice records and field note. I collected information as needed from respondents with the help of observations and interview.

Data Analysis and Interpretation Procedures

The raw collected data information at first was categorized according to the measurement system, counting system and data for mathematical operation: addition, subtraction, multiplication, and division. Then, different themes were given in the text of the observation and interview guideline note. These themes were considered as a code. The similar code version of the respondents was collected together and explained in their perspectives. The validity and reliability of the result was maintained by cross matching and triangulation of the data.

Chapter IV

ANALYSIS AND INTERPRETATION OF DATA

This chapter deals with the analysis and interpretation of collected information of my research study. The objectives of this study are to find the measurement system practiced by Nachhiring Rai community, to find the counting system adopted and practiced by Nachhiring Rai community, to explore the way of using four fundamental operation of mathematics practiced by Nachhiring Rai Culture and to suggest the pedagogical implications of mathematical practices in Nachhiring Rai culture. There are 10 respondents. I have used observation guideline and in-depth interview along with photos, videos, audios records for instrument related to my topic "Basic mathematical concepts practiced by Nachhiring Rai community" and its pedagogical implication.

I spent one month in my research field. In those days, I regularly observed the activities of the Rai people [senior Rai people, farmer, house wife, artifact carpenters] in the study site. I discussed with senior Rai people, farmer, housewife, artifact and carpenters to collect the data. I talked with Nachhiring Rai ancestor Mr. Pratapi Nachhiring Rai and Mr. Shree Kumar Nachhiring Rai. First of all I told about my propose then talked about on the basis of collected information. This chapter has been divide into three parts such as measurement systems, fundamental operation system and different geometrical shapes in use etc.

Measurement System Practiced by Nachhiring Rai

Through the observation and in depth interview, I found the following measurement systems adopted by Nachhing Rai in their daily life activities.

Measurement of Length. About the measurement system adopted by Rai people in the questions Regarding measurement of length, I asked the respondents

about the measurement system adapted by Nachhiring Rai people and the respondents said that: *"Generally we use traditional measurement systems like haat, bitta, kuret, amal, kachhi, to make Gundri, Juwa, Halo, Doko, Dalo, Ghum, Pira, Khat, Dade and other household items for daily activities"*. Here, I have collected some photograph, which are used in traditional measurement as follows:

4Aamal

1Kuret

1Bitta

1Kachhi

1Haat

Figure No. 1. Measurement of Length

The Nachhiring Rai people use Amal, Kuret, Bitta, Kachhi and Haat to measure the length in their daily life activities. If they have to measure the very short length of anything, they use number of Amal. Amal means hand, fingers, one Amal is equal to one finger. Amal is the very small unit of measurement. Kuret is distance between tip to the thumb to tip of the pointer finger. Moreover, Bitta is between the

tip of the thumb to the tip of middle finger. Kachhi is distance between elbow to tip of the small finger. Other measurement unit is Haat which, is distance between elbow to the middle finger. If they add four Amal in one haat, then that is called pakki which is largest unit instrument of measurement. These all measurement units; Amal, Kuret, Bitta, Kachhi & Haat are used to measure the length, breadth and height of the houses, length of Juwa, Halo, Land making Gundri, Pira, Bhakari, etc. and in many works which they face in everyday work related with measurement. The measure systems are valid with the standard units where 1 haat = 1.5 fit.

Measurement of Distance. In the measurement of distance, the Nachhiring Rai people use the following traditional systems in their everyday activities.

I. Time Concepts and Time Duration

They express the concept of distance in terms of time duration. For example they use years, months, days for long distance and they used minutes, hours for short distance. The respondents told me on my questions. That how long time does it take to reach Rakha's school from here? Then the respondents answered to me,

"It takes half a morning from here". It means Dinko aadha is equal to 12 hours, Aadha dinko aadha is equal to 6 hours, and again aadha is equal to three hours. Nowadays, younger and educated Nachhiring Rai people are familiar with the standard measurement units of time like; second, minute and hours. So I asked same question to 17 year old respondent and he replied me that, *"it takes three hours from here to reach Rakha's school"*.

