CHAPTER- I

Introduction

Background of The Study:

The discipline of mathematics in Nepal is considered as a tough subject for the students. The school mathematics curriculum designers have not yet been able to relate the subjects with the Nepali life style. A Nepalese proverb *'desh gunako bhesh kapal gunako……'* is related to the study. The knowledge of the illiterate people is the area of the study. The use of mathematical concepts can be observed in the temple, *stupa*, palace etc which are not noticed by the general public. The people of ancient period and their creations have motivated for their study. We don't have the ancient documents to justify for their existence, period and respectable architects. But instead of this, we have still remaining their artistic creations. This is one of the areas finding the use of mathematics and the most essential part of in-depth study, because new generations are unaware about it and give less priority to this study. Modern education directs new generation for the adjustment to existing challenge. This study carries slightly different nature of understanding the world because this gives first priority to the cultural importance. While considering the mathematics from counting numbers to its advanced level, it can be found in the local practices but the point is that people who are using mathematics are unable to systematize them. The study tried to understand their mathematical practices and explore the importance of their culture

The religion, social, cultural practices of indigenous people still have some originality. Whether the mathematics is practiced by the illiterate or literate, the

purpose is to adjust or fulfill the present demand. Mathematics adopted by the illiterate people of indigenous group is the scope of this study.

The Gopali caste group is well known in the history of Nepal because they ruled over Nepal as the Gopal dynasty (Up to 1000BC). They were the first ruler of Nepal. In order to raise the mathematical inquiry from the cultural perspective, the Gopalis are taken for the study. The Gopalis have distinct collective identity, own language, religion, tradition, own traditional egalitarian social structure, traditional homeland or geographical area. They are considered as the minor group of Nepal.

The perception of mathematics among illiterate Gopalis is the major theme of the study. Their daily practices are observed from mathematical perspective. Ethno-culture and ethno-science are interlinked with ethno-mathematics because each has mathematical practices. Mathematics is being the crucial factors of all developmental sectors, the present era of modern technology is also impossible without mathematics education.

This study gives the importance to the local practices of mathematics which will be better achieved in this context of mathematical difficulties faced by the school children. Linking school mathematics with locally practiced mathematics learning could be significant study in our country. The mathematics education in Nepal is influenced by globalization. Because of new technology traditional cultural practices are influenced. The study represents ethno-mathematic practices of Gopalis.

Twenty years ago it was argued that ‘The cultural placement of an educational system and scientific structures is probably the most relevant fact in modern development of education, mainly in underdeveloped countries’ (D’ Ammbrosio

1979). As far as mathematics is concerned, in the last two decades many researchers have agreed that teaching must be related to its cultural and geographical context. The issue of ethno-mathematics is an emerging field of mathematics and a strong means of mathematical education. It must be considered as a good response to the problems regarding the cultural component of education. On the other hand, the explosive way of communication media and information technology (internet, satellites etc) have created further cultural dependence to the North hemisphere. This dependency is the major cause of the disappearance of traditional knowledge of many societies or identifiable groups of people especially in the south hemisphere.

Statement of Problem

Traditional knowledge of indigenous people is going to extinct. The documentation of their knowledge and practices has become essential in this colonial market situation. The Gopalis considered for the study are lacked behind in education, economic status and the mainstreaming of the people. Because of the educational purpose, I have focused the study in their cultural importance and interlink their culture in mathematics education. Mathematical learning is required for all the human being whether they are illiterate or literate for their social life. But its use might be different. The indigenous mathematical practices of the Gopalis are demanded by the study.

If the concepts of mathematics are practiced before formal schooling or in home environment, it can be better achieved the goals of education. The subject of mathematics is being the causal factor in the case of dropout rate of students in passing the examination is the common voice of all dropout students. For this there must not be gap between social and cultural demand form of mathematical concepts

and the school mathematics. The study is focused on the documentation of ethno-mathematics of Gopali community in their tradition and cultural settings.

Rationale of the Study

The area which I have chosen for the study is very little explored ethno-knowledge in the field of mathematics education. The study provides the valuable information about the gap between cultural mathematics and the school mathematics and the interrelationship between culture and mathematics. In recent years, there has been given a great importance to the ethno-mathematics. The study does not depend only to explore the ethno-mathematics of the Gopalis but also attempts to explore the pedagogical implication as well.

The foundation of mathematics might have emerged from the need to trade. Philosophers have always claimed man to be an economic animal who invented math to facilitate trade with others. For example, a traditional 'apples-to pigs' exchange would consist of a variable number of apples for one pig. Such transactions were several factors among several factors that led to the development of number systems. (Hammond. Tracy, 2000, p.16). This clarifies that mathematics has developed from culture and the mathematicians develop it as the demand of present situation. The reality of our context is different that mathematics was not developed in our local context. The field of mathematics was highly extended in the western culture, so it is difficult to inculcate the people in the other parts of the world.

The ethno-mathematics was identified as a new area of research just more than a couple of decades rather than the academic area of the study. So far, we are not yet been able to develop school mathematics textbook relating Nepalese culture and

tradition. Our educational environment is focused from the very beginning on the modern mathematical concept rather than the local oriented culturally thousands examples for mathematical concepts. It has become a convention that the cultural study is simply a study of the local people and their practices such as their language, food habits, religion, dress/ornaments, and living status. But the study clarifies that the development of mathematical concepts and their use is also a part of culture and traditions in their daily life.

As far as my understanding from the cultural perspective, very few studies have been done in Nepalese context. It is a challenging task to explain the use of mathematical concepts in the cultural settings. Nepal being a multicultural, multi-ethnic, and multi-lingual country, the influence of globalization process around the world by the development in science and technology, extending urbanization process of the districts and the implementation of high technology in communication media has the negation impact to pursuit the cultural traditions, beliefs, norms and the values of the different parts of the country which results to change the life style and the teaching learning situation of the people. In this situation we have to face a problem of preserving social norms, culture and traditions. It is our opinion that ethno-mathematics can have better/effective implication in teaching/learning mathematics.

The indigenous practices of mathematics in each ethnic group of people have not been able to address in the existing mathematics curriculum. In the name of practical education, some examples are relating to the practical life have been incorporated. The educational planners, curriculum designers are also facing difficulty to identify the applicable aspect of the curriculum. In the absence of multicultural flavor in school curriculum, the students are practicing the mathematics in their

locality on the theoretical approach. So, to address the local practices in mathematics, the ethno-mathematics of the Gopali community has to be identified. So, it is attended to develop the cultural mathematical practices in the study.

The out put of the study is to incorporate the ethno-mathematics in the school education. The educational issue of the mother tongue is addressed by the study. Especially, the study can be a reference of primary mathematics education. Such studies promote the national cultural identity and explore the indigenous knowledge and their use in the academic field. This study is also focused in the same purpose of educational implication of the ethno- mathematics.

Research Questions

Overarching Question:

- How ethno-mathematics can be perceived by Gopali community?

Subsidiary Research Questions:

i. How Gopali community people practice their own mathematics (numeric, measurement, geometric concept)?
ii. What are the potential of ethno- mathematics aspects of the community to incorporation in the school mathematics curriculum?

Limitation of the Study

There are two types of culturally different Gopalis in Nepal. They are influenced by Newari and Terai culture. This study is focused on the Gopali community who are from Newari cultural background. The study is focused on the

inhabitant of Gopali of Chitlang village of Makawanpur district. The other core area of the study consists of the 'Taukhel', 'Nhulgaun' and Kunchhal villages for additional information.

It is difficult to identify the features of the specific ethnic group from the mixed and modern culture. The population of the study represents all the Gopalis who are inhabitant of Makawanpur district and the other parts of the country who have same cultural and traditional background.

Cultural Background of Gopali Community

Historical Background:

The Gopalis consider themselves as the descendants of the Gopala dynasty, the first dynasty that ruled Nepal in ancient days. Matatirtha was their capital. Gopali which literally means caretakers *('pala')* of cows *('gp')* are also known as *Gwalas* (cowherds). The stone-inscription at Taukhelpati (Nepal Sambat 827) still stands as its evidence. There is also evidence that two decades ago the present Gopali had *Gwalas* as their surnames (CERID, 1991, pp.7-8). According to the Nepalese history, the great importance of Pashupatinath Temple has heard by the Sage 'Ne' then he came to the image of Pashupatinath for mediation. He stayed in between two rivers as Keshawati and Bagmati and started his religious mediation. Mean while he made the King the son of Gopal Sardar named Bhuktaman. The Gopal sardar had died due to the shrine of the Pashupatinath image is the first person who found the image of Pashupatinath. After Bhuktaman, seven Gopal Kings ruled over Nepal. Altogether they ruled Nepal for five hundred twenty one (521) years. The last Gopal king Yakshya Gupta was childless by the result Var Sinha got the chance to become the king. He was from

Ahir Dynasty. After that Jayamati Singh ruled over and at the period of Bhuwan Singh the Yalamber of Kirat Dynasty defeated him and then the Kirat dynasty started ruling in Kathmandu. The historical evidences show that the Gopalis of the Chitlang village are the successors of ancient Gwalas. In this way, we can notice the presence of Gopali folk group from the ancient time to the beginning of human settlement in Kathmandu valley. They are still residing in some localities of Kathmandu valley and in some villages of Makawanpur district. It is probable that the Gopalis had entered the northern part of Makawanpur which is near from Kathmandu valley as well as Simraungad, which lies on the south.

Gopali Community of Chitlang Village:

The major inhabitants of Chitlang village of Makwanpur district are Gopali community. Chitlang is the beautiful, historical village which is 80 kilometer east from Hetauda and 17 kilometer south from Thankot of Kathmandu. The climate of Chitlang village is very pleasant.

Chitlang village consist different communities of people with the distinct features of their own language, culture, traditions, religious, castes, etc. Among them the Gopalis is one of the distinct communities. Most of the houses of Gopali community are joined together and they live in joint family. They use Newari language. Except some old women others can speak *khas* Language. *Gathemangal, hilejatra, gaijatra* etc are the special festivals of Gopali. But they celebrate other Hindu festivals as well. Agriculture is the main occupation of Gopalis. They called themselves indigenous and before two decades they wrote *gwala* (cowherds) after their names.

Folklore of Gopali Community:

Gopalis consider themselves as the ancient ethnic group. They believe that their ancestors were the Gwalas who came to Shonitpur (Thankot, Kathmandu) from Dwarika (India) during Dwapar Yug (a mythical period in the ancient time) with Lord Krishna, for the purpose of killing the demon King Banasur. Gopalis call themselves the descendants of Nandagopali and Krishnagopali, but there is no evidence yet to support the claims they make about their ancestors. However, historians have said that there is some truth in the Gopalis' belief on this matter.

According to the legend, Krishna's son Pradhumna had married Prabhavati, the daughter of Banasur. Later, Krishna went back to Dwarika after establishing the Gwalas' kingdom in Kathmandu valley. The Gwalas ruled over the kingdom for a long period in Kathmandu valley. They followed the tradition of worshiping the cow. It was found that they had ruled over the valley for 9 generations in the kingdom.

As some historians have explained, the Gopalis kings belonged to the sub-group of Nep ethnic group, and Par was the name of sub-group who used to live taming buffaloes. Both Nep and Par (also called Mahispal) ethnic groups were interested in training animals (cows and buffaloes respectively). So they wanted reside near the forest areas because pasture land was essential to keep their domestic animals. They resided in the localities where there was jungle in the hillside above and plain land on the foot of the hills –like the places of Tistung, Palung, Thankot, Balambu, Kisipidhi, Kirtipur.

In this connection, some information mentioned in inscription found in Toukhel, Chitlang VDC Ward Number 6 (Makawanpur district), was established by

Amshubarma in Sambat 827. According to inscription, the king Amshubarma had granted some land to the local people to transfer the village from one locality to another because there was no enough land to keep the domestic animals in the village. From this evidence, it is concluded that Gopalis earn their livelihood by taming domestic animals such as cows and buffaloes. Explaining this inscription, historians have identified from the inscription that the typical ethnic group residing in the localities of Chitlang such as Taukhel, Nhulgaun, Kunchhal etc. are the *Gwalas* or Gopalis.

Gopali Language:

The language of Gopali community is similar to Newari. However, it differs from the standard Newari in accent, vocabulary, pronunciation, sentence structure, word formation etc. Besides, the influence of localization is found in the language, there is also of some Nepali and Tamang words in it. The language is spoken with a long tune, and it is difficult to understand for the Newari speakers. The conversation of Gopalis cannot understand by the Newari language speaking person.

Gopali language belongs to the Tibeto-Burman branch of Sino-Tibetan language family. They call their language *gwaa bhay* or *newaa bhay* and the language spoken by the Shrestha community of Kathmandu, Patan and Saraswati Bazar (of Bajrabahari VDC) as s*yasya bhay.*

Dressing:

Gopalis have their own traditional dresses. The women wear *Haku Patasi* (black home-made sari), *putulan* (a kind of blouse), white home made *jani* (also called *patuka*, which is worn round the waist), and *gacha* (shawl). The traditional

items of Gopali male dress are: *khesa tupuli* (cap made of *khesa*, a kind of thread), *tapalan* (home-made garment like Nepali *daura*), *jani* (white waist-cloth) etc. They also wear *suruwal*, *istakot* and shoes. Gopalis used to wear the shoes made of straw materials or *nalu* (a plant fiber), and the women used to wear beads made of silver coins. But these days, the use of these traditional dress items is gradually reducing.

These dress described here used to prepare by the Gopalis married women. In the ancient period young girl must learn to make clothes for marriage. This was the essential requirement towards them. The measurement length of *haku patasi* and other dress materials show their knowledge of measurement. The length measurement units used by them are *hatt* and *bitta* rather then meter and centimeter and they have their own counting practices.

Si (death ritual):

Gopalis have a *si-guthi* (an indigenous organization like 'trust') to manage the death ritual. In Kunchhal village, altogether 105 households are involved in the *si-guthi.* In the funeral ritual, all the members of *si-guthi* have to attend the funeral procession with a piece of firewood. Death ritual consists of several events, which the members of *si-guthi* have to perform, if any member of the *si-guthi* missed the events, one has to pay the fine. The family members should mourn for 13 days at the death of adult person and thereafter, the family members are considered normal. In the past, the Gopalis used to invite a Newar priest *guvaju* for performing this ritual, but nowadays the Aryan priest is invited. The Gopalis wear white dress for 6 months after the death of their mother and for 1 year after the death of father. This period is called *barkhi*. The rituals are based on the lunar calendar. So, they are accustomed with the counting practices done in astrology.

Folk Art and Architecture:

The Gopalis used to have three-storey houses. Such houses are still found in Nhul Gaun and Taukhel. There are also four-storey houses in Kunchhal, Gahate, Papung and Kulgaun. In Papung and Toukhel, the houses are made of bricks; but in Gahate, Kulgaun and Shikharkot, the houses are stone-made. The houses are of ancient model. They exchange labor system among them. This is also called *bola* system. Whatever skill they have they used to share or contribute to the community. The traditional architectural designs they have in their old houses. It is the evidence of having geometrical concepts in the Gopali community.

Agriculture and Animal Husbandry:

Most of the Gopali families are depending fully on their agricultural land for their survival as well as for economic activities. They have two types of land: a) *Boon* (plain terraces), where they grow paddy, potatoes, cabbage, chilly, maize etc; and b) *keu* or *bari* (slope terraces), in which they grow radish, millet, corn and other vegetables. Gopalis also tame animals keeping them at *goths* (sheds). They construct the *gothas* in *keu*, which is usually far from their house.

Basically, all the Gopalis manage their economic activities by using their farm and live-stock products. Despite their limited income, they do not have to face problem for their life survival.

The constructions of agricultural tools need the use of geometrical figures and models. This is another evidence of having the knowledge of geometrical concepts among the Gopali community for the cultivation of their land.

Life Cycle Rituals:

Although Gopali folk rituals are found similar to those followed by the Newar community, there are differences between them. For example, while the ritual of *ihi* (girl's marriage to *bel,* a wild fruit) and *bara* (a ritual of keeping the girl in isolation after *ihi*) are customary in Newari culture, Gopalis do not observe these rituals. Instead of *bara,* they have the tradition of fasting for 5 days and giving *gunyu-cholo* (a set of traditional lady's dress) to the girl.

Some typical rituals observed by the Gopalis are described below:

Macha byanki: After the birth of child, Gopalis have the practice of observing *sutak* (period of ceremonial un-cleanliness) for four days. They invite *derima* (a lady having special duty to fulfill on this occasion). Generally, women deliver the baby on the first floor of the house. The woman sleeps on paddy straw. The ritual for purifying the woman after the four days of un-cleanliness is called *macha byanki*. To perform this ritual, the baby is exposed to the sunlight and kept on a bundle of the straw which was used for delivering the baby. After taking the bundle of straw out, it is kept at a place safely, and *derima* scratches the bundle with an arrow. Then food items are put in a leaf plate which is kept on the bundle.

Bhusha khaya (hair cutting): The hair cutting ritual is performed between the 6^{th} and 12^{th} year of the male child's age. After hair cutting, some Gopalis, though not all, also perform the ritual of *bratabandha* or *kaitapuja*. The boy's sisters, paternal aunt and maternal uncle have special duty on this occasion. Maternal uncle usually cuts the hair and the boy's paternal aunt collects the hair in a brass plate and then takes it to the stream nearby to dispose it and let it flow with water. Gopalis do not cut

their boy's hair prior to this ritual; and even if it is cut before, the hair should be kept safely and should be taken to the water in the stream on this occasion.

Vijayadashami: They cut goat in the day of *mahanavami* and keep it by burning the fur of the head. In the day of *vijayadashami*, the head is cut into four equal pieces. Again the cut pieces are joined together and tied with a rope and boiled. After putting *tika* they eat the head of the goat. Elder one of the house eats right eye of the goat, similarly second elder eats right ear and third, fourth eat mouth, tongue, jaw etc according to the seniority. In the evening they have *tauke bhoj*. They go the eldest one of their community and exchange right eye and ear of the goat and eat. In the same way, they eat different dishes of meat.

In the process of making four equal weights of the head of goat, they use their mathematical practices. According to Janga Bahadur Gopali, it is easy process of making four equal parts. First of all, in the middle of the two horns there is soft part from where it is easy to cut the head into two parts and in the second step, below the eye levels use to cut then no need to measure whether they are of equal weight or not. It will be accurate measures of equal weight. This practices of the fraction which the children use to learn in the school relating to the weight measurement. But in the school mathematical fraction, that is not related to the weight. It is calculated in the basis of the area of the figure. This is one of the ethno-mathematical strength of the Gopali community of making four equal weights of the head without measurement and it is also difficult practices of making four equal parts of the shape like head of goat. This study is focused in the numerical system, measurement system and the geometrical practices so being a mathematical practice is also involved as the additional information.

The more details of cultural practices are attached in the appendix- III

CHAPTER- II

Overview of Related Literature

Overview of Research Conducted in The Nepalese Culture

The studies which are concerned with ethno-mathematics and culture are overviewed in this chapter. The overview of the literatures shows the correct path for the present study. Only two researches have been done in Gopali community till now. But the cultural studies can be found so many in numbers. Researches which are done within the country and other countries related to ethno-mathematics as well as cultures are overviewed here.

The people of Nepal in the past consisted of the native inhabitants and the settlers that came from the south as well as the north. These settlers mixed up so well with the native dwellers that no dichotomy existed between the settlers and the natives. They got integrated in many respects. Assimilation and diffusion marked the Nepalese culture. Nepali becomes a common language for inter-communication with all ethnic groups. But a distinct residential pattern emerged which made each group of settlers confined to a particular geographical location. These settlers confined to a particular geographical location. These settlers thus remained isolated from and untouched by development parameters. Gopali, Gamal and Balami people were also no exception to this.

Gopalis are friendly, tolerant and gentle. That’s why they live in a neighborhood cluster. Male Gopalis are involved in agriculture and some in business. The females keep themselves busy in household work. Weaving is their off-farm activity. Gopalis raise cattle and duck but they do not raise chicken. They are Hindus

by religion and consider themselves to have descended from Lord Shiva and Ganesh. In addition to numerous Hindu festivals, they observe some other festivals like *dhyak, gathemangal* and *hilejatra.* The Gopalis are no more occupational cowherds these days. They are hard-working and follow their traditional culture and customs in good faith. Their culture is a blend of the culture brought by the settlers and that of the Newars with who they had been in contact for long. They speak like Newari, wear Newari dress, and observe Newari feasts and festivals. Most of the Gopalis are illiterate. They hardly send their girls to school. Very few Gopali children can be seen in local schools (CERID, 1991, PP 8-9). But the situation has been changed. Significant numbers of Gopali girls are enrolled in school education. Similarly, some of the Gopalis are in higher education but not as satisfactory. Due to the use of Nepali language applied in school, except some aged illiterate women all can speak Nepali language, this study provides the educational scenario of the Gopalis and their moral characteristics in the attachment with culture.

Another study was also conducted in the Gopali community. Although it was related with health but it provides the developmental trend and their cultural activities related to the health education. Thapa (1989) has done research about Gopali community to know the effect of 'nun-chini-pani' (salt-sugar-water) in Gopali community. His research was not only depended upon the health factor of Gopali community but he has given overall geographical, economic, and educational as well as cultural practices of Gopali community. He is the habitant of neighboring village of the study area. So, his personal influences towards the Gopalis are also mentioned in the study. From which I have got the information about the Gopalis inhabitant of Chitlang village. According to his research, Gopali are helpful, hard workers and lover of the community. This study explored that the ethno-knowledge cannot be

detached with different disciplines like, mathematics, science, social study etc. Each discipline can be found in the community as common. The traditional healing practices among them are still in existence but due to health consciousness and health post near by them, traditional treatment gradually reduced.

In the relation between cultural and the educational background of the indigenous people, Kamal (2004) has done research on Kumal community on the topic "Push and pull forces for Kumal education". He argues that cultural background plays important roles in studying human behavior. He also supports Tylor (2002) that culture as "that complex whole which includes knowledge, belief, art, morals, law, custom, and any other capabilities and habits acquired by man (and woman) as member of the society". Non-schooled culture is being transitioned to the school culture. The effects of modernization change the Kumals cultural education. The priority given to the pottery and farming hampered the educational status of Kumal. Now, the situation changed due to urbanization. This is the period of cultural transition by the result, Kumals do not left earlier culture (pottery/farming) and new culture (schooling) is not fully accommodated. This study further elaborated that Kumal children faced difficulties to adjust in school environment rather than in home environment. So, Kumal children felt difficulty in learning rather than working in the field. One hidden agenda is found in this study that Kumal children are forced to send school and follow modern ways to adjust in the changed environment. "The Kumals have been rather depressed community living in complete isolation from other communities. This has deprived them of the benefits of social –cultural interaction. They still love to live with close relatives-preferably paternal relatives. This finding leads to conclude that Kumal students are living in dilemma because of the lack of the social –cultural interaction". (P117). So the lack of social cultural interaction is the

main cause of affecting the Kumal education. The Gopalis are also in the same category and can be linked in the study.

In the case of mathematics development the connection between the culture and mathematics is compulsory and should not separate them. This has been more elaborated by the study done by Hammond (2000). He has written that 'mathematics is constantly evolving and co-existing with and around culture' (p. 54). Mathematics development is related to the capacity of thinking. So, mathematics is being used as a universal subject because of cultural necessity. It was the forefront of communication and trade and was a tool to the logical conception of our mind. Without mathematical knowledge there could not be communication and trade. He has taken the example of necessity of language in culture and language is affected by the culture. Similarly mathematics is also interlinked with the cultural activities. We see many cultural influences on the way mathematics is studied in our everyday thought. We are reminded of the Chinese abacus and how different cultures study mathematics. Some cultures prize rote memorization and are concerned with a strong foundation of the basic whereas other cultures are more concerned with the more theoretical aspects of mathematics and don't care what calculator, computer software abacus or other aids are used to get there. (ibid 2000, p.52)This belief that mathematics is universal subject is well founded. Every culture appears to have counting, sorting and other mathematical basics, which seem to imply something fundamental and powerful about the basics of mathematics. Every culture has a concept of numbers and the idea that 1+1 =2, no matter how technologically advanced the culture is. We can’t find 2+2=5 in any culture. In most of the languages the base is ten for some others due to the logical counting of fingers on the hand. All mathematical languages have counting and multiplicative elements.

The education of disadvantaged people is influenced by the language, occupation, social status, culture etc. The low voice groups of children have been faced problem in school education. Such hindrances of the cultural groups should require revising in the case of curriculum design and its application. Similarly, for the overall development of indigenous people, their cultural background and the social condition should be learnt and then it will be more applicable. In this issue, Adhikari (2006) conducted a study on the topic ‘cultural discontinuity and learning difficulties in Mathematics a case study of primary Dalit school children’. This study focused on the difficulty in learning mathematics for the Dalit students at grade five. The objectives of the study were to identify the cause of mathematics learning difficulties and its impact in home environment. The study was conducted with the sample size of four Dalit School children from grade five who have just passed class four from the Shree Bani Bilas Secondary School. Purposive sampling is the method of selecting samples. Case study, interview and observation were the tools of data collection which were applied to identify the learning difficulties, influencing factors and impact of home environment on mathematics. Further the researcher used John, U. Ogbu's theory of cultural difference and discontinuity and Madsen's theory of everyday life. Great discontinuity was there in between their everyday life and school activities in school. She found that, the language of Dalit students was very poor. There is discontinuity in interpersonal relationship between students and teacher's understanding. There is discontinuity between practices of mathematical concepts in school and in home environment. There is discontinuity between traditional and modern measurement. The measurement tools which they have used in schools are not applicable in their homes. While concluding this study, home environment does not support the mathematics learning.

Literature on Ethno-Mathematics:

Mogege David Mosimege, from the University of the North in South Africa, is investigating the relationships between cultural games and the teaching and learning of mathematics. The main aim of his current work is to look at various cultural and traditional games that are found in different cultural settings, with a view toward making use of these games in the mathematics classroom. Three games that he has examined so far are "String Figures," "Morabaraba" and "Moruba." Mogege is investigating how these games are played and what are the strategies that players develop, and then looking at how these games might be used to teach children mathematical ideas.

Madalena Santos, from Faculdade de Ciencias da Universidade de Lisboa in Portugal, has been studying how students' mathematical knowledge is structured and developed through the interaction with their everyday activities in the context of the mathematics classroom. She has been working with a group of eighth grade students. Her work is grounded in Saxe's research framework, and she is focusing on the students' appropriation process of mathematical artifacts. She examines the role of (a) social interactions with peers and the teacher, (b) the structure of practice, and (c) the students' individual goals while examining how students accomplish mathematical goals.

Pedagógica, Delegação de Beira in Mozambique, has been examining the understandings that children in Mozambique have of operations such as subtraction and multiplication. Some of their work is focusing on the confrontation between subtraction verbalized in Portuguese and subtraction verbalized in Mozambican languages. They have already found that some Mozambican students' understanding

of concepts of multiplication is influenced by their mother tongues, and their mental addition and subtraction habits are influenced by Bantu numeration systems. The first name to be remembered when speaking of Brazilian Ethno-mathematics is that of Ubiratan D'Ambrosio (1987, 1990, 1991, 1993, 1996, 1997), considered the most important theoretician in this field, both for the quality and range of his academic production, and for the role of leadership and dissemination of the ideas involved in ethno-mathematics, ideas which seek to establish a close relationship between mathematics, culture and society.

The second name to be mentioned is that of Eduardo Sebastiani Ferreira (1987, 1991, 1993, 1994), a pioneer in field research in the Brazilian Ethno-mathematics movement, who performed and guided investigations. His empirical research was/is developed in Native Brazilian communities in the central-west and northern regions of Brazil. Sebastiani Ferreira, based on his activities with in-service and preserves Native-Brazilian teachers, has contributed to furthering the theory of Native Brazilian education, specially focusing on the connections between what he calls "white man's mathematics" and "mother mathematics", an expression which he uses (as a homology to mother tongue) to "express the ethno knowledge of the child [which s/he] brings to school" (Ferreira, 1994, p.6).

Among the studies of Brazilian educators directly connected to ethno-mathematics, we should also mention those of Marcelo Borba (1990, 1992, 1993) with children of a slum, in the state of São Paulo; Nelson Carvalho (1991), with the Rikbaktsa tribe, who live in the central-west region of the country; Samuel Bello (1995), with the Guarani-Kaiowa tribe who live in the same region; Sergio Nobre (1989) about the "Animal Lottery, the most popular lottery in Brazil; Geraldo Pompeu

(1992) about the influences on the changing of teachers' attitudes in a project he developed which attempted to introduce ethno-mathematics in the school curriculum; Adriana Leite about the interrelations between children's games and the learning of mathematics; Sonia Clareto about children's notion of space in a small community of fishermen in the state of São Paulo; and the doctoral dissertation of Mariana Ferreira called *From Human Origins to the Conquest of Writing: a Study of Indigenous Peoples and Schooling in Brazil*, in which she discusses the construction of knowledge in a tribe of the North Region of the country.

From an ethno-mathematical perspective there are mathematics Educators developing works with one of the most important Brazilian social movements: Movimento dos Trabalhadores Rurais Sem-Terra, in english, the Landless People's Movement. It is a national organization, spread throughout 23 of 27 states of the country, involving about seven hundred thousand peasants who strive to achieve Land reform and social changes in a country with very deep social inequalities. Currently there are three Ethno-mathematics investigators working with the Landless People's Movement. Gelsa Knijnik (1993a, 1993b, 1994, 1996, 1997) is developing work in different projects of the Movement, such as Youth and Adult Numeric and in-service Teacher Education. Her work is based in what she calls an ethno-mathematics Approach: the investigation of the traditions, practices and mathematical concepts of a subordinated social group and the pedagogical work which was developed in order for the group to be able to interpret and decode its knowledge; to acquire the knowledge produced by academic mathematics; and to establish comparisons between its knowledge and academic knowledge, thus being able to analyze the power relations involved in the use of both these kinds of knowledge (Knijnik, 1997). The two other researchers working with the Landless People's Movement are Alexandrina Monteiro

and Helena Doria. Monteiro, Sebastiani's doctoral student, is doing her research based on her work with a group of adults in a Numeracy Project. She is investigating their social practices which can be incorporated into the pedagogical process. Helena Doria, under Knijnik's supervision, is doing her Master's research in a settlement in the southernmost state of Brazil.

Mary (Betsy) Brenner, from the University of California, Santa Barbara, is exploring the distinction between everyday problem solving and mathematicians' problem solving practices by examining how students use the two modes of problem solving in the context of small group discussions. For this study, she and her colleagues are working with students in seventh-grade classrooms that are using a curriculum unit that was designed to introduce mathematical concepts involving variables and equations in the context of a thematic problem solving unit.

Marta Civil, from the University of Arizona, is working with colleagues to try to develop mathematics classroom communities in predominantly minority classrooms. In these communities, they are engaging children in doing mathematics (like mathematicians) by working on open ended, investigative situations, sharing ideas and strategies, and jointly negotiating meanings. Civil and her colleagues also are working to have these communities develop from the students' backgrounds and their experiences with everyday mathematics in an effort to bridge the gap between outside and inside school experiences. Data about the students' everyday mathematics experiences are collected through household visits.

Sabrina Hancock, from the University of Georgia, recently examined the mathematics practices of four seamstresses. Her research study describes the mathematics she recognized in the skills, thinking, and strategies of the seamstresses

as well as documents the skills, thinking, and strategies that they attribute to mathematics. She also compares the mathematics practice of the seamstresses with the mathematics practices of other tradespersons. Steven Guberman, from the University of Colorado at Boulder, is examining how students understand and transform school mathematics as influenced by their intuitive mathematical knowledge. He has been working with students in three elementary school classrooms by observing during mathematics lessons and then interviewing students about the content and goals of the lessons and how the lessons were related to their intuitive mathematics and its everyday uses.

Jon Rahn Manon, from the University of Delaware, is studying the ethno-mathematics of upper elementary North American school children. He is seeking to identify children's out-of-school mathematics practice and to describe how this lived mathematics interacts with the reified mathematics of the school curriculum. He was also examined implications for a reformed pedagogy that takes into account this out-of-school practice of children.

Joanna Masingila, from Syracuse University, is examining middle school students' perceptions of how they use mathematics outside the classroom in an attempt to learn more about and build on students' everyday mathematics practice in the classroom. Data were collected by interviews, logs, and follow-up interviews. She found that the mathematics that the students perceived that they used outside the classroom could be classified as one of the six activities that Bishop has called the six fundamental mathematical activities. She was also examining the influence of the students' perceptions of what is mathematics on their perceptions of how they use mathematics.

Michelle McGinn, from Simon Fraser University in Burnaby, British Columbia, recently completed a case study investigating the mathematical activity of two elementary school teachers in different contexts of their everyday lives, inside and outside their classrooms. She found that the teachers' everyday mathematics practice revealed a marked contrast from mathematics practice legitimated in classrooms, including their own classrooms. Judit Moschkovich, from the Institute for Research on Learning in Palo Alto, California, has been working on examining the theoretical assumptions underlying two perspectives of mathematics practice: everyday mathematics and mathematician's mathematics. She has been examining in detail which aspects of school mathematics are compatible with different aspects of everyday mathematics and mathematician's mathematics with the goal of building a coherent conceptual framework for understanding mathematical practices in different communities and for designing classroom environments.

Andee Rubin and Andrew Boyd, from TERC in Cambridge, Massachusetts, are doing research in a setting where they think it is possible for everyday mathematics and mathematician's mathematics to coexist in a natural and important interdependence. Their research is part of the VIEW project at TERC (Video for Exploring the World) and they are studying how learners make mathematical sense of motion phenomena in a Video Based Laboratory setting in which their own movements become mathematical data through computer and video technology. Jim Barta, from Georgia Southern University, will be starting a two phase project with the Seminole people (Florida) to examine from an ethno-mathematical perspective, traditional (historical) daily activities in which mathematical principles were embedded. Phase It can be to interview a number of Seminole tribal members, beginning with three well-placed tribal cultural/educational directors and

representatives who have knowledge of the daily living practices of their ancestors. They have agreed to facilitate additional contact and interviews with a number of other tribal members (Cultural Center Site Directors, Seminole School Administrators, craftspeople, and elders). The accounts and descriptions they provide will be examined to identify mathematical knowledge and principles necessary to complete such activities. Phase II (to be carried out at a later date) will be predicated on the knowledge base developed resulting from Phase I. Its focus will be to design culturally inclusive mathematics curriculum in collaboration with teachers at the Ahfachkee (Seminole) Elementary School in Clewiston, Florida for their elementary students. Ultimately, the research will impact 72 Ahfachkee Seminole Elementary students.

Paolo Boero, from the Universita di Genova in Italy, and colleagues have been investigating some cognitive and didactic issues regarding the relationship between mathematics and culture in teaching and learning mathematics in compulsory school. They have focused on (1) how everyday culture may be used within school to build up mathematical concepts and skills, (2) the contribution that school mathematics may give to everyday culture to allow (and spread) a scientific interpretation of natural and social phenomena, and (3) teaching mathematics as part of the scientific culture.