From the above information, the oldest Nachhiring Rai people used their traditional methods, but younger Nachhiring Rai people use standard units while measuring. So, I found that the oldest Nachhiring people's traditional methods are similar with standard units used by young and educated Nachhiring Rai people to

measure the distance. The traditional method of measuring distance on the basis of days is also a scientific and realistic at that time. So, they could guess accurately the distance on the basis of time distance.

A 'Bas' is the distance in which, a people can walk in a whole day by carrying a load. The respondent answered me on the question ' how long time does it take to reach your district's head quarter?' Then they replied *"It takes one day to reach district's headquarter from here"*

One 'Bas' means the half of the early in the morning to the evening of that day. It means it is from 5am – 5 pm. i.e. 12 hours.

The time period from early in the morning to late evening is called *Bas*. From above interview what I can conclude is that traditional Nachhiring Rais used to measure distance on the basis of *Bas* which was not standard unit of measurement of distance because all people don't have same pace of walking or same speed of walking. They just used to determine distance on the basis of their own guess or prediction.

The measurement of Area

The sense of measurement of area in the Nachhiring Rais reflected in the construction of houses, weaving, Khungi, Gundri, Pira, Radi, Bhakari, Theki, Dalo, Chitra, Mandro, Thunche, Nanglo, Doko, Namlo and estimating farmland, etc.

Area estimation for house plan

At the time of field study, I asked to one of my respondents about his concepts of geometry, which he used at the time of construction of a house with the help of interview guidelines. Then he answered me that,

"Normally we constructed the house in chaukas. At that time, there were no meter, fit, tape, so while building our house, we made a piece of bamboo measuring with one

hand which was used to measure the base of house. After having measurement, we used to put Tiskula (wooden pegs) in each corner with the help of stretching the rope of hateuri in each corner of Tiskula. While digging the foundations of the house, we used to dig at least one waist deep on field."

Most of the Nachhiring Rai people make their houses in rectangular base. They estimate the house by bamboo stick; the bamboo stick is prepared according to the haat measurement units. If they want to build medium size of house, then they need 15/9 it means the length and breadth of houses are 15 haat and 9 haat respectively. Similarly, for small house they take 13/7, means 13 haat length and 7 haat breadth.

The measurement of length by using bitta, haat and amal small measurement units by traditional Nachhiring people but young Nachhiring Rai people use meter, centimeter, millimeter to measure distance. The traditional measurement is not scientific because the length of haat is differ according to the height of people. So it is not standard unit.

Measurement of Land for Farming

The area measurement of the farmland is usually measured in Nachhiring Rai community in the following ways;

Production Quantity of Grains/Crops

Quantity is measured in Mana, Kuruwa, Pathi and Muri.

The respondents said that in my question " how your farmland is ?" then she replied me " *it needs 10 pathi of paddy to plant."*

Here I have collected the photograph of Mana and Pathi which are used as a tool for measurement of grains or crops.

Figure No. 2. Tools Measure in Quantity of Grains

It means, the measurement or area of land measured in terms of grain seed required. Some people expressed the measure of their lands in terms of production of their lands. If production of crops in Muri is high, such farmland is generally taken as big in size and if production of crops in Mana, Pathi then farmland is small in size.

According to the respondents:- 1 Mana = 10 Muthi = 1 Kuruwa, 1 Muri = 20 Pathi
1 Pathi = 8 Mana.

Traditional Nachhiring Rais used to measure the area of land based on the production of grains in that particular land. They assumed that the land where is high production of grains has large area and the land where is low production of grains has small area. But the fact is that production grains don't only depend on its area but also depended on different factors. Thus, to analyze this what I have found is that the measurement system of land by traditional Nachhiring Rais is not valid and similar to present standard unit of measurement of area.

Ploughing Time

Some Nachhiring people estimate their farmland in terms of plough time. Ploughing day as the measurement unit. I asked one respondent, how much is your land? Then Mr. Parshuram Nachhiring Rai replied "*it needs five hal to plough the Khetbari*"

One hal is the area plough in one day at a normal ploughing speed. So if Nachhiring Rai people need more hal to plough then the area of farmland is large in size if not then small in size.

To make more clear about ploughing time that there are sixteen(16) aana in one (1) ropani where as the land ploughed by one hal oxen is equal to three ropani which covered forty eight (48) aana. But this is not scientific because all oxen are not able to plough with same speed and pace.

Volume Measurements

In Rakha Bangdel's Nachhiring Rai community, there are different kinds of local volume measurement systems. The volume measurement units are based on local values; Mana, Pathi, Muri, Sher etc.

Measurements of Solids.To measure the volume of solids Nachhiring Rai people used muthi, Mana, Muri, Pathi, Kuruwa etc. Here the production of grains / crops such as paddy, millet, maize, mustard, soybean, potato, etc are solid grains they produce. The smaller unit is muthi and the larger one is muri. Besides these units Dalo, Dhokro, Thunche, Bhakari are the volume measurement used in their daily works. They use Dalo in different sizes 1 pathidalo, 2 pathi Dalo up to 5 pathi Dalo. According to the respondents; 1 Muthi is equal to a fistful of grain, 1 Mana is equal to 0.545 kg, 1 Pathi is equal to 4.361 kg and 1 muri is equal to 87.215 kg.

The pictures of solid are given below;

5 patheDalo sano Bhakari = 2 Muri Thulo Bhakari = 10 Muri

Figure No. 3. Measurement tools of Solid.

Generally, in traditional manner Nachhiring Rais use muthi, kuruwa, mana, pathi, muri to measure solid grains like paddy, corn, wheat, millet, mustard, etc. according to them 10 (ten) muthi is equal to 1 (one) mana which is not compatible with standard unit because all people don't have equal and similar hands that some people have small hands where as some have big hands. But educated and young Nachhiring Rais measure such solid grains based on grains, kilo grains, quintal, etc.

Measurements of Liquid

The respondents said that "*Generally, we measure liquid things in sher, Mana, Pathi etc.*" Butter, Milk, honey, wine, Jand, curd, oil, etc are measured in Mana, Pathi and Sher. One Mana is equal to 1/2 liter. One pathi is equal to 4 liters. One Sher in volume measurements of liquids. One Sher equal to 2 manas. Similarly Nachhiring Rai people widely use kathuwa to measure their local alcohol (*Jaad and Raksi*).

The pictures of Ghyampa, kathuwa, dudheri and theki which are used to measure liquid;

Kathuwa

Ghyampa

1 mane 2 mane 4 mane 8 mane

Dudheri

Theki

Figure No. 4 Liquid Measurement Tools.

It is made by wood in different sizes like 1 mane, 2 mane, up to 5 mane. Kathuwa is one of the most important measurements pots of Nachhiring Rai people community. it is always necessary in cultural and special program like; marriage, death, born and sakela etc. moreover milk, curd and whoy are measured in Theki, Dudheri, Dhungro, Theka and Gyampa. Dudheri is the pot of milk. One Dudheri is equal to 4 liter.

Weight Measurement

The most important tool used in Nachhiring Rai community for measuring weight is called Palapsu (Tulo) which is made of horizontal iron bar and has a fixed blob of mass one side of that bar. An object like a plat is made of Ningalo and suspended by three ropes. The suspension could be shifted at different measurement marks on the horizontal iron bar to balance the weight. The first marked is for Dharni, second is for Bisauli, third one is for Athpol and the last one is for Bodi.

Usually Tulo is use for weight of Meat, fishes, onions, potatoes etc.

Figure No. 5. Weight Measurement Tool.

According to the respondents; one dharni is equal to 2.5 kg, one Bisauli is equal to 2 Aathpol which is equal to 1.25 kg and one Aathpol is equal to 2 bodis which is equal to 625 gm in standard units.

There are special 15 measure marks and 4 mark dharni, bisauli, aath pol and bodi are special out of 15. The weight is express according to the number of dhaks. If there is no dhaks at iron bar, they measure the weight using different sizes stones.