David Carraher, from Universidade Federal de Pernambuco in Brazil, and colleagues has been examining ways in which knowledge learned in one situation might be transferred to other situations. Their work has convinced Carraher and his colleagues that the ways in which students learn to deal with new specific situations involves remarkable use of previous knowledge as analogies, categorizations, comparisons across situations, search for correspondences between different settings,

as well as generalizations, and that to recognize them as such one needs to set aside stereotyped/formal views about what transfer and use of previous knowledge are.

Venus Dawson, from the University of California at Los Angeles, is examining the mathematics practice of basketball players in an inner city basketball league. She is particularly focusing on how the players make sense of and use concepts related to statistics. In a second phase of her study, she is investigating how some basketball players and some non-basketball players make sense of problems involving statistics when the problems are similar to those found in school textbooks and when the problems are framed in a basketball context.

Guida de Abreu, from the University of Luton in the UK, has been investigating how children growing up in a rural sugar-cane farming community in the state of Pernambuco, Brazil, experience the relationship between their home and school mathematics. When engaged in the practices of sugar-cane farming, people in this community make use of an indigenous mathematics that differs markedly from the mathematics taught in the local schools. As part of this study, Abreu studied two teachers who taught in the primary school in this rural community. Both case studies illustrate that to come to terms with the situation (i.e., the wide gap between the students' home and school mathematics), teachers develop representations of mathematics that enable them to: (1) understand and explain the situation and also justify their teaching practices, and (2) locate themselves and the children in the social structure of the farming community.

On May 1995, Maria Luiza Oliveras Contreras presented a doctoral dissertation at the University of Granada, Spain, with title *Ethno-matemáticas en Trabajos de Artesanía Andaluza: Su Integración en un Modelo para la Formación de*

Profesores y en la Innovación del Currículo Matemático Escolar [Ethnomathematics in the Artisanal Work in Andalusia. It's Integration in a Model for Preservice Teacher Training and in Innovation of School Mathematics Curricula]. This important work is the result of more than 10 years of research on the mathematics identified in artistic artifacts typical of Granada. Three kinds of these were chosen for the research: *empedrados* (stone pavement), *taraceas* (marquetry) and *alfombras* (carpets). A very original ethnography is proposed by the author to identify the mathematical contents of these beautiful handworks. An ethno-mathematical theoretical framework allowed the recognition of important styles of doing mathematics which would be unrecognizable with the prevailing views of academic mathematics. An important aspect of the theses is researching the way the techniques of work are transmitted among artisans, the masters and the apprentices. This was very appropriately called "ethno didactics" by the author. And the methods there observed were important in proposing a structure of teacher training through projects. We recognize there a model of training teachers to act as researchers. This important contribution to Ethno-mathematics will probably become a book in the series published by the Department of Didactics of Mathematics at the University of Granada.

In March 1995 Gelsa Knijnik submitted to the Faculty of Education of the Federal University of Rio Grande do Sul, in Porto Alegre, Brazil, a thesis under the title *Cultura, Matemática, Educação na Luta pela Terra* [Culture, Mathematics, Education in the Struggle for Land] . This very important work is the result of several years of research among teachers of the so-called "Movimento dos Sem-Terra". This is a political action with the objective of occupying the lands which, according to Brazilian constitution, are subjected to expropriation for land reform. The effective possession of these large tracts of land after the occupation implies several legal

démarches which may take years, normally about five years. Meanwhile, those occupying the lands are confined to these areas and have to develop their own social structures: schools, medical assistance and production. They cannot leave the territory and the support they receive is nonpermanent, obeying humanitarian demands. In this period of confinement they have to rely on their own resources. These rural populations have a minimal education and have to run their own surveying and land demarcation practices, and the production system, as well as their schooling. There is so much mathematics in all these activities. The ethnographic research of Gelsa Knijnik focused on identifying the ethno-mathematics of these processes and giving the supporting instruments to integrate these practices in a school mathematics curriculum relevant for their immediate needs and allowing the transition to the official school system after overcoming the legal obstacles. How to conduct the teacher training for these parallel educational systems, relying, of course, on the human resources provided by uneducated confined population, is a major challenge. The thesis of Knijnik presents a socio-political and pedagogical study of these issues, always stressing the Mathematical content in every step of the process. The theoretical framework includes a thorough discussion of conceptual aspects of ethno-mathematics.

In April 1995 Adriana Isler P. Leite presented a dissertation to the Programa de Pos-Graduação de Educação Matemática of the Universidade Estadual Paulista/UNESP at Rio Claro, under the title *A Brinadeira é Coisa Seria: Estudos em Torno da Brincadeira, da Aprendizagem e da Matemática* [Playing is serious: Studies about playing, learning and Mathematics]. The dissertation was the result of an extended ethnographic research over three years involving children aged between 5 and 8 years old. The focus was in understanding the way children play spontaneously

and recognizing the mathematics contents of these activities. The theoretical framework was ethno-mathematics and the ethnography adopted, with the analysis of about 60 hours of video taping, lead to an important contribution to understanding the formation of mathematical concepts in early childhood. It is of much importance to the conceptual discussion of the nature of ethno-mathematics in view of the theories of cognition and learning, particularly of Vygotski.

Marianna Kawall Leal Ferreira submitted a dissertation to the University of São Paulo on *Da Origem dos Homens a Conquista da Escrita: Um Estudo sobre Povos Indigenas e Educação Escolar no Brasil* [From the Origin of Men to the Conquest of Writing: A Study of Indian Peoples and School Education in Brazil] dealing with the construction of knowledge in an Amazonian tribe. Very careful research was conducted among a number of different tribes of the *Parque Indígena do Xingú*. A variety of cultures provided the author with the opportunity to understand the historical and philosophical ground upon which these tribes build their knowledge. Several aspects of Indian culture, as seen in the schools of the tribe, are analyzed, focusing on the educational processes which give emphasis on the transmission of "official" knowledge and values.

Samuel Lopez Bello submitted a dissertation on *Educação Matemática Indígena -- Un Estudo Etnomatemático dos Indios Guarani-Kaiová do Mato Grosso do Sul* [Indigenous Mathematical Education -- An Ethno-mathematical Study of the Guarani-Kaiovaa Indians in the State of Southern Mato Grosso] . The dissertation refers essentially to questions about education, particularly mathematical education, among Indian communities in a somewhat remote State in Western Brazil. The main objectives were to identify and recognize different ways of explaining and knowing in

the Guarani culture and to relate these with the strategies of formal schooling. The ethnographic research gave origin to new methodologies and techniques on participant observation. New interpretations of cognitive models among indigenous cultures resulted from the research. An important result was the recognition of the role of the history of the individuals and of the communities in the cognitive processes. Among the variety of topics discussed, particularly important were questions about shapes, measures and counting.

Cultural Dimension on Mathematics:

Alan J. Bishop. (1989). ‘Report of Working Group on mathematics in Different Cultures’ Leeds, England This group felt that although its brief might have appeared limited at first sight, it has important points to make to everyone concerned with popularization. The term "culture" can, and should, be interpreted broadly in order for popularization to stand any chance of success.

The key aim of popularization is to overcome alienation. We identified power imbalance in society as one of the fundamental causes of alienation, with "Western" mathematics being seen to be a strong part of the "education" system helping to alienate various groups in different societies.

In some countries there are indigenous cultural groups as minorities (e.g. New Zealand, Australia, USA, Canada, Finland) and in the majority (e.g. South Africa) though in all those countries the dominant culture group assumes Western Mathematics to be the only mathematics worth knowing.

In Africa and South America there are ex-colonial societies trying to identify their own view of Mathematics, while in Europe, North America and Australia there are new immigrants feeling alienated from the "resident" culture

In all these situations it is as much the process of cultural alienation which needs to be overcome as the dominant mathematical view itself. This implies some particular consideration that: who does the popularizing?" is a key question. Basically, "we" can't do it for "them," and we need to recognize the need to develop such notions as bilingual/bicultural units, family and community groups and leaders, indigenous leaders and popularizes. Most popularization is carried out in the language of the dominant group and this issue needs addressing. Culture and language are intertwined, and language is for many the heart of culture. "Their" language expresses "their" mathematics. Everyone in mathematics and Mathematics Education needs to be aware of the cultural nature of mathematics. Western mathematics is a particular form of knowledge having a particular cultural history. This fact needs to inform all kinds of popularization. Awareness is not enough though, and in the context of this seminar, legitimating is crucial - that is, popularization must legitimize mathematical ideas which are not in the dominant mainstream. It means legitimizing other forms of mathematical knowledge and values, and it means legitimizing the activities of those mathematicians who practice in other cultural groups. There are appropriate and inappropriate ways to talk about knowledge and to use knowledge in different cultures. This demands sensitivity within the popularization process, encouraging again the need for other cultural representatives to be engaged in the process. The early mathematical knowledge of the dominant group should not be ignored in any popularization; otherwise there is a danger of other cultural knowledge being projected as primitive and inferior. In other words, old non- western mathematical

ideas should not be contrasted with new western ideas. There are significantly different conceptual frameworks in different cultures and mathematical ideas will not necessarily be separated from other ideas in the ways that western mathematics is. Care should be taken not to glorify, or make exotic, other peoples' culture. One may well be referring to westerner's historical version of that other culture which may not coincide with the other person's present views.

The western cultural tradition tends to think of mathematics as a unique flowering of European culture, and insofar as the history of the subject is taught in schools in the United States, it may appear to be so. However, cultural evidence suggests that mathematics has flourished worldwide and that children benefit by learning how "mathematical practices arose out of the real needs and desires of all societies" (Zaslavsky, 1989). Students should learn that mathematical thinking is part of the basic human endowment. For as Anthropologist Edward T. Hall (1977) stated: *"Most cultures and the institutions they engender are the result of having to evolve highly specialized solutions to rather specific problems."*

It is this very universality of mathematics that can become the most obvious contributor to a curriculum that seeks to address any challenges coming from diverse populations. Math developed by many non-European cultures can communicate recognition and a valuing of the cultural heritage of ethnic minorities present in the classroom, whereas not doing so can communicate the opposite. This perspective can help minority students by increasing their knowledge of and respect for the cultures of their origins, at the same time informing students from the majority culture about the mathematical richness of the various cultures whose people now live alongside them.

Additionally, students need to learn to identify, respect and value alternative solutions to problems, as well as the many unique and varied approaches to problem solving.

"Schools should prepare individuals to take part in the dynamic pluralistic society by teaching respect and value for different positions, by encouraging students to rely on the scientific method of problem solving, and by fostering a commitment to the general welfare of society (Appleton, 1983, p.93)."

An understanding of minority and learning styles can offer important insight for the development of experiences and problem solving tools relevant to the mathematics classroom. This awareness is important in order to build an understanding of why many minority students experience difficulty in certain contexts. An understanding of differences in learning styles allows the teacher to build upon a student's strength, instead of considering these differences as a deficit. A particular cognitive style, encompassing "the way one perceives and thinks about the world" including "thinking, perceiving, remembering and problem solving" is culturally determined (Appleton, 1983). Developing a cognitive style in learners encourages diverse and creative methods, through cross cultural sharing and interchanges should become a vital attribute of any mathematics program.

Learning and Culture:

The mental activity is part of the overall human endowment, yet at the same time, much of the way it is directed is culturally determined (Appleton, 1983). Cognitive style, or the way in which a person "encounters, orders and thinks about the world" (Appleton, 1983) influences how well a student performs in a given academic environment. Experience in multicultural learning environments, and specifically,

experience in dealing with more than your own culture, exposes learners to alternative methods in perceiving the world around them. Hall (1977) has said:

"The natural act of thinking is greatly modified by culture; Western man uses only a small fraction of his mental capabilities; there are many different and legitimate ways of thinking; we in the West value one of these above all others--the one we call "logic", a linear system that has been with us since Socrates.

The "ability to solve problems, or create products, that are valued within one or more cultural settings" (Gardner, 1983) is a valuable asset for all societies. Finding ways to tap into the diverse strategies that exist within any given classroom should become a primary concern. While at the same time, a teacher can encourage those linear/logical methods that connect all students to the dominant culture. The recent call for a re-direction in mathematics education (Commission on Standards for School Mathematics, 1989) as well as certain computer software activities offers an extraordinary opportunity for educators to accomplish this goal.

Table 1 outlines the following discussion, as gleaned from the literature on culturally determined differences in learning styles for school-aged children. It is understood by this author that not everyone falls into one or the other group. The literature has supported the idea that most children come to school stronger in one or the other style. Presently, the dominant culture stresses, indeed appears to have built its curriculum upon, the majority learning style. "Successful" students, as labeled by the dominant culture, tend to be better at the use of those items that are in the majority category.

Table 1: Learning Styles

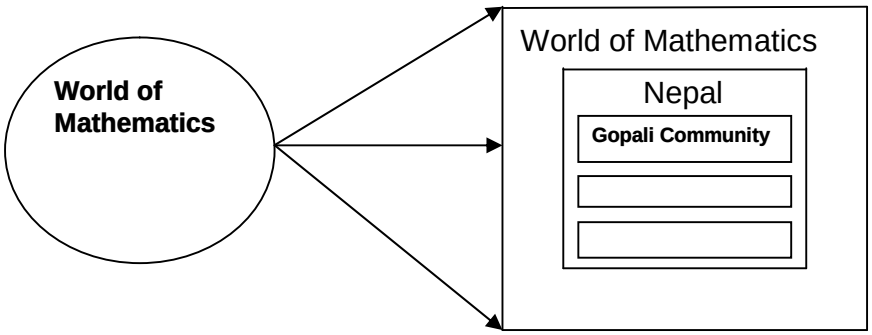
Minority	Majority
People-oriented	Object-oriented
Relational	Analytical
Field Dependent	Field Independent
Polychronic Time	Monochronic Time
(P-time)	(M-time)

While giving many students timed tests, dittos, rote memory work, or works that asks them to copy and answer (often meaningless) problems, is mind-numbing for many children, it is particularly alienating for many minority children who come from cultures where human interaction and cooperation are highly valued. Though there are times when these activities are necessary, it is imperative that teachers in multicultural environments understand that their students may have particular difficulty with these kinds of solo work activities. It is imperative that the teacher in an ethnically diverse environment use cooperative strategies for problem solving because minority students come from cultures that place value upon interpersonal communication encouraging all students to work together in cooperative groups and gives opportunities to communicate mathematics information (Kantrowitz & Wingert, 1989). As well, learning to work successfully with other people, in a dynamic and complex environment, is vitally important in an information society (Peters, 1988). The multicultural perspective on mathematical instruction should not become another isolated topic to add to the present curriculum content base. It should be a philosophical perspective that serves as both filter and magnifier. This filter/magnifier

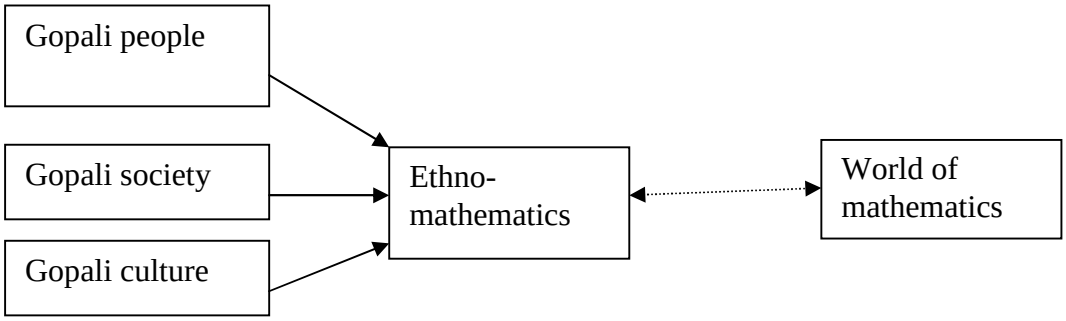
should ensure that all students, be they from minority or majority contexts, will receive the best mathematics background possible. Every step a teacher makes in designing, planning and teaching mathematics should be fed through the filter and exposed to the magnifier. It is possible that the most interesting aspect of what NCTM has proposed not only is good for the majority student population, but empowers the minority learner as well. In this regard, education should be related with local base or should interlink between school and local practices. This study is also aimed to interlink of the

Conceptual Framework

Global Trend in Mathematics Education



Mathematical Education Through Ethno-Mathematics



The literature reviewed in this study tried to explore the ethno-mathematics concept from different cultural group and tried to relate these with the formal school education. Schools are considered as the common home of different cultural group. Either teacher or students all have own cultural background. So, school education without cultural relation cannot be meaningful. The historical knowledge and their practices provide the strength of culture. In the name of modern education, students are focused towards western knowledge rather than local knowledge and practices. Many literatures show that the area of ethno-mathematics focused in the primary level education. It is difficult to focus the study in higher education because community people generally practices simple mathematics in their daily use. This study is also focused on primary level ethno-mathematics practices in Gopali community.

In the context of Nepal, there is no connection between school mathematics and ethno-mathematics. As a result children from cultural groups have been facing the difficulties in learning. Mathematics is being difficult subject in the comparison to the others. One of the causes of maximum dropout is the knowledge gap between culture and school because student has to face new environment which is distinct from their home environment. Ethno-knowledge are practiced in verbal communication but not in written form. The emerging requirement in school education is to relate the school education with cultural education. Two ways bridging between modern mathematics and ethno-mathematics is the concept of the study and the preservation of ethno-mathematics is also focused in the study.

The modern trends of mathematics are advance in nature which is difficult to adopt by illiterate group of people and the simple calculation / application of ethno-mathematics is not promoted in educational field. Both practices of mathematics can

be interlinked if the priority is given to the ethno-mathematics in the academic field. The issue of ethno-mathematics can be addressed positively by the government and curriculum designer. It is also becoming necessary in the alternate way of teaching learning process.