Most of the Nachhiring Rai people use traditional types of units. The 15 measurement units are; dharni, satser, hamali, pachser, naubodi, bisauli, 18 pol, 15 pol, 12 pol, 10 pol, 8 pol, 6 pol, 4 pol, 1 bodi and literate Nachhiring Rais are slowly changing this measurement unit and have been started to use modern measurement units like; kilogram, gram etc. when they have to import some goods from other places and cut the meat of pork or buff then they use their measurement units.

Counting System

In Nachhiring Rai culture they have own mother language. Therefore, they have been counting in their mother language based on following topics;

Number Concept and Counting process

Through the observation and interview, I found that the Nachhiring Rai people have their own symbol to represent the numbers. They use their own native name for counting but their scripts aren't found widely in their culture. The Nachhiring Rai numeration is base 10 but in counting money they used base 20 (bisha). They made counting easier by using corns, grains, small stones and fingers of hand etc.

Table I : Nachhiring Rai have native name for number and their symbols

English	Symbol	Nepali	Symbol	NachhiringRai	Symbol
Zero	0	शुन्य	०	वा	○
One	1	एक	१	इ	1
Two	2	दुई	२	नि	∧
Three	3	तीन	३	सु	S
Four	4	चार	४	लि	X
Five	5	पाँच	५	डाँ	५
Six	6	छ	६	तु	६ or 7
Seven	7	सात	७	नु	8
Eight	8	आठ	८	रे	8
Nine	9	नौ	९	भउ	9
Ten	10	दश	१०	पउ	8○
Eleven	11	एघार	११	पउइ	11
Twelve	12	बाह्र	१२	पउनि	1∧
Thirteen	13	तेह्र	१३	पउसु	1S
Fourteen	14	चौध	१४	पउलि	1X

Fifteen	15	पन्ध्र	१५	पउडाँ	1 ५
Sixteen	16	सोह्र	१६	पउतु	1 ६
Seventeen	17	सत्र	१७	पउनु	1 ७
Eighteen	18	अठार	१८	पउरे	1 ८
Nineteen	19	उन्याइस	१९	पभिउ	1 ९
Twenty	20	बीस	२०	निस्सा	२ ०

Most of the elder Nachhiring Rai people count the number of things by using their hand finger. After 10(pau) the counting is repeated from 1. For example, eighteen is expressed as pau Re where, pau is ten (१ ०) and Re is 8 (८) or १ ० + ८

Which is similar to Devanagari system. Ikchhum (१ ० ०) denotes one hundred.

Some symbols of Nachhiring Rai numbers and Hindu Arabic are same like; 0, 1, 11 and the number seven of Nachhiring Rai is same like the number of 8. The numeration system of Nachhiring Rais is similar to Devanagari systems which is based on base 10. Similarly, money is counted on the basis of Bisa or base 20. Nachhiring Rais use their fingers for normal calculation and they use piece or beads of corn for paranormal or big calculation. Although traditional way of calculation takes longer time, calculation is found to be correct. But the young and educated Nachhiring Rais use calculator and formal methods with rules for education.

The above system of counting is formal system.

Number concept in Cultural Heritage. I observed the process of making alcohol. The respondent who was Nachhiring woman. She was making alcohol then she told me that "At first, to make alcohol must put morcha, which is made of flour, rice and leaf of white Dudhi. While making ale which means Jaad of chhyang, we need to boil 1/3 water and 2/3 part of millet is cooked. After cooking this, we dried and mixed with 100 gm Morcha. Moreover we are kept in sack and finally in to the drum. After about five days, it will be converted in to ale which is called Jaad in my culture. Then after 10 days it will be ready to make alcohol (Raksi). Then we placed the pot on that Chula keeping with water and ale. Than we placed the Jhajari and put

small pot into Jhajari which is called NaniHadi. Then they placed Bata on jhajari and put water in to it. When the water is boiled then they replaced water by cold water similarly it is repeated 6/7 times then alcohol is ready in Nanihadi".

Figure No. 6. The picture of the making alcohol.

In this process of making alcohol, different kind of basic mathematical concepts are found. Every pan (change hot water in different times) has to record by writing line of ash on the Funga. Thus Nachhiring Rai women used counting system on the process to prepare raksi by sketching ash line. So this is one example of number concepts of Nachhiring Rai in cultural heritage.

Money Counting and Their Units. In counting of money is different from the other communities. They counted in terms of units and expressed systematically in the ascending order. The respondents said to me that "*the greatest money is 1000 rupees and the smallest money is 1 paisa*". Generally, most of the people recognize

the money notes of Rs. 1 , Rs. 2, Rs.5, Rs. 10, Rs. 20, Rs. 25, Rs. 50, Rs. 100, Rs. 500 and Rs. 1000 and the coin of 25 paisa, 50 paisa, five rupiya and ten rupiya etc.

So, it was found that the concept of money is perceived through Money notes and coins existing in their culture.

The official money units and their Nachhiring Rai synonyms;

Table No. II

Nepali Names	Nachhiing Rai Names
1 paisa	Ibubuludam
2 paisa	Nibubuludam
1aana (4 paisa)	Libubuludam
10 paisa	Pau buludam
1suka (25 paisa)	NipauNgabuludam
1 Mohor (50 paisa)	I Aadali
1 rupees (100 paisa)	I bulu
10 rupees	Pau bulu
20 rupees	1 kori (bisa)
100 rupees	Ikchhumbulu
1000 rupees	Habaubulu

From above information what I found that, they have their own identification to know the value of money. Young generations are unknown about the knowledge due to the modern education system. The traditional money counting system is totally replaced by the modern system.

Concepts of Time

The time concepts are based on the routine events in the environment and the units of time are fixed out and used with reference to these events. Days, weeks, months and years are important units of time. Generally in Nachhiring Rai community people guess the time based on the following:

-) Observation changes in the environment.
-) Cock crowing.
-) Location of sun's shadow and positions of stars and moon.

) Listing to the radio and watching clocks.

From the above discussion, I analyzed that traditional Nachhiring Rai people have different concepts of time that they tell the time or follow the time based on cock crowing, location of sun's shadow, and position of stars and moon which was not scientific and relevant, but young Nachhiring Rai people use clock which shows or tells the time accurately that is accepted univesersally.

Basic Mathematical Operation

In this section, I presented the mathematical processes practiced by Nachhiring Rai people, i.e. this section deals with how Nachhiring Rai people perform mathematical operation. Here, mathematical operation means addition, subtraction, multiplication and dividing practiced by Nachhiring Rai people in their real life. The mathematical process of solving numerical problems are exclusively based on counting and cumulating process.

Addition. Generally, Nachhiring Rai people do not feel difficulty in the addition process. They use grain, stones, and hand fingers to add more than one number together. Especially, group of twenties is widely used in money counting and group 10 is used in counting solid things. To add two consecutive numbers first they count first number from initial level of counting to top level of that numbers together, express the number in the groups of 10. Similarly, they count second number and they first add in terms of 10 and again they add the remaining to get the sum. For these activities, if they have to add small number then they use hand fingers otherwise they use stone and grain. I asked research question to my respondent ;

"There are two hens in your home, one hen gave birth 22 chickens and another hen gave birth 25 chickens. Now, tell how many chickens are there in your home?"

$$\begin{array}{ccccccc}
 & & & + & & & = \\
 & & & & & & \\
 22 & & & + & & 25 & = & & 47
 \end{array}$$

Figure. No. 7. Addition of number of chickens.

At first, there should be beads of corn, then count 22 beads of corn and keep in one place after counting. Again count 25 beads of corn and mix with already counted 22 beads of corn in the same place. When all beads of corn are counted at once there are altogether 2 bisa and seven chickens.

From the above discussion shows which that the illiterate and elder generation take it easy to solve additional problems. But young generation takes it as time consuming practice. The young and literate people or students use the system of addition of mathematically as formal education system.

But literate people can easily add these two numbers together using numerals in both Nepali and Nachhiring Rai language.

Subtraction.Subtraction is the process to remove or to reduce a number from another. Nachhiring Rai people use hand fingers, stones, and grains for subtraction. They can solve small subtraction problems orally. Theydon't have any concepts of negative number and they understand only the positive number. The researcher asked the following question about subtraction.