CHAPTER- III

Research Methodology

This Chapter deals with the ways of writing study in systematic pattern. Thus we talk of research methodology. We do not only talk of the research methods but also consider the logic behind the methods we use in the context of our research study and explain why we are using particular methods or techniques and why we are not using others (Kothari, C. R. 1995. p. 11). This section covered the whole methodological queries of the study. Because of qualitative design of the study, it is related to the cultural study more focused is given to the empirical inquiry in the natural setting. Few numbers of informants were chosen for in-depth study. Simultaneously, the general practices among Gopali community are also covered by the information collection procedure. More emphasis is given to the field study rather than other aspects of the information sources for the fulfillment of the research questions of the study. For the convenient and coverage of maximum information, interview and the participant observation methods are applied. More time is given for the collection of information and the interpretation. Emergent design of guidelines questions, communicational approach of inquiry, follow-up interviews, involvement in the cultural and daily life schedule of them are some process of information collection. The study is guided by the ethno-methodological understanding and the approach of grounded theory. From both points of view, cultural study in related to the ethno-mathematics has become easy access of the information collection and the interpretation. “Why a research study has been undertaken, how research problem has been defined, in what way and why the hypothesis has been formulated. What data have been collected and what particular method has been adopted, why a particular

technique of analyzing data has been used and most of similar other questions are usually answered when we talk of research methodology about research (Dhoubhadel & Bajracharya, 2003). Such queries are sincerely followed for the significant result of the study. This chapter covers the major themes of the analytical description, informants/samples, tools, procedures of the study. The main tools and strategies of data and information collection are guided by the methods applied. The chain of information collection helps the study in the conclusion.

Ethno-Methodological Techniques

The ethno-methodology study is focused on the continuous type of the study. It is clear that cultural study never terminate but use to limit within timeframe and the satisfactory level of the researcher in the qualitative inquiry. This study is also the part of the Gopali cultural study. Ethno-methodology concentrates the intelligent activities constitute by the community members. “Ethno-methodology can be described briefly as a way to investigate the genealogical relation between social practices and accounts of those works (Lynch, 1993, cited in Seale Clive et. al. 2004). Ethno-methodology further elaborated as the conversation analysis (CA) in the research field. So, it is designed for the natural setting inquiry in the cultural context. The daily life style, historical evidence, cultural activities, children’s games are the focused area of the study guided by ethno-methodology and got the proper path of the study.

The ethno-methodology is the major methodology of the study which addresses the problem of order by combining a 'phenomenological sensibility' (Maynard & Clayman, 1991) with a paramount concern for everyday social practice (Garfinkel, 1967). From an ethno methodological standpoint, the social world's facility is accomplished by way of members' constitutive interaction work, the

mechanics of which produces and maintains the accountability circumstances of their lives. In a manner of speaking, ethno-methodologists focus on how members actually 'do' social life, aiming in particular to document the mechanism by which they concretely construct and sustain social entities, such as gender, self, or family (Dengin & Lincon, 2005, p. 486). Because of Gopalis' study, ethno-methodology is suitable / appropriate for the study purpose. The ancient and present practices of Gopalis related to mathematics education are the area of methodological application.

The ethno-methodology aims to study members' methods they are persistently used in the construction of the social world. There are two main varieties of investigation. The first is illustrated by Garfinkel's experiments in the disruption of everyday life. Garfinkel asked students to go home and behave as if they were lodgers. The reactions of parents and relatives were dramatic, at first puzzled and then hostile. For Garfinkel this illustrates how carefully constructed, yet delicate, is the social order of everyday life and in other studies (of Jurors, for example), he investigated how people constructed this order in different settings while taking it entirely for granted. The second type of ethno-methodological investigation is conversational analysis, the study of the social organization of talk.

Since the publication of studies in ethno-methodology in 1967 has developed in various ways, one of the most important is the emergence of conversation analysis (CA) as a related-as-well-as-separate discipline. CA is related to ethno-methodology in its stress on the local achievement of order by the use of socially organized procedures, most notably sequential organization, which can be seen as one of the major ways in which 'indexical expressions' gain their local intelligibility (Maynard & Clayman, 1991). While, in these cases, a researcher's own experiences play an

important role, in others ethno-methodologists have used more or less ordinary ethnographic fieldwork practices. They have been closely observing situated activities in their natural settings and discussing them with the seasoned practitioners, in order to study the competences involved in the routine performance of these activities. To further close this study, or to be able to study these activities after the fact, recording equipment is often used, but researchers may also rely on traditional note- taking in order to produce their data.

Use of Grounded Theory

As per the nature of the study, grounded theory is applied for the systematic analysis and interpretation of the information obtained from field of participant observation and interview.

The grounded theory in contrast is formal, abstract theory obtained by logico-deductive methods. Grounded theory is grounded in data which have been systematically obtained by social research. The development of grounded theory was an attempt to avoid highly abstract sociology. Grounded theory was part of an important growth in qualitative research in the 1970s which sought to bridge the gap between theoretically uniformed empirical research and empirically uninformed theory by grounding theory in data. It was a reaction against grand theory and extreme empiricism. The concept is a truism; because one cannot collect data without theory of develop theory without an empirical reference (Abercrombie, 2000, pp 157-158)

In the early days, grounded theory offered first and foremost a vision of how to do theoretically innovative research, from project design right through to writing up. Its authors believed that theory could and should be stimulated through and

'ground' by- empirical research and they set out to show this could be done. They asked and answered some pretty basic questions about how to do theoretically relevant research: how to start, how to precede, how to stop. First of all this requires of the researcher a sensitivity to empirical evidence a disposition to 'discover' ideas in data without imposing preconceptions. Grounded theory was conceived as a way of generating theory through research data rather than testing ideas formulated in advance of data collection and analysis. Second, the process of generating ideas through data requires an innovative approach to data collection. Instead of identifying a sample at that outset, grounded theory involves a process of 'theoretical sampling' of successive sites and source, selected to test or refine new ideas as these emerge form the data. Sites and sources are selected flexibility for their theoretical relevance in generating comparisons and extending or refining ideas, rather than for their representational value in allowing generalizations to particular populations. Third, grounded theory relies primarily- but not exclusively-on qualitative data acquired through a variety of methods: mostly observation and unstructured interviews in the initial stages, then more structured forms of data collection as the study becomes more focused. Thus decisions on sampling and data collection develop as the project progresses, informed by and not merely anticipating the results of ongoing data analysis. The process of analyzing data, fourthly, centers on 'coding' data into categories for the purpose of comparison. These categories are analytic-not mere labels but conceptualizations of key aspects of the data. And categories are also sensitizing, offering meaningful interpretations of the phenomenon under investigation. Through 'constant comparison' their relations and properties can be identified and refined. Finally, grounded theory offers pointers to how to bring the research to a successful conclusion. Data collection stops when categories reach

'theoretical saturation', that is, when further data no longer prompts new distinctions or refinements to the emerging theory. Data analysis stops when a core category emerges around which the researcher can integrate the analysis and develop a 'story' encapsulating the main themes of the study.

In grounded theory there is an important distinction between emergence and forcing of data. Forcing is what happens when researchers look for specific things and ask questions according to preconceptions. Emergence of data is a result of a flexible, open approach to the field where various events and activities and registered from different context and settings (Madsen 1999, P. 30). Grounded theory is applied here in the purpose of cultural study in the unstructured way of natural setting.

The grounded theory is adopted here for the collection and interpretation of the information. Not only that, this study is guided by the grounded theory. The finding of the study depends on the information achieved from the Gopali community's literature review. Every activity was overlooked in natural setting and their relation / connection to the other references is the way of study. Generating theory from ground/ study area is the way of concluding the mathematical concept adopted by indigenous people.

In the empirical study, readymade theory might not cover all aspects of the field. Because of ethnographic study, demands to achieve information like their mythical story, poem, dialogue, drawing, painting, architecture, activities of feast and festivals etc. which is possible by the grounded theory. So, the grounded theory has applied for the study of overall activities of Gopali community. The grounded theory gives the processing ideas like how to start, how to precede, how to stop, and the

sensitivity towards are sincerely adopted in the study duration. For example, I went to field without setting any questions. My study started as conversation from small tea shop among a group of the Gopali people. I got some clues to make further plan which was emerged from the field. During field period, activities are focused on the observation and interviews in the initial stage and gradually constructed as the research questions then the study got the proper shape. It means there were no preconceptions imposing them. I was not also imposed by any format for information selection in the process of inquiry. I have visited three villages where there are majority of Gopali inhabitant.

As grounded theory, data analysis stops when a core category emerges around which the researcher can integrate the analysis and develop a 'story' encapsulating the main themes of the study. The final form of completion of information were formulating in the field. Only the remaining part of grouping and regrouping of the information was next step of interpretation. The flexibility and open approach of inquiry adopted here as the concept of grounded theory.

Rational of Site Selection

The area which is taken for the study purpose is nearby Kathmandu. But due to lack of transportation and communication facility people are still backward. The Gopali community taken for the study is the major population of Chitlang village. The agricultural occupation of them and own way of living in traditional manner are their characteristics and the less impact of globalization, typical Gopali villages are the main causes of selecting area. They have well recognition in the ancient history of Nepal as first ruler of Nepal. So, the special research should be conducted from which their cultural identity, situation educational status and historical background can be

introduced. The health related study was conducted, that could not cover their cultural values and norms. As far as my understanding two cultural studies are in process but not completed yet. In this scenario, this study definitely carries great value in the anthropology and academic field of inquiry. Among indigenous groups, the Gopali is one of the culturally rich groups and many more educational implications can be drawn from them. They cannot be neglected by any researcher or study group in the case of cultural as well as indigenous study. So, this study is also focused among the Gopali community.

I have selected Nhulgaun, Taukhel and Kunchhal villages of Makawanpur district where most of the inhabitants are Gopalis. The significance of field selection is that the Gopali do not have great change from the past. The location map of the study area is attached in Appendix- IV. We can see ancient practices in the present situation. The old people have been giving continuation to the cultural activities but the young generation is a bit far from this. The compulsion is that the head of the each family must involve in cultural and religious activities other wise they are neglected by the community which helps to preserve and give continuity to the cultural and religious practices. They perform many festivals and *jatras*. On such occasions, there is compulsion to participate from each family according to the rule and regulation of such festivals and *jatras*. This proves that the Gopalis have own cultural identity and appropriate group of people for ethno-mathematics study which requires original culture and traditional evidences etc.

Informant Selection

In the case of sampling design, I used non-probability sampling which does not afford any basis for estimating the probability that each item in the population has

included. In this type of sampling, items for the sample are selected deliberately by the researcher; his choice concerning the items remains supreme. In other words, under non-probability sampling the organizers of the inquiry purposively choose the particular units of the universe for constituting a sample on the basis of the small mass that they are selected out of a huge one will be typical or representative of the whole. Purposive sampling procedure is adopted for the selection of key informants. It was designed in the field rather than presumptions because I didn't know about the informants and their background. Communicational approach of ethno-methodology supported me to select the informants as required. For the coverage of cultural, religious, historical, vocational, social, games, domestic activities, informants are chosen as like illiterate social elite, aged women, and children. So, the selection of the field and informants of the research questions, I have selected the persons who take interests for providing the information without any hesitation. Purposive sampling is the way of selecting the research place because "the researcher handpicks subject on the basis of specific characteristics, building up a sample of sufficient sizes when multiple groups are to be selected, but it is difficult to justify the representative ness of the resulting samples. (Thomas R. Black 1999, cited in Dhakal, 2003, p. 19). Due to ethno-mathematics study, I have focused my study with local illiterate people. The study is of the qualitative type because it emphasizes on culture and their ethno-mathematical practices.

The purpose of selecting the social elite is to collect historical information as well as the comparison of past and present cultural activities. The skilled person was essential in this study because they are playing great role for the continuation of the traditional culture. The people who are not very much influenced by the modern culture considered as the informants of the study. Three social elites were chosen

purposively and to observe their day to day activities was the characteristics of the study. This study did not categorize the informants as gender perspectives. Total eight key informants are chosen for the study. The details of the informants are attached in the Appendix - V. The age factors of the informants are of above fifty except children.

Tools/ Instruments

In the case of ethnography study, there are many methods of inquiry but I have used two methods i.e. interview and participant observation. The case study method was not considered as major methods. It is also one of the methods of ethnography study but the key informants were chosen as the major sources of the information of the study purpose. This study was focused on ethno- mathematical information whether that might be specific in Gopali culture or the common practices of the indigenous groups. So, the case study method was not incorporated although it is applicable in such study.

The main tools/instruments of the study are the participant observation and interview. Participant observation, key informants' interview is the methods applied in the study for the purpose of information collection, guidelines tools were developed for the collection of information which are attached in the Appendix-VI & VII.

Participant Observation:

In the ethnography study, observation is most required to understand the cultural practices. The participant observation demands such cultural study. The participant observation was created during the late 19th century as an ethnographic field method for the study of small, homogenous cultures. The ethnographers were

expected to live in a society for an extended period of time (2 years, ideally), actively participate in the daily life of its members, and carefully observe their joys and sufferings as a way of obtaining material for social scientific study. This method was widely believed to produce documentary information that not only was "true" but also reflected the native's own point of view about reality. As participant observer, I stayed in one of the Gopali's house. They are too much busy in their agricultural occupation. So, without disturbance or in natural setting all the information were collected. Going to the field, playing with illiterate children near by forest, watching the daily practices of Gopalis were my field schedule.

Interview:

Another method for information collection was interview that was used with the key informants. Both observation and interview go simultaneously while observing the present activities. Interview applied for the understanding of past activities and the activities which could not held in the period of field study. The guideline questions were prepared for the interview of informants. "Any elicitation of information for an ethnography proceeds from the general to the particulars of an individual's knowledge. The interview sequence follows the same progression-one usually starts by engaging the consultant in an open-ended interview, posing general indirect, or grand tour questions first. Eventually, as the focus narrows toward specific key terms on topics, questions with a narrower range or structural questions are asked to elicit greater detail on particular items. All of these are mini-tour questions (Werner & Schoepfle, 1987, p.314). Some information can be collected from participant observation but some are out of these tools. For example, the information of ancient practices and annual practices should be collected by interview tools. The open-ended

questions were asked to the informants in continuous basis up to the end of field period. Eating with them, singing/ listening songs and story were the tools applied for interaction with them. Within limited period, without disturbance, field study went ahead. Similarly, taking photos of ancient artifacts and visible things and inquiry about them was the area of interview tools. The mathematical process preserved in making the things and their cultural background related to the mathematics was one of the ways of interview.

The ethnographer find no systematic, internally ordered data if there is no structure to one's interviewing. While the ethnographer may get a general idea of things through a conversation, more precise and detailed information may be gathered through a well-constructed interview guide. Two extremes of the continuum between open and closed interviews are open-ended conversation and perhaps, a standardized questionnaire such as a personality inventory test. The open-ended interview can be more structured than a conversation. It is a type of conversation dedicated to a specific purpose and to specific safeguards of methodology. This study was focused on the open-ended interview tools in the informal setting.

I have focused the study on "Grass huts" setting rather than the white room setting because the field area is accessible for me. I should not face difficulties to contact with the informants. In the farming period they must involve to cultivate while in the leisure period they spend time for weaving handicraft. It is not required to make schedule of field because I have involved in their daily life setting. Asking question in natural setting helped me to collect more than more authentic and real information.

Participatory Activities

The total duration of field in the Gopali community was of one and half month. In the initial period of my field study, I was fully involved in the observational inquiry. Because of new environment, community and different mother tongue people, every thing was new and curious to me. Mr. Karna Bahadur Gopali, the person met in the field from the Gopali community, his cooperative nature became easy to interact with other Gopalis. Not only this, he has also permitted me to stay in his house during the field study. It was better to stay in Gopali house because the study is focused on Gopali community from which it became easier to understand indoor and outdoor activities of them.

The small tea shop of Narayan Das Gopali was another important place for information collection. It was among the Gopali village. The trend of meeting aged Gopalis in the tea shop is common early in the morning and sharing past experience and present activities among them. So, tea shop can be considered as information center. I have also benefited from there. The providing free tea cups for Gopalis who were present there was my great pleasure and way of adjustment and information collection. In this way, I came to know the key informants for the study purpose. I used to be in the activities of key informants for the information. Because of agricultural occupation, it was quite difficult to find people in leisure or taking rest. So, meeting them in their own activities and involving with them was my way of information collection. Information which was collected in this way was noted at night. With the morning glow my duty was started with Gopali community for the collection of further new information which was untouched and gave continuity to the previous incomplete information. In this way information was collected in field by

involving in their own world, by eating with them and by transfiguring me in the Gopali community

Although Gopali have own mother tongue, they can easily speak Nepali language as I speak. So, I did not face the problem of communication in the field period. Because of same language interaction, I feel easy of interpreting the information. In the case of difficult understanding, it is better to include

CHAPTER- IV

Ethno-Mathematics in Gopali Community

This chapter is designed for the interpretation of the indigenous mathematical concepts inherent in the Gopali community. The ethno-mathematics of the Gopali community collected from the different tools like participant observation, follow-up interview, and informal discussion are discussed. I have categorized the whole information on similar manner like children practices of mathematics, social elite practices of mathematics, and women practices of mathematics. The perception of the knowledge of understanding of mathematics learning like counting system, addition, subtraction, multiplication, measurements geometrical application by the Gopali community is through the analysis and interpretation of the collected information etc. How mathematics is perceived by them in their daily uses and cultural practices are summarized in this chapter.

This study is guided by Grounded theory. It offers the indicators to the study are bringing out to a successful conclusion. In this context, data collection stops when categories reach 'theoretical saturation', that is, when further data no longer prompts new distinctions or refinements to the emerging theory. The analysis of the data terminates when a core category emerges around which the researcher can integrate the analysis and develop a ‘vision’ encapsulating the main themes of the study. It reminds as the view of Franz Boas (Boas in Stocking, 1968:p.63, Cited in Ulin, 1984 pp. 1-11).