"There is one hen of yours, which gave 24 eggs. Among 24 eggs, the same hen gave birth only 16 chickens among 24 eggs, then how many eggs did not give birth chickens?"

$$\begin{array}{r}
 - \\
 \\
 24 \quad - \quad 16 \quad = \quad 6
 \end{array}$$

Figure No. 8. Subtraction.

At the same way, count 24 beads of corn in one place. After that take out 16 beads of corn the another place from 24 beads of corn, then remaindering beads of corn from 24 beads of corn are the numbers of eggs which did not are birth chickens. i.e. 8.

Thus, the subtraction methods were different in the old Nachhiring Rai people and student (literate people). Old age group of Nachhiring Rai had done in traditional ways that is counting cone or using some pieces of stones whereas literate people group had seen the effectiveness of formal rule.

Multiplication. Nachhiring Rai people did not have any multiplication concepts but there was the concept of addition. So, for them mathematical processes means addition and subtraction only. I found that the multiplication process was done by grouping system of addition process in their lives. The process of multiplication is repeating the addition for them. They can not do multiplication with formal mathematical rules. As a researcher, I asked some questions to verify the information which are given below.

"You have four hens, and each hen has 6/6 chickens then how many chickens, are there in total?"

]

$$\begin{array}{ccccccc}
 & + & & + & + & & + & & = \\
 \\
 \mathbf{6} & & + & \mathbf{6} & & + & \mathbf{6} & & + & \mathbf{6} & & = & \mathbf{24}
 \end{array}$$

Figure No. 9. Multiplication.

One of my respondents solved this problem as following.

First of all, I keep 6/6 pieces or beads of corn in four, places , then I mix all beads or pieces of corn and count. In this way there are 24 beads or pieces of corn in total.

Similarly, I asked another multiplication question to the respondent.

"If 1 kg pork costs 160 rupees then, how much costs of 3 kg pork?"

Answer; 1 kg pork costs 8 bisha and 3 kg pork costs 24 bisha. So that it costs 480 rupees.

From the above, they have been using addition in multiplication in Nachhiring Rai people. The conversation with the respondent shows that in this way they solve multiplication.

The young Nachhiring Rai people and students do multiplication problem as the formal system of multiplication.

Division.For the Nachhiring Rai people, division means to make physical objects into different pieces and distribute these pieces to each person. According to them, any object is exactly segmented into half segmented denotes what division refers. They used three methods while they divide. One is for volume, second for counting number and third for division of money. Especially in case of volume, they use pot, for example they have to divide rice, corn and maize they use measurement

pots; mana, Pathi and kuruwa etc. in case of number like dividing bananas, oranges, apples etc, they give one to one each person to whom that things have to be distributed till the things remain. If there remainder then they distribute respectively.

For dividing money, they decompose the total amount of money into different groups. Such as groups: 10, 20, 40, 80 etc. after dividing the groups, they divide the remainders and make result. Mainly they use base 20 (bias).

I asked a research question to Nachhiring Rai People. "Suppose, you have 200 oranges. If you divide equally to five people. How many oranges will each person gets?"

Ek bisha = 20

I	II	III	IV	V	
					= 100
					= 100

Figure No. 10. Division.

At first, there are 5 bisha in one hundred. Similarly when we divide 100 oranges to five people then they will get 20/20 oranges. So, five people will get double of 20 oranges that 40/40 oranges.

From above the conversation and observation, I found that Nachhiring Rai people solve mathematical problem with traditional methods, which is related to their daily work.

For Nachhiring Rai people, division means to make physical objects into different pieces and distribute these pieces to each person. According to them, any object is exactly segmented into half segmented denotes what division refers. They

use three methods while they divide. One is for volume, second for counting number and third for division of money. Especially in case of volume, they use pot. For example while they have to divide rice, corn, and maize they use measurement pots; mana and pathi. In case of number: like dividing bananas, oranges, mangoes etc, they give one by one to each person to whom that things have to be distributed till the things remain. If there come remainder then they divide randomly.