With the background of grounded theory technique, let us discuss the measurement practices, number concepts and geometric practices of the Gopali community.

Length Measurement Practices:

The development of measurement system is the natural outcome of the human civilization. The art works can be sufficient documents for the study of ancient measurement practices. Without measurement, the construction of temple, palace, painting, instruments, houses etc. are impossible. Although, there were no standard unit but the concept of measurement was there. It must be the concepts of the ancient people about the door in a house those should go through comfortably and directed them to develop the concept of height of the door and the concept of width of the door. On the other hand, there should be a convention of non-standard unit for measurement. Obviously, the simple example of door can be considered natural length measurement units like *hat* (length of hand), *bitta* (fingers' length) were used. Such non-standard dates back to Kautilya or Bishnu Gupta (321 BS) from his book entitled *Kautilya ko arthasastra*, where it is introduced the natural units *"hasta"* (cubit) for the measurement of length in the planning of construction of fort. This is a very obvious convention of measurement system developing upon the natural units in different cultures of the world.

In the medieval period, the then rulers tried to systemize the measurement units of ancient period. The credit goes to the King Jayastithi Malla who played great role in the length measurement units. He coined the units of length measurement in Newari Language called *ku, bitta* and *langu.* The culture and customs of Gopalis resemble to Newar civilization. As per the study conducted by Budhathoki (2039 BS),

King Jayasthiti Malla coined *tango* which means seven and half. The measurement units of length developed by Jayasthiti Malla were used for the land measurement and other constructional works. The land measurement system of study area is *ropani* system which is the developed stage of the natural units coined by him.

The information collected from the informants and the historical study found the same concept. So, it can be considered that the length measurement coined by King Jayasthiti Malla and the Gopalis practices of measurement is similar. It means Gopalis follow the measurement units coined by him. The land area of *ropani* is considered as 4 *muri* paddy production areas. While relating to the hands unit one *ropani* equals to 6400 sq. hats while the land is of square shape then the length of each side equals to 80 *hats.*

Another bigger unit of length measurement unit used in the past and present is "*kosh"* (The length measurement unit of walking distance). While asking to the informants about the distance between Kathmandu (The Capital City) to their village was answered as 2 *kosh* while traveling the way of Chandragiri and 15 *kosh* walking of Tribhuvan Highway. It is not only the practices of villagers but also used in official documents of Nepal. There are two concepts of length measurement of *kosh* system, one is *rumal* (handkerchief) *kosh* and another is *hatti* (elephant) *kosh*. The *rumal kosh* means walking distance in the time duration of drying handkerchief and *hatti kosh* means the walking distance of an elephant taking a rest after running. Such non-standard units are still in practice among the Gopalis.

For the measurement unit of the *bitta,* Shrestha (2007) identified the relation between *bitta* and *angul* with the help of ancient example. He has noted that: 1 *bitta* = $3\sqrt{1729}$ *angul* = 12 *angul*. He also clarified that in the medieval period, King

Jayasthiti Malla had issued that his 24 *langu* as one *ku*. Thus, two *bittas* is equal to one *ku.*

From this study, it is concluded that the length measurement units used in the past were both standard and non-standard. Non standard units were more in practice because the length of hands differs from person to person. But while Jayasthiti Malla developed fixed units i.e. 24 *langu* of his fingers as 1 ku and one *tanga* as seven and half *ku* and then little bit standard units were applied. These units of lengths are still in practice among Gopalis for the measurement of land, construction of house and other domestic purposes. So, natural units gave the cultural harmony rather than diversity.

The natural units practiced in the cultural groups must be preserved in both purposes, like cultural identity and the easy way of learning in natural setting. Because of the study focused on primary level mathematical practices found in the Gopali community, the study is focused on basic mathematical practices. School mathematics education and the ethno-mathematical concepts must be bridged each other. Children can feel easier to learn ethno practices because of natural units. Unknowingly, they gain ethno-mathematical knowledge. Because of the agricultural occupation of their parents, children are involved in the work with their family members, so, it won't be justifiable separating them from ethno-knowledge of mathematics.

The Measurement System of Weight and Capacity:

The units of measurements known as '*mana'/ 'pathi'* are of special type. It is used to measure two categories of substances like liquid things such as kerosene, vegetable oil, ghee, *jaad*, *rakshi*, milk etc. and other substances of grains like rice,

cereals, beaten rice, etc. Obviously, these units give amount of volume of liquid substances and grains. For the small amount, they use *chumna* where *chu* means one and *mna* means *mana* (one *mana*), *nemna* (two *mana*), etc. Similarly, for the concept of half (1/2) of the whole part the word, *'bachhi'* is used by them. *chhurani* (*dharni*) is the larger unit used in measuring weight and for the half part of *chhurani* is known as *barani* (*ba* means ½ and *rani* means *dharni*). In many cases, instead of taking weight, they measure by *mna* and *phwa* (*pathi*). One fourth part is indicated by *chakhachi* (*chauthai*) half *mna* of any thing is known as *bamna* (1/2 *mana*). From these understanding, *mana* is found as standard unit in the application of capacity and weight measurement.

In the ancient period, the measurement units of weight were used like *tola, biesauli, dharni.* Similarly, for grains, instead of weighing they used *mana, phathi* system coined by the Lichchhavi King Mana Deva. Both practices are still in practice in Gopali community. In the cultural activities like *jatra* and death rituals the grains must measured by *mana / pathi* because fixed amount of grains must be collected. Likewise *mana / pathi* are also used for liquid measurement like ghee, oil, *jaad, rakshi*, milk etc. Up to now, their religious feasts and festivals help for the continuation of ancient practices.

The interesting example of the relation between length (Inch) and weight (*dharni*) is common for all the Gopalis while buying male buffalo they never take weight by any measurement units like kilograms. Instead of weighing, they use a thread or rope and then with the help of thread or rope they easily estimate the weight of animals. In this case, they measure the length of front leg from knee to the joining part of stomach.

The estimation of one inch of rope is equal to seven *dharni* meat. The generalization part of relation between length and weight is mentioned below.

1 inch × 7 = 7 *dharni*

2 inch × 7 = 14 *dharni*

3 inch × 7 = 21 *dharni*

4 inch × 7 = 24 *dharni*

5 inch × 7 = 35 *dharni*

6 inch × 7 = 42 *dharni*

7 inch × 7 = 49 *dharni*

8 inch × 7 = 56 *dharni*

9 inch × 7 = 63 *dharni*

10 inch × 7 = 70 *dharni*

11 inch × 7 = 77 *dharni* and so on.

On the basis of this measurement, the customer use to pay the amount for he-buffalo.

In the case of buying goat, they use thread to measure the goat's body from *hyakula* to round part of body and then thread folds into four parts and measured by inch. Here one inch is equivalent to one *dharni*. If we convert it into kilograms, then 1 inch is equal to 2.5 kilogram.

Mana Pathi Units of Measures in Cultural Events:

The beaten rice has the great role in Gopali culture. It is attached with cultural activities. In the death rituals of Gopali beaten rice is must needed. After 7th day of the death, *ek* (one) *mana* beaten rice should be given to the *kusle* community similarly on the 13th day of the death rituals must be carried out *ek pathi* beaten rice is given by the relatives to the priest. For the *jatras* (feast) and *bhoj* (feast) the beaten rice of fixed amount measured by *mutthi, mana* and *pathi* should be used to feed relatives and other neighbors.

The traditional practice of making beaten rice is still found in Gopali community. Beaten rice especially in the occasion of *kartik* 1st (7th month of BS), *pyabai* (*latte*)and *thon* (*jaad)* are famous because it is offered to an idle as *prasad.* The maximum number of people of Chitlang village use to gather in the temple of Champeshwor to take *pyabai.* More than nine *muri* (one *muri = nipha*) *pyabai* is prepared by Gopalis who cultivated the land of *guthi.* The generalization of measuring system used by them as:

Jhimhu (ten *muthis)* = 1 *mna* (*mana)*

chyamna (eitht *mana*) = phwachhi/ chhupha (1 *pathi)*

nipha (20 *pathis*)= 1 *muri*

Mana Pathi Units in Jaad Preparation:

Fosi, hansi, corn flour or beaten rice, rice, *marcha* are the material used in the preparation of *jaad.* Mixture of water and flour are kept in the *hansi.* The *hansi* is kept over the *fosi* which is filled with water. The steam of *fosi* cooked the flour. Mrs. Jinu

Maya Gopali measures water by *gagri (*water vessel). She keeps two *gagris* water in the *fosi*. She has excellent knowledge about the time duration of cooking. If cooking time starts after breakfast then it will be prepared in the noon. If we convert this time into hour, 4 to 5 hours are approximately taken. After cooking, she mixes up 12 *manas marcha* for 8 *pathi* cooked flour.

Similarly, 5 *pathi* four = 6, 7 *manas marcha*

10 *pathis* flour = 16 *manas marcha*

The quantity of *marcha* may differ in making *jaad* and *raksi.* For the *raksi, marcha* is used more than in *jaad.* Similarly, quantity of *marcha* depends upon the types of grains. For example, 11 *pathis* beaten rice require 1 *pathi marcha* which is greater than corn flour.

- In the cold season, 15 to 20 days require for the *jaad* preparation.
- In the hot season 10 to 15 days require for the preparation. Due to heat it takes short time.

She uses to make special *jaad* for *ashar* (3^{rd} month of BS). For this, *jaad is* kept minimum 5 months in the *ghyampo* (The pot of large capacity). She keeps *jaad* on the month of *magh* (10^{th} month of BS) and takes out in *ashad.*

The Gopali children are confused because at home, they observed different practices of measurement units for grains, milk, vegetable oil, kerosene, ghee, *jaad, rakshi* etc. by *mana, pathi* but in the school; they do not find such measurement practices in their books. What happened to, *mana, pathi* measurement practices? Whatever they learn in school that is the right and the home practice is wrong? So the

children directed to discourage the ethno-mathematics practices because the formal education never tries to relate this. But the learners are previously acquainted with concept of measurement units of *mana / pathi* before the enrollment to school. It has its own original context and attached to the cultural identity and these units of measurements are in use in many auspicious occasions, rice feeding ceremony etc. Then units of measurements cannot be ignored by cultural events so long in exists.

Development of Number Names of the Gopalis

Since the Gopalis are the ancient rulers of Kathamandu valley, the Gopalis of Nhul Gaun, Taukhel and Kunchal were migrated from Matatirtha. So, there is harmony in their culture to the Newars of Kathmandu valley. The numerals used by them are of Newar civilization or Newari- scripts. The reason behind it was their settlement in Kathmandu valley as former rulers.

The authentic numeral system of Newars is the product from the oldest inscription of Manadeva's petrograph carved in rock pillar at Changu Narayan where there can be found some symbols for the indication of numbers. Newari scripts can be claimed as the origin of Gopalis. It is obvious the changing of numerals generation to generation. The ancient scripts were quite difficult to read and write. So, gradually, scholars developed new script on the basis of Newari like Bhujimol, Golmol, Kumol etc. The scripts used by Gopalis are Ranjana scripts. The Brahmi (Around 5^{th} century AD), Pre Lichchhavi (5^{th} – 8^{th} Century AD), Late Lichchhavi (8^{th} -13^{th} century AD), Newari (10^{th} -21^{st} century AD), Ranjana (11^{th} -21^{st} century AD), All scripts with 'mol' suffix (11the -18^{th} century AD), Tibetan (13^{th} -21^{st} century AD), Devanagari (14^{th} -21^{st} century AD), Maithaili (14^{th} -21^{st} century AD), Sarada, Gujrati, Kashmiri, Utkal (14^{th} -18^{th} century AD), Roman Alphabet (English) (16^{th} -21^{st} century AD) But

in the modern period, no script is developed, however Ranjana, Devanagari and Newari are still used in changed form (Adhikari, 2002, P.19). Newari scripts are taken as oldest in contemporary use and latter converted there into Devnagari and Roman for the easy learning to all language groups.

The Newari, Ranjana, Devanagari and Hindu Arabic numerals are mentioned here for comparing of their similarities and non-similarities. The following table reveals that the changing patterns of numerals. It depends upon the maximum use of numerals. It indicates that the numerals developed in the medieval period (10^{th} -18^{th} century AD) are still in practice. The following table represents the numerical representation of Newari.

The Ranjana, Devanagari and Hindu Arabic scripts which are in the practices in the schools' education and in the communities are mentioned here.

Scripts	Numerals									
Newari	९	२	३	४	५	६	७	८	९	१०
Ranjana	১	৩	৩	৪	৫	৬	৭	৮	৯	১০
Devanagari	१	२	३	४	५	६	७	८	९	१०
HinduArabic	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**

(Adhikari, 2002, P.25)

The numerals were developed for the counting of objects. The words for counting found in inscriptions and Manuscripts are mentioned in the following table

The words and their corresponding numerals

Numerals	Indication of numeral
0	*kha, vindu, vyoma, aakash, sunya, gagana, nava, ananta, etc.*
1	*chandrama, prithivi, adwaya, bhumi, eka, dhara, dharani, etc.*
2	*chakshu, yugma, ayana, bhuja, dwaya, bahu, akshi, sama etc.*
3	*agni, guna, rama, bhuvan, traya, pura, dahana, etc.*
4	*veda, yuga, stuti, dewipa, jaladhi, chatu, samudra, turya etc.*
5	*bana, ranga, ishu, bhuta, pancha, sastra, prana, madanvana, etc.*
6	*ritu, skanda, kumar, rasa, shastha, kaya, kumarbadana, etc.*
7	*risi, muni, giri, parvat, achala, turaga, aswa, suryabaha etc.*
8	*hasti, vashu, naga, matrika, asta, gaja, siddhi, mangala etc.*
9	*ratna, graham, randhra, nidhi, nava, durga, labdha, etc.*

(ibid, 2002, P.34)

The description of table was totally depended upon the natural setting of counting. For example zero is indicated as *vindu, aakash, sunya* etc. which means empty or out of imagination. The number one is indicated as *chandrama* (moon), and *prithvi* (earth) which is single indicators. For the indication of two, *chakshu* (eye), *yuagma* (copulating pairs), *bhuja* (hands) are used. So, the '*ota'* system is the original concept of numeral development.

The Gopalis have their own language for counting numbers. The details of the number names are attached in the annex-II. It is justified from Mrs. Dalli Maya Gopali. She is illiterate and does not know the numerals but in her language she is quite expert in the counting objects. The examples are follows:

Chhuge means *ek-ota,* (one)

Nege means *dui-ota,* (two)

Swoge means *tin-ota*. (three)

…….

This clarifies that their counting system was developed from the counting things. The excellent practice of counting system can be attached in women weaving clothes. Women have great knowledge than men in counting numbers. Mrs. Dallimaya Gopali can easily count the numbers in her mother tongue.

"ketaketi ke ke ganchan malai aaudaina (I don't know the counting number used by children)

Mchasa chhu chhu lekheyai jan masyoo (I don't know the way of counting numbers used by children)

Jan ja anka nu mhwamasyoo (I don't understand the written number)

Jan aakha bonai moro (I am illiterate)

Dhgaba lekhe ya pho, ka lekke ya pho (I count money, thread while weaving clothes)." Practically, she has counted the seeds of grain.

I gave her seed of maize, and then she started to count by naming: *chhuge, nege, swoge, pege, nage* so on.

They learnt counting in real life situation or in practical way. Thus counting system is emerged from realities and necessities of life. The occupations of Gopalis in

the ancient period were agriculture and rearing cows which is attached in their cultural identity. It can be supposed that the counting system is developed by them for the counting of animals and weaving clothes. The counting pattern of school education and ethno-counting seems similar in the sense of oral counting. The counting sounds like four- forty- four hundred started with the sound */f/*. Similarly, while concerning with Gopali language of counting 4, 40 and 400 counts as *pege, pige* and *pesage* respectively, which is also have same sound /*p/*. Similarly, two- twenty- two hundred all have started with sound /t/ and while taking about Gopali language *nege, nige* and *nesage* for 2, 20 and 200 respectively started with the sound /n/.

nege, nige, nesage (2, 20, 200)

swoge, syuge, swasage (3, 30, 300)

pege, pige, pesage (4, 40, 400)

nage, nenge, nhesage (5, 50, 500)

khuge, khuige, khusagen (6, 60, 600)

The learning system of counting numbers seems similar both in school and ethno-counting. For example:

11= 10 + 1 (ten + one)

11= 10+1 *(jhinge + chhuge = jin chhuge)*

12 = 10+2 *(jhinge + nege= jin nege)*

From this similar learning pattern it is difficult to identify the originality of counting system. It might be co-incident or developed both mathematics are similar in nature. The important aspect of Gopali's counting system easily can apply in school mathematics or anybody easily can understand and apply.

The Counting Number of Gopalis

Number names	Numbers	Number names	Numbers	Number names	Numbers
Chhuge	1	*nige*	20	*pesage*	400
Nege	2	*suige*	30	*nasage*	500
Swoge	3	*pige*	40	*khusage*	600
Pege	4	*nenge*	50	*nhesage*	700
Nage	5	*khuige*	60	*chyasage*	800
Khuge	6	*nhege*	70	*gusage*	900
Nhege	7	*chege*	80	*Dochhige*	1,000
chyage	8	*guige*	90	*jhidoge*	10,000
Guge	9	*sachhige*	100	*sachhidoge*	1,00,000
Jhige	10	*nesage*	200	*dochhidoge*	10,00,000

This table indicates different patterns of speaking things like *'ge'* for counting grains, money (only between 1 to 99 paisa) but in the case of one and more than one rupees '*chhurka'* (one rupee), *nerka* (two rupees), *sworka* (three rupees) etc are used. It indicates that for rupees 'ka' is used up to 99 rupees. For example, *guigurka* means 99 rupees. For hundred and more than hundred *sachhi* (100 rupees), *nesa* (200 rupees), *swosa* (300 rupees) …….. are used. This indicates that they use the different

terms for counting paisa, rupee. The counted numbers mentioned are clearly approved the cultural identity and its strength in the ethno-mathematical concept.

Geometric Figures Practices in the Gopali Community:

The geometric figures, geometric shapes and geometric models are usually drawn and constructed for different purposes by the Gopalis. They construct their agricultural tools, domestic materials from their inherent knowledge of geometric concepts discussed below.

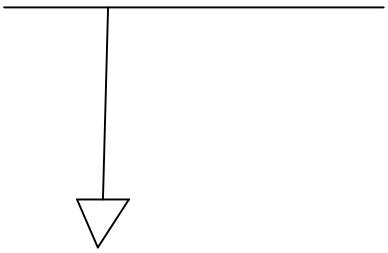
The knowledge of mathematics is needed in every step of life, the difference is only that some mathematical concepts are used knowingly and some are used unknowingly. Because of different language groups, the terms and mental schema differ. Same things are known by different names and concepts. The study is also focused in the geometrical perception of Gopalis. They have master mind of geometrical application although they do not have name of geometrical shape. Their excellent result can be observed in the construction of home and other furniture and in women practices also many geometrical shapes are applied.

The Concept of Perpendicular and Parallel Lines:

The Gopalis have the concept of perpendicular and parallel lines. These can be observed in the construction of doors, windows, *juwa* (*ika*), *pataha* (agricultural tools used for making land plain and crushing of the soil), *phyako* (*pirka* like instrument using for cultivating paddy in rainy season). These concepts are used by them to construct the perpendicular and parallel types of instruments.

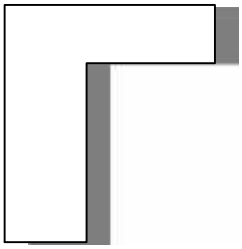
Phyako:

Ghanti: The instrument consists of a thread tied on the stick and hanging cone type wood at the other end of the thread. While hanging thread, it forms perfect perpendicular lines to the stick.



This instrument is used for the construction of wall.

Buttom: The instrument is for making perpendicular shapes is *buttom*. It is used for making furniture, construction of house etc. It is in the shape accurate perpendicular means 90^0 angles.

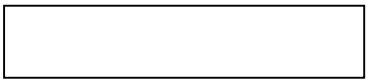


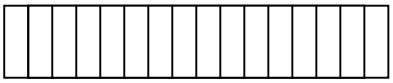
While making the frame of doors and windows, the corner of frame should touch the outer line of *buttom* other wise it is not in perfect shape. Before using *buttom* we measure *tala mathi ko lambai* (length of up and down) with the help of any things like two sticks of equal length, ropes, *bitta*, inch etc.

The idea of Ram Bahadur Gopali of making perpendicular shapes is to make hole straight then whatever set up in the tight shape can be straight. For example, he took the example of sticks of *pataha.*

Here, two sticks are fixed in perpendicular shapes and the *haris* is also fixed in the perpendicular shapes.

Lhepu (like as comb used in weaving clothes): The *lhepu* used by Gopali women for weaving clothes are the examples of parallel lines. According to Mr. Shyam Bahadur Gopali, while making *lhepu*, he takes two straight bamboo sticks of 2 *hats* length and 1 *bitta* for the outer frame and many numbers of *sinka* (thin sticks made up of bamboo). The length between the two long sticks is fixed by the short sticks joined two opposite end points of sticks. So, first of all, he prepares frame of *lhepu*, with the help of frame, small sticks are set up in the frame.





The space between small sticks is very small from where threads are set up while weaving clothes. While comparing it with school mathematics, the length between small sticks is only 1 millimeter. It looks like scale of geometrical instruments. The innovation of these instruments by the ancient Gopali community is the evidence of the existence of having the knowledge of parallel lines and perpendicular.

Rectangles in Household Things:

The concept of rectangular and square shape is common practice in the Gopalis. The four sided closed figure is named as *peklu* in their language which does not clearly distinguish the rectangular and square shape but while comparing to the things made by them came to know that large plain shape like *tahasuku* (long *suku* used in feeding feast and festival for many persons at a time) is of rectangular shape similarly, *tpasuku* (large shaped *sukul*) which is also the rectangular shape. *peklu* is used in any kind of four sided figure but especially in rectangular shape.

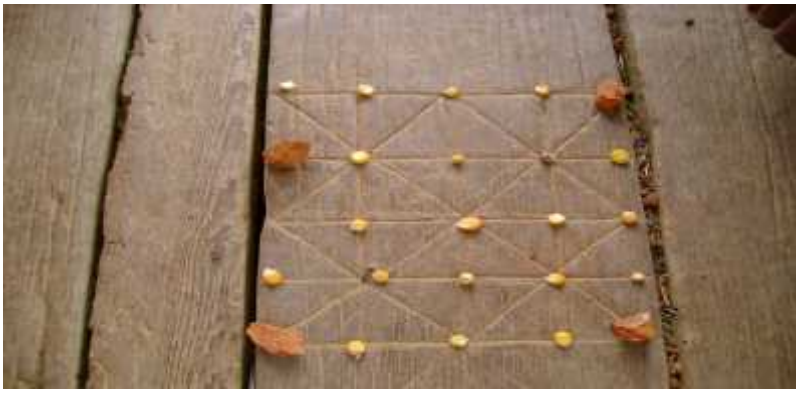
The area of rectangular shape can be seen in the measurement of land for building house. Generally, the land shape of house is of rectangular shapes. It is my great luck of presence in the period of building house of Gopalis. Mr Shyam Bahadur Gopali was the *'nayo'* (head of construction team). He was going to build the house of 20 *hats* length and 13 *hats* breadth. It is clearly rectangular shape. The area of rectangular shape of room or house is measured as 20 by13

hats. Similarly, area of room as 12 by 7 hats etc. Same concept is found for the square shape like 7 by 7 which shows that they have concept of rectangle and area. Doors, windows, *kalopati* (small size black board used by children before the use of paper and pencil), mat (made by straw), *chaukos*h, cot etc. are the example of rectangular shape things found in Gopali community. The creation of these objects is due to their previous concepts of rectangle.

Triangles and Squares in Dhusa (Baghchal):

The most common game among the male Gopalis is the *dhusa*. In order to play this game, one has to draw a network as shown in the figure. This game is played by two persons one is favour of four *dhu* (tiger) and the other is in favour of twenty *sa (cow)* . The strategy of the game is the movements of beads representing cows and tigers are along the network obeying its rules. Our focal point is the network of *dhusa* rather than its strategic rule of playing the game.

It is observed that one of the players has to draw the network. In the course of its drawing, he must have the concept of the geometric figure of square and the concept of congruent lines segments. These two concepts lead him to complete the construction of network which consists of a number of congruent isosceles right angled triangles and smaller congruent squares. It is interesting to note that one who draws this network is unaware of the different below mentioned geometric shapes.



The Concept of Angle While Making Su (Plough):

Innumerable examples and practices of angles are found among Gopalis. The concept of right angle is explained in the subtopics of perpendicular lines. Like wise one suitable example of angle formation is making '*plough'*. Making *su, yasila (haris), ika (juwa), pataha* are the wooden things for cultivating fields. Making angles of accurate measurement is challenging tasks but for them it is habitual tasks. Each male family member should have knowledge of making them because of their most essential agricultural instruments.

The slightly curved round wood is taken for plough because it is easier to make an angle. The plough of other parts of the country and here is different in making process. Here whole plough is made of single wood but in other area the two parts are joined (*tundo and aanau).* So they search the curved like wood for *aanau and tundo.*

The wood of 7 *bittas* is cut for plough. It means the total length of plough is 7 *bittas*, 3 *bittas* for *tundo* (down part of plough) and 4 *bittas* for *aanau* (upside part of plough used to catch while using like handle)

Su (plough) is the main agricultural tool used in the cultivation. This is an example of the highly ethno-mathematical practices found in each Nepalese community. The plough is the combination of the different instruments like *yasiba, ika, kasee, lajoo.* There is excellent combination of the height of oxen, length of haris and the angle of the plough.

The angle between haris and tundo is measured by the angul which is approximately 45^0 i.e. acute angle. The tundo itself an angle shapes of obtuse angle. The making process of the tudo is different than other communities because in other community anau and the tundo is made up of different wood and later will be attached but the Gopali use to make by the single wood of curved shape. The knowledge of curve shape can be found in their community. The *bangya* is the term used to the curve shape wood for making plough. For the balance of the height of the oxen and the angle of the plough, it is depend up on the length of *nakhi* and *yasiba.* According to the height of the oxen the angle of the plough and the length of the *yasiba* are fixed. The length of both oxen should be equal height otherwise difficult to adjust the balance of the plough. This is called '*hall badhnu*.' So, the *tundo* of the plough is fixed after one and half hat from the feet of the oxen legs. It depends up on length of *tundo.* The *saya* (ploughman) use to tie the *nakhi* to the *yasiba* where many *okhi* are attached in different length and can be easily measured by them.

Circles in Household Things:

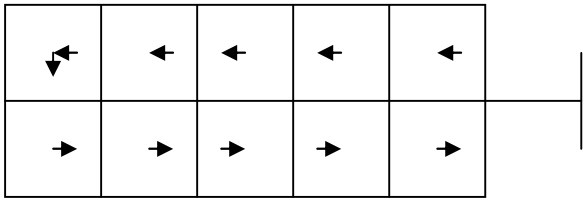
The concept of circular shape is common among Gopali community. The plain round shape is known as *chakla* in Gopali language. So, the *chakla* means the round shaped figure from which it can be seen that the concept of circular shape in the agricultural, musical and households instruments is in use. The instruments like *hasa* (*nanglo*), *ta* and *bagu* (musical instruments) are the concrete example of circular shape found in the Gopali community. Mr. Ram Bahadur Gopali was making *chakla suku* (round shaped mat). In his concept *chakla* means round and the *suku* is the name of mat made up of straw.

Ordinal Number in Gopali Community

The concept of ordinal numbers is also found in the Gopali community but not in the direct form. According to their perception, the application of cardinal system can be generalized. By the indication of first position or extraordinary person can be considered as first position. They use to call first person as *nhaplakamu* (*nhaplaka* = first & *mu* = person) and the second and third do not have actual name. For the indication of second, third position they use the word *okonalipam*u where *okonalipa* means after that and *mu* means the person.

Ordinal Number in Ek Khutte Khel (One Legged game).

This game is popular among the girls. It has a network of ten (10) rectangular rooms. It is played with two or more players. The players draw rooms on the plain ground. The place must be clean and plain. A round shaped object like coin is needed for the game. The players are not allowed to move the circular dice made of stone by their hands. The dice is displaced from one rectangular room to another room by the movement of the player with one leg only. The whole length of rectangle equal covers five steps because they have to play with one leg. Each step is equal to length of each small box. The game gives the concept of ordinal numbers like *pahilo kotha, doshro kotha, teshro kotha* etc.



CHAPTER –V

Findings and Discussion

This chapter deals with the interpretation of information obtained from the Gopali community and historical evidence found in the study area and some findings are also derived on the basis of discussion of chapter –IV. Literature study is also considered in the interpretation of collected information and in the conclusion and findings as well. My personal reflections are also the sources of this concluding chapter.

Finding of the Study:

The findings of the study are based on the information from the Gopalis and the literature related to ethno-mathematics. The major findings of the study are as follows:

The practice of measurement systems are found in ancient as well as medieval period but the perception was different. *hat, bitta,* were the measurement units of length used in the ancient period is also in practices of Gopalis and it is taken as easy learning.

King Jayasthiti Malla developed the standard measurement unit of length. For the land area of one *ropan*i is taken as 4 *muri* paddy production areas. While relating to the hands unit one *ropani* is equal to 6400 sq. hats while the land is of square shape then the length of each side is equal to 80 *hats.* Similarly, King Jayasthiti Malla standardized the units of length as his 24 *anguls* = 1*ku*, 7 ½ *ku* = 1 *tango*. The unit *'tango'* was coined by him.

The *kosh* is the approximate length measurement of walking distance unit. There are two length measurements of *kosh* systems, one is *rumal* (handkerchief) *kosh* and another is *hatti* (elephant) *kosh*. *Rumal kosh* means walking distance in the time duration of drying handkerchief and *hatti kosh* means the walking distance while an elephant taking rest after running.

The relation of length and the weight are applied in buying he-buffalo for meat purpose. In the case of he-buffalo, they measure the length of front leg from knee to the joining part of stomach. The estimation of one inch of rope is equal to seven *dharni*. The generalization part of relation between length and weight are as: 1 inch × 7 = 7 *dharni* 2 inch × 7 = 14 *dharni*, 3 Inch × 7 = 21 *dharni* etc.

The authentic numeration system of Newars is the evidence of the oldest inscription of Manadeva's petrography carved in rock pillar at Changu Narayan where there can be found some symbols for the indication of numbers. Newari scripts can be considered as the origin of Gopalis.

The naming of numbers of objects by Gopalis are spelled as *chhuge* means *ek-ota,* (one item), *nege* means *dui-ota,* (two items), *swoge* means (three items), etc.

In the ancient period, zero is indicated as *vindu, aakash, sunya* etc. which means empty or out of imagination. The number one is indicated as *chandrama* (moon), and *prithvi* (earth) which is single indicators. For the indication of two *chakshu* (eye), *yuagma* (copulating pairs), *bhuja* (hands) shows two items.

The learning system of counting numbers seems similar both in school and ethno-counting. The counting sounds like four- forty- four hundred started with the sound ***/f/.*** Similarly, while concerning with Gopali language counting 4, 40 and 400

counts as *pege*, *pige* and *pesage* respectively, which also have same sound /***p/.*** Similarly, two- twenty- two hundred all have started with sound **/t/** and while taking about Gopalis language *nege*, *nige* and *nesage* for 2, 20 and 200 respectively started with the sound **/n/.**

In the case of one and more than one rupees *'chhurka'* (one rupee), *nerka* (two rupees), *sworka* (three rupees) etc are used. It indicates that for rupees 'rka' is used up to 99 rupees. For example, *guigurka* is called for 99 rupees. For hundred and more than hundred *sachhi* (100 rupees), *nesa* (200 rupees), *swosa* (300 rupees) …….. are used. This indicates that they use the different terms for paisa, rupee, hundred rupees etc.

*Ghant*i and *buttum* are the tools for making the shape of perpendicular and parallel lines. *Buttom* is used for making furniture, construction of house etc. It is in the shape of accurate perpendicular means 90^0 angles.

The concept of rectangular and square shape is in common practice among Gopalis. The four sided closed figure are called *peklu* in their language which does not clearly distinguish the rectangular and square shape but while comparing to the things made by them it came to know that large plain shape like *tahasuku* (long *sukul* used in feeding feast and festival for many persons at a time) is of rectangular shape similarly, *tpasuku* (large *sukul*) which is also the rectangular shape. *peklu* is used in any kind of four sided figure but especially in rectangular shape.

They have clear concept about circular shape. The plain round circular shape is known as *chakla* in Gopali language. So, *chakla* means the round shaped

figure. From which we can generalize that the concept of circular shape is also found in Gopali culture.

The concepts of measurement and the angle are found while making *su* (plough). The wood of 7 *bittas* is needed for plough. It means the total length of plough is 7 *bittas*, 3 *bittas* for *tundo* (down part of plough) and 4 *bittas* for *aanau* (upside part of plough like a handle used to catch while using). From 7 *bittas* wood they use to form the angle shape approximately 45^0 which is measured by fingers.

The concept of ordinal number is also found in the Gopali language and practices. They use to call first person as *nhaplakamu* where *nhaplaka* means first and *mu* means person but the second and third do not have actual name. For the indication of second, third positions they use the word '*okonalipamu'* where *okonalipa* means after that and *mu* means person.

Discussion of the Study:

This section is designed for the critical analysis of literature, theory, field information and my personal reflection towards the study. These are the components of the study. The study is based on grounded theory. The grounded theory has been applied for the overall study of the Gopali. It is difficult to claim a better theory because each theory consists of its own value and guided by some ideas to go further. But the researcher must feel comfortable in the application of theory. I have adopted grounded theory as the reference guideline. It recommends in bridging the achieved information to the related theories.

The observation of Gopalis' ethno-mathematics practices and their proper documentation without ignoring their cultural identity is my ethical consideration. It is being an ethnographic study; it should not modify the concepts of cultural values.

Some of the studies have been conducted related to ethno-mathematics and other cultural studies. In the context of Nepal, a few studies were focused on cultural study. The literatures reviewed for the study are valuable in nature but do not represent the complete picture of the study matter. Many researches have been done for the academic purpose rather than non-academic. Each community has their specific identity and needed to preserve them but some people of same community do not like to expose their traditions because they feel uncomfortable. This is crucial constraint while conducting study. The main cause for focusing informants' selection is to collect real information. Some of the literatures are incomplete in nature for information. The pre-set up questions, formal situation, limited time frame etc. influences the study output. An ambitious generalization of the study may not be justifiable to the cultural study and nobody claimed to accomplish the study although he/she is from same community. The problem of seeking support from theory and literature is being essential; the researchers can face the problem of terminating the study.

Some of the studies consist of valuable information but it may not applicable in the present situation.