Chapter V

SUMMARY, FINDINGS, CONCLUSION AND RECOMMENDATIONS

This chapter synthesizes the data gathered from primary and secondary sources as findings of the study and draws conclusion of the study. Then the implication of this research and recommendation for further research areas are presented.

Summary and Findings

This study has done to explore the basic mathematical concept used in Nachhiring Rai people. The study is conducted in ethnographic base. In this chapter, I have presented the findings of the study, conclusions of the study and implications of the study. The objectives of this study were to find the measurement system practiced by Nachhiring Rai community, to find the counting system adopted and practiced by Nachhiring Rai community and to explore the way of using four fundamental operation of mathematics practiced by Nachhiring Rai community.

The study area was Aiselukharka Gaupalika -1 wadasku of Khotang district as the field of research and sample size selected by the purposive sampling method. For the study, ten members were selected and among them two were females and 8 were males. This study is based on ethnographic research and descriptive method was adapted to analyse the data. While doing this study, I visited the Nachhiring Rai community and observed their basic mathematical concepts. In this study, I collected data with the help of observation, interview and informal discussions and meanwhile, I took photos of different domestic objects. On the basis of their information and field data I have presented the following findings, conclusions and implications of the study. The findings of the study are as follows:

- Nachhiring Rai people have special system of counting number 1 up to 100 as well as place system in their Nachhiring language.
- Mostly, selected Nachhiring Rai people are not literate and they did not know about formal mathematics but they always used mathematics in their daily lives knowingly or unknowingly.
- The Nachhiring Rai numeration is based on base 10. but while counting money they use base 20.
- Nachhiring Rai people don't have their own separated script. So, there is no any special symbol to represent the particular numbers. They practiced orally simple mathematical operations. Old Nachhiring Rai people couldn't solve large numbers problems.
- Specially, elder Nachhiring Rai people(male) did simple mathematical operations orally but they can't solve complex mathematical problems.
- They measured length and breadth by using hand and fingers, Amal, kuret, bitta, kachi, and haat are the measuring units of length and breadth.
- The area of land is measured in terms of production of grains and ploughing time in Rai community.
- Nachhiring Rai people use different types of their traditional objects like Muthi, Mana, Pathi, Muri to measure volume. And they have different measurement system to measure liquid like dhudhero, Kathuwa, Kuruwa etc.
- Nachhiring Rai people measure the weight with their traditional measurement device 'Tulo' the units of weight were ;dharni , satser, hamali, pachser, naubodi, bisauli, 18 pol, 15 pol, 12 pol, 10 pol, 8 pol, 6 pol, 1 bodi.

- To add two numbers together, they count the first number and using grouping system in base ten; they start to count second number using grouping system. For this activities they use grains of corn.
- To solve subtraction problem, lowest number is deducted form highest number or total number and the remaining numbers are taken as the result or answers. In this process, Nachhiring Rai people use pieces of stones, grains and fingers.
- To solve the problem of multiplication, they use their own traditional method of addition by the help of grains of corn, they separate the group of multiple numbers and then they add each number of groups.
- They solve division problems from different methods. They divide any solid and liquid object with the help of traditional pots. To divide any number they decompose the number into different groups and divide by each other. They feel division is very difficult process.
- Younger and literate Nachhiring Rais are becoming aware of formal system of mathematical processes and measurement systems.

Conclusion

There are several ethnic groups with their own typical traditions and practices. Different groups have their own mathematical concepts and practices. The Nachhiring Rai community is also one of the ethnic groups of Nepal. They have their own system of counting and measurement as well as mathematical process for their normal day to day lives. Nachhiring Rai people mostly are farmers and they sell their products in village's market and they learn the simple mathematical operation from those activities. So, they have their own traditional system of measurement and numeration. The system was locally developed in the past when there was no need of standardizing measurement units and no pressing needs of the use of numerals. But

still the mathematical concepts used in Nachhiring Rai community has not been expanded, explored and linked with formal Mathematics.