In the study, the information related to ethno-mathematics is derived. The ethno-mathematics study among indigenous people is really needed in primary level school mathematics education. There is learning gap between ethno-mathematics and the academic field. One of the causes of learning difficulties among Gopalis children

is cultural discontinuity and cultural difference between home and school because children learn ethno-mathematics in cultural context and modern mathematics in the school environment. The cultural discontinuity theory of Ogbu (2000) in the children's learning environment is considered in my study output. He argued that the gap between the minority cultures and the mainstream culture does not favor schooling / learning of minority children who are socially and cultural disadvantaged. School education in our context does not give priority of indigenous knowledge between educations as a result imbalance between educational statuses can be observed.

In the case of ethno-mathematics literature, innumerable researches have been conducted in the international context. All are of highly appreciated and meaningful in the modern period. But while over viewing such researches / studies do not found theoretical relation. The most important aspect of the ethno-mathematics is the fact finding, no dedication and priority is given to link in the teaching / learning situation. The studies are focused on the perception / process of learning mathematics in the cultural context. Similarly, expectation of research framework is not neglected but not limited and in some cases study tried to go beyond the framework. This is the strength part of the study output. The inputs of previous studies are accepted. Because of cultural study, religion, language, ancient practices etc. are the area of the study focused from which the difference between caste groups identified and the way of ethno-mathematical process learnt from them. Similarly, the invention of mathematical concept of western are also related part of the study. Thus mathematics learning at home and school should be interlinked if it is in the similar manner. If ethno-mathematics can be developed as a subject of learning in the academics field, it will beneficial for indigenous group and it will be highly enrolled of the Gopalis as

well as other minority mother tongue group in education. The equal priority should be given to both ethno-mathematics and modern mathematics otherwise it will be complicated in the sense of learning cultural and modern mathematics education.

My study in the sense of mathematical learning might be reference among indigenous people because the similarity among different indigenous groups can be found in the context of ethno-mathematics practices but applied in different ways and purposes.

In the conclusion of my discussion, theoretical base is applied here for reference, literature supported me to fill the gap of knowledge and the theoretical concept guided the study in the appropriate remarks.

CHAPTER- VI

Conclusion and Suggestions

Conclusion:

The study was focused on the ethno-mathematics practices of the Gopali people situated in Chitlang village of Makawanpur district. Measurement system, numerical system, geometrical application and other mathematical concept preserved by them is the major area of the study. As the nature of qualitative research, informants are few in number for in-depth study. The general practices of the surrounding of Gopalis are also mentioned for the study analysis. Participant observation, simultaneously interview are the methods of study. The grounded theory is applied here for the guidelines of information collection and interpretation process

The historical practices of ethno-mathematics are also found in the cultural practices of Gopalis. They are given great importance of preserving the cultural identity and very much serious in this concern. Compulsions for the participation of cultural activities do not allow the traditional practices to disappear. The study is focused on illiterate children, women and men, so the information achieved from them are traditional oriented rather than modern.

The culture and mathematics are interlinked each other because in the absence of one, another cannot be defined. Life styles, making domestic instruments, cultural dress, measurement system, numerical system etc. are common and fixed in nature because of mathematical application.

The ancient mathematical practices were of natural units like *bitta*, *hats* such practices are also applied by illiterate people who are taken here for informants. Some rulers like King Jayasthiti Malla, Man Dev had played great role in the standardization of natural units like measurement units.

The mathematical concepts of illiterate people are different than the school mathematics. The children before school age have some mathematical concept developed in their mind but after the enrollment in school, they have to learn totally different concepts from which Gopali children certainly face the problem. For, example, if we ask the counting numerals to the children of the Gopalis, they can easily, count as *chhuge, nege, swoge,* ……. for the indication of the numerals. What will happen with such children in the school? The answer of this question should be seriously taken by the scholars. Actually, this study does not focus the problem faced by Gopalis children in the school education. The strength of mathematical concept preserved among Gopalis is appreciated and can be easily applied to the school education.

The ethno-mathematics are in neglected position in the context of Nepal because only the importance is given to the school education and the concept of adjustment of modern technology is the mission of school education. In some extent it is not wrong but should also think the excellent practice of indigenous knowledge. In the case of mathematics education, many Gopalis are in backward position. It is a bitter truth among them. But illiterate people use to feel comfortable in the application of mathematics. Although children of the Gopali are faced the problem in mathematics learning, they cannot take support of ancient mathematical concept because there is no any position of ethno-mathematics in their study. As a result,

indigenous knowledge is discouraged in this transition period of modern influence. Some traditional evidences had already replaced by modern knowledge/ technology and some are in crucial position. Actually ethno-mathematics is highlighted by some research works and tried to link in academic field of application.

From this study, it can be concluded that the ethno-mathematics found in Gopali culture is more applicable and can be used easily in the practical life because ethno- mathematics is emerged from cultural practices. Nobody can neglect the importance of cultural knowledge. Primary level school mathematics education can be related to the ethno-mathematics which is the major concluding remarks of the study.

Suggestions:

The network of *baghchal* use to make perfect square shape otherwise diagonals cannot be drawn. The excellent geometrical shapes like squares and their area can be easily found by counting small squares can be considered as the example of square.

Instruments like box, *doko, hasa (nanglo), namlo, chalno, tophe (kucho), ta* and *bagu* (like *jhamta*) *dalo* are the concrete examples of congruency. They are perfect in making such things of same shape and size but they don't know the word congruency. Circular shapes are common every where. So, it cannot be neglected in the teaching and learning process as example of congruency.\

The measurement systems developed by King Jayasthiti Malla are still practiced in official records like *ropani* system of land measurement. Such systems are attached with culture. So, it should relate to the academic field which can be more practical in the measurement of the land.

The ethno-mathematical concept should develop in written document and the actual fact with their cultural attachment should be learned.

This study recommends the primary education should be based on ethno-knowledge. From which children from cultural group feel comfort in learning. In such situation, parents can take part in children education and it will be more practicable or real life oriented.

The ethno knowledge should develop as the demand of modern period. Then it will be acceptable by each generation. I never recommend to the modification of the cultural.

While doing cultural research, it should cover all aspects of ethno knowledge like ethno-mathematics, ethno-science, civic education, social status etc. from which it will be easy to implement their knowledge in the real life situation and also understand the cause of backwardness in education, economic, social, political field etc. which gives overall information of the culture.

With the reference of quantitative research, qualitative research should be focused on the understanding of cultural knowledge and actual outcome can be achieved from the study. Similarly, the result of research can be related to the academic field. So, the study gives the ways to continue such type of study.

It is clear that there is gap between school education and ethno- education. The teachers might play vital role of bridging the knowledge gap. So, the teacher should be promoted towards ethno knowledge. It will be better to learn cultural background of children for the psychological understanding of the children.

Educational Implication of the Study:

The educational implications are also carried out from the overall study of the Gopali community. It is well known that comparing to other subjects mathematics do not feel comfortable by the students of any grade. The indigenous education is in acceptance position while relating to the school primary education. The importance of local knowledge is also accepted by the government. The concept of local knowledge adoption in the school education is in the government priority. In such situation, more than more researches / studies should focus among indigenous groups. This study can be one of the reference materials in the case of primary mathematics education. The application of counting system, measurement systems, geometrical shapes and others among the Gopali community should incorporate in the school education. Similarly, the application of the ethno-mathematics in school education, multifarious positive influences can be observed like cultural preservation, high enrollment of indigenous children in school education, better achievement in the subjective knowledge, moral behavior, mutual environment between school and the local people etc. Many efforts are done for providing education to all Nepalese people but could not achieve accepted result. But finding the reasons is not focused and the result remains same. Education should meet the demand of people and life oriented activities.

The ethno-mathematics actually carried knowledge from ancient to the modern period. There is no specific teacher for ethno-mathematics but the persons are able to apply ancestors' knowledge. We must not be confused that school mathematics and ethno-mathematics do not carry different features only the difference is that school mathematics is designed for meeting the national goal in formal situation but ethno-mathematics is the mathematics which is learnt from past

generation in the informational way of real life practices. So, the bridging between two trends of mathematic practiced in our context certainly will be more effective and applicable. In the one hand the application of ethno knowledge in academic field can be related to the local practices and on the other hand cultural identity can be preserved. The problem of mitigating the requirements of person is challenging task for the curriculum designers but to get rid from the problem, only imported knowledge cannot be applicable in all context. School mathematics is also blamed as the vast collection of arbitrary topics. Like Schmidt et al. say, "….. in the United States, mathematics standards are long laundry lists of seemingly un-related, separate topics.' Similar practices are also found in the mathematics education in Nepal. The ethno-knowledge can support the school education in a coherent and logical order rather than arbitrary fashion.

The children acquire knowledge and skills, and develop an understanding of mathematics from their own experience in the real life situation in their locality. School mathematics can be more meaningful when it is rooted in real life contexts and situations, and when children are given the opportunity to become actively involved in learning. Teachers and other adults play a very important role in providing children with rich and meaningful mathematical experiences. The learning should be related to the ethno practices which support the students in easy way of learning with concrete example in real life situation.

The ethno-mathematics concept can be easily included in the primary level mathematics. As the study covered the area of ethno-mathematics practices includes the numeration, measurement and its practices (length, weight, capacity), geometrical shapes and their concepts

The following points further elaborate the application of the ethno-mathematics in academic field.

Real-life Problem Solving:

The knowledge should be linked with real life problem solving, further more the generalization and advancement in application. The ethno-mathematics emphasizes the application of mathematics to real world situations. Numbers, skills and mathematical concepts are not presented in isolation, but are linked with situations and contexts that are relevant to everyday lives.

Cultural/Religious Skill Development:

The theme of education should meet the requirements of the nation because it should support the life otherwise it would be meaning less. The indigenous knowledge and the vocational skill is limited within local level should be interlinked in the academic field also. Both cultural knowledge and mathematical concepts can be learnt by the students. In the case of mathematics learning, there is no problem of adaptation of ethno knowledge in the academic field because the practices are not in the totally different contexts. Many cultural/ religious activities are interlinked or practices in Group. While talking about education without support of local setting cannot be imagined in effective manner. So, the linkage between ethno-mathematics and school mathematics will be one of the way of problem solving in mathematics education.

Long Term / Ongoing Practices.

The mathematical concepts learnt in previous class can be forgotten due to the lack of daily use but ethno-mathematics do not allow such situation if the priority is

given to the ethno-mathematical practices in the academic field because of ongoing practices. The use of ethno knowledge in the academic field can be long term applicable.

Multiple Methods for Basic Skills Practice:

The ethno-mathematics provides numerous methods for basic skills practice and review. These include written and oral fact drills, mental math routines, practice with fact triangles (flash cards of fact families), daily sets of review problems called math boxes, homework, timed tests and a wide variety of math games. From which students in school feel easy to acquire each of the mathematical concepts.

Emphasis on Communication:

Throughout the ethno-mathematics knowledge students can be interested in the discussion, mathematical thinking, in their own words. Opportunities to verbalize their thoughts and strategies give children the chance to clarify their thinking and gain insights from others.

Enhanced Home/School Partnerships:

For the primary level (1-5), culture provides opportunities for family members to participate in the students' mathematical learning. Study links are provided for most lessons in the primary and local people can also understand the mathematics knowledge which they have been used.

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Appendix- I
Glossary of the terms

Roman	**Gopali**	**English**
Ek bitta	*Cwarachhi*	Length between two ends of thumb and small finger
ek ropani	*chhupe*	Units of measuring land in hilly area
ek dharni	*chhurani*	Unit of weight of 2 and half k.g.
adha dharni	*barani*	Half of two and half k.g.
jaad	*thun*	Alcoholic liquid
raksi	*ela*	Alcohol
bakhra	*chole*	Goat
latte chiura	*peinbai*	Beaten rice
dalla	*pein*	Hard piece of mud
marcha	*mana*	Yeast
pathi	*phwan*	Measurement unit of mass and liquid both
mana	*mna*	Standard measurement unit
chauthai	*chakhachi*	One fourth unit of mana
ek mana	*chhumna*	One mana
dui mana	*nemna*	Two mana
adha mana	*bamna*	Half mana
hat	*lha*	Hand
ek hat	*kuchhi*	Length between elbow and the tip of index finger
kan	*nhepu*	Ear
euta kan	*chhupa nhepu*	An ear
chandrama	*Temla*	Moon
ek ota	*Chhuge*	One piece
dande	*Dandya*	Agricultural instrument
pirka	*tukwa*	Seat
samathar golo	*chakla*	Circle
gola	*gorkya*	Sphere
chaudai	*vhya*	Width
lambai	*taha*	Length
tala	*kopa*	Down/below
mathi	*thapa*	Up/over
kaiyo	*lhepu*	Comb
golo sukul	*chakla suku*	Round shaped mat
lamo sukul	*taha suku*	Long mat
thulo sukul	*tpa suku*	Large mat
nanglo	*hasa*	Winnowing fan
kucho	*tophe*	Broom
	ta and bagu	A kind of religious musical instrument used in bhajan
anau	*Lajoo*	Handle of plough
pahilo	*nhaplakamu*	First
tyes pachhadi	*okona lipamu*	Second (following the first)
dhyak	*ghwai*	Round shaped solid like coin

Appendix - II-a

Number names of Gopalis

No.	Gopali number name	No	Gopali number name.	No	Gopali number name	No	Gopali number name
1	*chhuge*	32	*sui nege*	63	*khui swoge*	94	*gui pege*
2	*nege*	33	*sui swoge*	64	*khui pege*	95	*gui nage*
3	*swoge*	34	*sui pege*	65	*khui nage*	96	*gui khuge*
4	*pege*	35	*sui nage*	66	*khui khuge*	97	*gui nhege*
5	*nage*	36	*sui khuge*	67	*khui nhege*	98	*gui chyage*
6	*khuge*	37	*sui nhege*	68	*khui chyage*	99	*gui guge*
7	*nhege*	38	*sui chyage*	69	*khui guge*	100	*sachhige*
8	*chyage*	39	*sui guge*	70	*nhege*	101	*sachhi wa chhuge*
9	*guge*	40	*Pige*	71	*nhe chhuge*	102	*sachhi wa nege*
10	*jhige*	41	*pi chhuge*	72	*nhe nege*	103	*sachhi wa swoge*
11	*jin chhuge*	42	*pi nege*	73	*nhe swoge*	110	*sachhi wa jhige*
12	*jin nege*	43	*pi swoge*	74	*nhe pege*	200	*nesage*
13	*jin swoge*	44	*pi pege*	75	*nhe nage*	201	*nesa wa chhuge*
14	*jin pege*	45	*pi nage*	76	*nhe khuge*	300	*swosage*
15	*jin nage*	46	*pi khuge*	77	*nhe nhege*	301	*swosa wa chhuge*
16	*jin khuge*	47	*pi nhege*	78	*nhe chyage*	400	*pesage*
17	*jin nhege*	48	*pi chyage*	79	*nhe guge*	401	*pesa wa chhuge*
18	*jin chyage*	49	*pi guge*	80	*chege*	500	*nasage*
19	*jin guge*	50	*Nenge*	81	*che chhuge*	501	*nasa wa chhuge*
20	*nige*	51	*nen chhuge*	82	*che nege*	600	*khusage*
21	*ni chhuge*	52	*nen nege*	83	*che swoge*	601	*khusa wa chhuge*
22	*ni nege*	53	*nen swoge*	84	*che pege*	700	*nhesage*
23	*ni swoge*	54	*nen pege*	84	*che nage*	701	*nhesa wa chhuge*
24	*ni pege*	55	*nen nage*	86	*che khuge*	800	*chyasage*
25	*ni nage*	56	*nen khuge*	87	*che nhege*	801	*chyasa wa chhuge*
26	*ni khuge*	57	*nen nhege*	88	*che chyage*	900	*gusage*
27	*ni nhege*	58	*nen chyage*	89	*che guge*	901	*gusa wa chhhuge*
28	*ni chyage*	59	*nen guge*	90	*guige*	1,000	*dochhige*
29	*ni guge*	60	*Khuige*	91	*gui chhuge*	1001	*dochhi wa chhuge*
30	*Suige*	61	*khui chhuge*	92	*gui nege*	10,000	*jhidoge*
31	*Sui Chhuge*	62	*khui nege*	93	*gui swoge*	1,00,000	*sachhidoge*

Appendix-II-b
Number names of Gopalis (continued)

Number	*Gopali number name*	Number	*Gopali number name*
1001	*dochhi wa chhuge*	2200	*ninesage*
1009	*dochhi wa guge*	2300	*niswosage*
1010	*dochhi wa jhige*	9900	*guigusage*
1011	*dochhi wa jinchhuge*	9999	*guigusa wa guiguge*
1020	*dochhi wa nige*	10000	*jhidoge*
1021	*dochhi wa nichhuge*	10011	*jhido wa jinchhuge*
1030	*dochhi wa swige*	10100	*jhido wa sachhige*
1099	*dochhi wa guiguge*	10199	*jhido wa sachhi wa guiguge*
1100	*jinchhusage*	10200	*jhido wa nesage*
1101	*jinchhusa wa chhuge*	10300	*jhido wa swosage*
1102	*jinchhusa wa nege*	10999	*jhido wa gusa wa guiguge*
1110	*jinchhusa wa jhige*	11000	*jinchhudoge*
1112	*jinchhusa wa jinnege*	12000	*jinnedoge*
1120	*jinchhusa wa nige*	13000	*jinswodoge*
1199	*jinchhusa wa guiguge*	99000	*guigudoge*
1200	*jinnesage*	100000	*sachhidoge*
1300	*jinswosage*	100001	*sachhido wa chhuge*
1400	*jinpesage*	100099	*sachhido wa guiguge*
1500	*jinnasage*	100100	*sachhido wa sachhige*
1600	*jinkhusage*	100101	*sachhido wa sachhi wa chhuge*
1700	*jinnhesage*	100199	*sachhido wa sachhi wa guiguge*
1800	*jinchyasage*	100200	*sachhido wa nesage*
1900	*jingusage*	100999	*sachhido wa gusa wa guiguge*
2000	*nedoge*	101000	*sachhido wa dochhige*
2001	*nedo wa chhuge*	101001	*sachhido wa dochhi wa chhuge*
2010	*nedo wa jhige*	101099	*sachhido wa dochhi wa guiguge*
2099	*nedo wa guiguge*	101100	*sachhido wa jin chhusage*
2100	*nichhusage*	101101	*sachhido wa jinchhusa wa chhuge*
2101	*nichhusa wa chhuge*	101199	*sachhido wa jinchhusa wa guiguge*