This research also concludes that, Nachhiring Rai people use their own system of counting and measurement as well as mathematical process for their daily activities such as concepts of counting, measuring and basic operational. Besides these, Nachhiring Rai people should learn formal school mathematical concepts and process because young Nachhiring Rai people are practicing modern mathematical concepts and process. If we use mathematical concepts of Nachhiring community at school level as a teaching object to teach the basic concept of mathematics and then formal mathematics would certainly be increased in their Nachhiring Rai community.

Educational Implications of the Study

This study was conducted taking short period of time, small number of respondents and limited area. Therefore, the findings of this study may not cover all the aspects of mathematics of Nachhiring Rai ethnic group.

-) This research was limited to measuring system, counting system and four fundamental operation practices by Nachhiring Rai people.
-) There are many ethnic groups in Nepal having their own language, culture and traditions. Similar study can be done in other ethnic groups too.
-) Concepts of Nachhiring Rai measurement system are simple and practical but lack of standardization. They need to be developed standardized and preserved.
-) This study was conducted in a short period of time. So an intensive study can be done for extended period of time.
-) This study is applicable to curriculum makers, text book writer, policy maker, in-service teacher and out service mathematics teachers.

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APPENDIX I

Interview Questions

1. There are two hens in your home, one hen gave birth 22 chickens and another hen gave birth 25 chickens. Now, tell how many chickens are there in your home?
2. There is one hen of yours, which gave 24 eggs, among 24 eggs, the same hen gave birth only 16 chickens among 24 eggs, then how many eggs did not give birth chickens?
3. You have 4 hens and each hen has 6/6 chickens then how many chickens, are there in total?
4. If 1 kg pork costs 160 rupees then, how much costs of 3 kg pork?
5. Suppose, you have 200 oranges. If you divide equally to five people. How many oranges will each person gets?

केहि प्रश्नहरु

१. तपाईंको घरमा दुई माउ कुखुराको पाथी छ, दुवै कुखुराको माउले एकै दिन चल्ला भारेछ, एउटाले २२ वटा र अर्कोले २५ वटा भरेछ भने अब कतिवटा चल्लाहरु भए तपाईंको घरमा?
२. तपाईंको त्यहि कुखुराको माउ मध्ये एउटा माउले २४ दाना अण्डा ओर्थादा जम्मा १६ वटा मात्र चल्ला भारेछ भने कतिवटा अण्डाबाट चाँहि चल्ला भारेन ?
३. तपाईंले २५० दाना सुन्तला बजार बेचन लानुभाको तर बाटैमा चिनेको केटाकटीहरुलाई ३५ दाना सुन्तला सितैमा बाँडिदिनुभएछ भने अब तपाईंसँग कति सुन्तला बाँकि रहयो ?
४. एक धार्नी सुगुरको मासुलाई रु ७०० पर्छ भने साढे सात धार्नी सुगुरको मासुलाई कति पर्छ ?
५. दुई पाथी चार माना घिउ को कति मुल्य कतिपर्छ ?

६. तपाईंसँग भएको ५०० दाना सुन्तला १० जनालाई बराबर हुनेगरि बाँड्दा प्रत्येकले कतिकति पाउछन् होला?
७. ५ पाथी कोदो पाक्ने भाडामा ५० पाथि कोदोको जाँड पकाउनु पथ्यो भने कति पटकमा पकाई सक्नुहुन्छ ?

Measurement systems

१. यहाँ बाट राखा स्कुल जानको लागि कति टाढा पर्छ ?
२. यहाँबाट सदरमुकाम कति टाढा पर्छ ?
३. तपाईंहरु कसरी गन्नुहुन्छ ?
४. तपाईंहरुको चाडपर्वमा कुन कुन विशेष सामाग्रीहरुको प्रयोग गर्नुहुन्छ ?
५. तपाईंहरुले घराएसी काममा प्रयोग गर्ने सामानहरु जस्तै : डालो , डोको , नाम्लो , गुन्द्री, पीरा , खुङ्गी आदी कसरी बनाउनु हुन्छ ? सानो ठुलो कसरी नापलिनु हुन्छ ?