Appendix- II-c
Number names of Gopalis (continued)

Number	*Gopali number name*	Number	*Gopali number name*
109001	*sachhido wa gudo wa chhuge*	111101	*sachhido wa jinchhudo wa sachhi wa chhuge*
109099	*sachhido wa gudo wa guiguge*	111111	*sachhido wa jinchhudo wa sachhi wa jinchhuge*
109100	*sachhido wa guichhusage*	112000	*sachhido wa jinnedoge*
109101	*sachhido wa guichhusa wa chhuge*	199000	*sachhido wa guigudoge*
109199	*sachhido wa guichhusa wa guiguge*	199999	*sachhido wa guigudo wa gusa wa guiguge*
109999	*sachhido wa guigusa wa guiguge*	200000	*nesadoge*
110000	*sachhido wa jhidoge*	300000	*swosadoge*
110001	*sachhido wa jhido wa chhuge*	900000	*gusadoge*
110099	*sachhido wa jhido wa guiguge*	1000000	*dochhidoge*
110100	*sachhido wa jhido wa sachhige*	1000001	*dochhido wa chhuge*
110101	*sachhido wa jhido wa sachhi wa chhuge*	1000011	*dochhido wa jinchhuge*
110199	*sachhido wa jhido wa sachhi wa guiguge*	1000100	*dochhido wa sachhige*
110999	*sachhido wa jhido wa gusa wa guiguge*	1001000	*dochhido wa dochhige*
111000	*sachhido wa jinchhudoge*	1001099	*dochhido wa dochhi wa guiguge*
111001	*sachhido wa jinchhudo wa chhuge*	1002000	*dochhido wa nedoge*
111099	*sachhido wa jinchhudo wa guiguge*	1099000	*dochhido wa guigudoge*
111100	*sachhido wa jinchhudo wa sachhige*		

Appendix- III

Cultural practices of Gopali community

Anna Prasan (Rice eating)

They put rice, dung, pulse, mud, pencil, copy and rupee in a saucer. Whichever child touches first, s\he may be under the same field in his future. For example, if he touches copy, he becomes a scholar, if he touches mud he will do farming in his future, if he touches dung he will raise cattle, if he touches pulse or rice there won't be hand to mouth problem in his life. It means there will sufficient food in his home and he must not work hard for eating.

Performing *anna prasan*

***Bya* (marriage)**

In the past, Gopalis had the child marriage practices. But nowadays, it is no longer in practice. However, the youngsters are considered ready for marriage after the age of 13-14 years. Even these days, there are events of marriage between the girls and boys of 15-16 years. There are several instances of love marriage in this age.

Fosi gifted to the bride

There are two types of marriage among Gopalis: arranged marriage and love marriage. In the case of love marriage, the boy and girl go away from their family and stay in the house of the boy's relatives for some time. In such cases, the boy's party has to organize *leratei* (a special ritual-cum-feast), with the consent of the girl's parents, to make the marriage socially acceptable.

***Bahra barse naach* (Twelve years dance)**

They perform a cultural dance in every twelve years in Champeshwor Mahadeva's temple. They started to rehearsal from the month of *Bhadra*. Instead of girls, boys wear the clothes of girls to dance. Girls don't take part in this dance. This dance depends upon the myths of gods. At the same time they perform drama on religious story like Ramayan, Mahabharat, Shree Swasthani Brata Katha etc. It was held last time in 2058 A.D. in Champeshwor Mahadeva's temple. It starts at 4 pm and ends at 10 pm in that temple, after that they go to Taukhel to perform dance. Next morning they take Prasad.

Champeshwor template Mahadeva

The main junction of the celebrating *jatra* is the Champeshwor temple. In the *jatra* of first Kartik whole Chitlang VDC's presentation can be seen to observe Gopalis' cultural dance and dramas. I was also present in the Kartik Naach of the year 2063.

Kartik mela

Performing Drama in first Kartik

Bhaitika

This festival is also celebrated by Gopalis. In this festival sisters put *tika* on their brothers' forehead. To worship rice flour is used to make a circle and within that circle, they make different types of braid. The sisters have to make this type of symbol in front of each brother. On this braid, they put different fruits, flowers and other worshiping things.

At that time they worship Yamraj (god of evil) and other gods too. They have make two circles for god and Yamaraj too. If there are four brothers, they have to make six circles. In each place a lamp is made of *yamari* (a kind of bread made by rice flour). Different kinds of fruits, sweets, orange, lime, *yamari*, an egg of duck, wine are presented to brothers by their sisters. Similarly brothers give money, clothes, water vessel, *fosi* (a kind of vessel which is used to make wine) etc. But it is not compulsory to give all things whatever they can give they give to their sisters.

Mahanavami

They sacrifice of goat in front of their kitchen. They put all things which are used in whole year and they put sugarcane, two duck eggs, *diyo, kalas, ful-aksheta* to worship. They also worship that goat and sacrifice there. To make goddess Durga

happy they sacrifice goat. If the goat sakes his legs or head after finishing *puja*, it is assumed that goddess Durga accepts the goat, after that they sacrifice goat.

The interesting cultural values of the cutting he goat is that it must not touch its body on the floor. Gopalis cut the goat on hanging up without touching on the floor.

Hanging goat while sacrificing

Indigenous Technology and Wisdom

Some of the important indigenous technologies found among Gopalis include: drainage for irrigation, *pani ghatta* (stone-made flour mill running through water power), using the oxen-pulled ploughs, etc. But nowadays, the tractor has also been introduced among Gopalis as modern technology.

To mention the folk knowledge, the Gopalis seem to be expert in making *sinabali* by pressing the radish in the deep hole under the ground, making *gundruk* keeping the mustard leaves in the heat of manure, making *chana* after cutting the radish, making liquor, etc. The indigenous skill of cloth weaving using the handloom is also found among them.

Gopalis have the tradition of treating the illness by shamans and traditional healers. In Kunchhal, people have the belief that the god/goddesses Panchkanya and Satkanya play role in making people ill; and only the shaman can treat the illness. In the case of

injury in the external body parts, they apply the liquid of banmara (a typical wild herbal plant) in the wound.

Folk Art and architecture

Gopalis used to have three-storey houses. Such houses are still found in Shikharkot. There are four-storey houses in Kunchhal, Gahate, Papung and Kulgaun. In Papung and Toukhel, the houses are made of bricks; but in Gahate, Kulgaun and Shikharkot, the houses are stone-made. In Nulgaun the houses are of mixed type.

Economic Life and Livelihood

Although most of the Gopalis are living on agriculture and animal husbandry, some are involved in other occupations as well. Their economic life and livelihood can be described in the points given below:

Agriculture and animal husbandry

Most of the Gopali families are depended in agriculture for their survival as well as for economic activities. They have two types of land: a) *boon* (plain terraces), where they grow paddy, potatoes, cabbage, chilly, maize etc; and b) *keu* or *bari* (slope terraces), in which they grow radish, millet, corn, and other vegetables.

Cabbage production on Gopalis' farm

Gopalis also tame animals keeping them at *goths* (sheds). They construct the *gothas* in *keu*, which is usually far from their house.

Basically, all the Gopalis manage their economic activities by using their farm and live-stock products. Despite their limited income, they do not have hand-to-mouth problems.

Educational Status of Gopalis

There are four schools around Gopalis areas where Gopali students are studying in high number of participation. The name of them are Shree Champakeshwor Lower Secondary School (Nhul Gaun), Shree Natyashwor Secondary School (Taukhel), Shree Bajrabarahi Secondary School (Bajrabarahi), Sunaula Lower Secondary School (Kunchhal). Very few numbers of Gopalis are studying in college level. I have collected number of

Some Gopalis are teachers in the local primary schools. In addition to their regular duty of going to school, the teachers are also involved in farming in the morning and evening hours.

Business: Some persons are involved in business activities, including:

a) Collecting and selling farm products: The vendor collects vegetables, paddy and other products from the villagers at a place and supplies these goods to the cities in gross quantities.
b) Managing small shops: The shopkeeper sells the items of daily use e.g. soap, matchboxes, kerosene, vegetable oil, biscuits, sandals, cigarettes, local wine, salt, sugar etc.

Foreign-wage labourers

Some people within the age group of 18-30 have gone to the foreign countries for employment. They are employed as labourers in Saudi Arabia, Qatar and Malaysia.

Cottage industries

Some Gopalis are also involved in the domestic/cottage industries- e.g. weaving looms, producing goods of domestic use such as *doko* (bamboo-made basket), *namlo* (long strip for carrying load) and making *gundruk* (fermented leaves of mustard, radish etc), *sinabali* (fermented radish etc), *lespati* (small pieces of radish dried on the floor), *leu chana* (long slices of radish hanging on ceiling etc). They sell these products going to city.

But the people involved in making such items do not spend their whole time in these works. As a regular business, they are involved in the farm activities; so they spend only their spare time in producing these goods.

Folk Literature

Folk literature is defined as the people's literature in which the folk's thought is presented in the folk language in the folk style for the welfare of the folk people. This sort of literature is found among Gopalis as well. They have fewer folk ballads, but their interest in folk songs is remarkable. Particularly due to their religious belief, they

give much time in worshiping the folk gods and goddesses, and in singing the religious and devotional songs. They spend the morning and evening hours for worshipping and singing religious songs. The religious song Gula Dapha is performed in the month of Shrawan; and Kwayala Dapha is performed in Kartik.

They have the tradition of *hile naach* (dancing in the mud) on the occasion of Saparu (also called Gai Jatra, cow festival) festival every year. There is also tradition of Barabarse Nach (a typical dance program organized once in every 12 years). Bade Pyakha (a dance devoted to goddess Bajrabahari), and Swet Vinayak Pyakha (devoted to god Swet Vinayak) are the religious dances found among Gopalis.

Gopalis sing the ballad on the biography of King Gopichand and Bharathali. Among the folk songs, the important ones are Tamimye (old folk songs), Baramase Geet, children's songs and several other songs related to love and attraction as well as trouble and pain – e.g. Maya Madhula, Juta thwa pir, etc.

Based on the available data and the relevant materials, Gopali folk literature can be studied by classifying it into: a) folk songs which include religious songs, seasonal songs, short folk songs, festival songs, children's folk songs and folk ballads; b) folk tales and legends; c) biography and memories d) folk proverbs, e) riddles etc.

Performing Folk Culture

Under the performing folk culture, two dramatic song performances deserve special mention, which are performed on the occasion of Barabarse Naach. The dance narrating the story of King Kam Sings and Chandra Singh is performed in Kunchhal. Another dance is Barabarse Bajrabarahi dance, which is performed in the participation of all the local people including the Gopalis of Purano Tistung (old Tistung). This dance is based on the story of king Satal Singh. In these dances, we can see the mixture of Newari and Nepali languages to some extent. The tradition of such dramatic song, performed once in every 12 years, is found in Toukhel also.

Barse Barse Mela

On the occasion of Gai Jatra festival, a folk dance called Gunla Pyankha is famours in the villages of Kunchhal, Papung, Toukhel etc. Similarly, Twak Naach is a dance performed on the occasion of Kartik Purnima (Full Moon Day in the month of Kartik- i.e. around October-November in Toukhel.

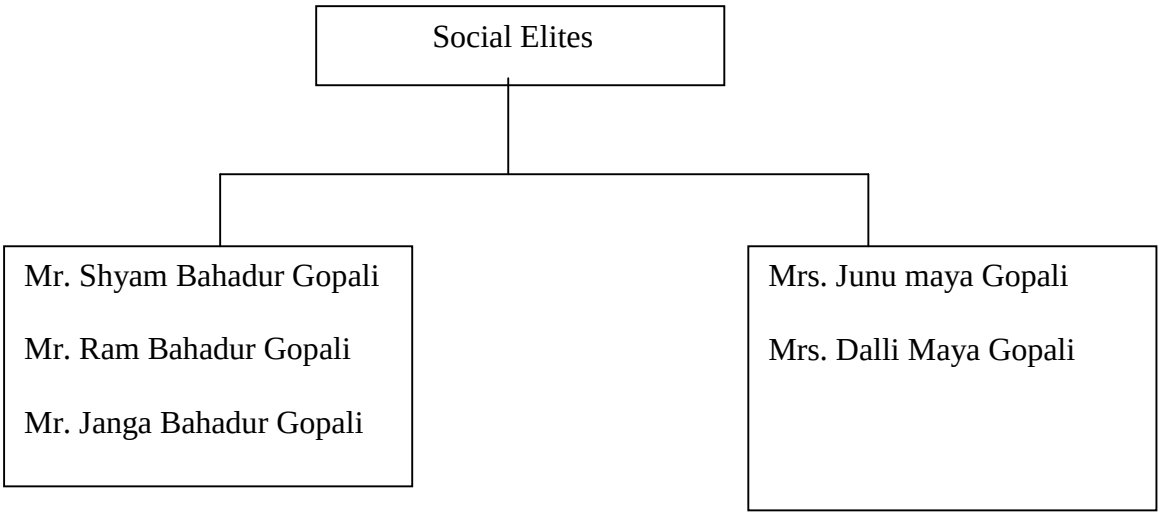
Among the various folk musical instruments found in the Gopali community, some major ones are: Khin, Jhyali, Ta, Bagu, Ponga, Bansuri, Dha, Muhali, etc.

Appendix- IV

Location map of Chitlang

Appendix - V

Key informants of the study



Children

Mr. Deepak Gopali
Ms. Bina Gopali
Mr. Tilak B. Gopali

Appendix – VI

Interview guidelines for social elite (male/ female)

1. Personal Information

Name: …….. Date: ……

Gender: …… Age: ……

Occupation: …….

2. Mathematical connection in folk tales, sayings, religions, story etc.
3. Practices of length, volume, area etc. in their daily life.
4. Use of astrology in their annual religious / cultural rituals.
5. Ethno mathematics in their occupation like agriculture, animal husbandary, weaving clothes, household work etc.
6. The concept of measurement like shape, cost and other in their locality.
7. Ancesters' practices as their understanding with relation to mathematics
8. The realization of mathematics in their life.
9. Record system of day to day financial activities by male/ female
10. Day to day mathematical problem solving style.
11. Counting system of them, if any specific way of counting and their mathematical operational.
12. Way of building houses, celebrating feast and festivals
13. Agricultural instruments with their mathematical application
14. Historical evidences if any and their mathematical representation
15. Artifacts and their mathematical process and application
16. Cultural activities which demand mathematical concept

Appendix – VII

Interview guidelines for children (boys/ girls)

1. Personal Information

   Name: …….. Date: ……

   Gender: …… Age: ……
2. Application of mathematics while playing games and their perception
3. Practices of length, volume, area etc. in their daily life.
4. Ethno mathematics in their works in farming, animal husbandary, household works etc.
5. The concept of measurement like shape, cost and other in their locality.
6. The realization of mathematics in their life.
7. Records system of day to day activities
8. Day to day way of mathematical problem solving style.
9. Counting system of them, if any specific way of counting and their mathematical operational.
10. Way of making tools for playing game
11. Agricultural instruments with their mathematical application
12. Understanding of mathematics among them
13. Children's observation in the use of mathematical concept of the family members and community people.
14. Source of mathematics learning

Appendix – IX
Introduction of the candidate

I was born in Belghari- 2, Sindhuli district in a farmer's family. The school education was completed from the school nearby my village. For the higher study, I left my village due to lack of college near the surrounding. The intermediate (I. Ed.) and the Bachelor (B. Ed.) degree were completed from the Saptagandaki Multiple Campus, Bharatpur, Chitwan in mathematics. Again I have transferred to Kathmandu for my master degree in mathematics education. After the completion of my master degree, I have got an opportunity to participate in the master of philosophy (M. Phil.) course, as a first batch student in the history of M. Phil. Education from the T.U.

I am from Brahmin family and have well attachment with indigenous groups of people from my early childhood. The distinct groups of people and their religious and cultural practices made me curious from the childhood. As the result, I was introduced as a folk singer and used to convert their painful life in the form of song and then became more popular/ demanded in the religious /cultural as well as my school programs. From such activities, I have got golden opportunity to learn many more about indigenous culture and the comparative learning between own and other cultures. While I was in Chitwan district for my higher study, I was awarded by the district excellent certificates in the folk song competition in 1995 and 2000 AD.

While explaining my past experiences, I have started my carrier as the mathematics teacher in the private boarding school and gained eight years experience in the school education. I was also played the role of extracurricular activities chief which is one of the essential parts of the school students. In this way, I never detached from the cultural involvement. Similarly, the membership of the Narayani Kala Mandir was another continuous participation in my cultural activities.

The master's thesis was my first formal study in the topic 'use of mathematics in the eastern classical music' that helped me to learn more about the classical music and their relationship in mathematics education. This is one of my previous supportive backgrounds of the M. Phil. study related to the culture. The involvement in the CERSOD as a field researcher in the research like 'Impact of UNFPA scholarship program in six PARHI districts', 'Teacher Management in Inclusive Exclusive Education' were my professional involvement. Similarly, 'The Status of early childhood development (ECD) conducted by Action Aid and 'developing culturally contextualized mathematics resources materials: Capturing of women and disadvantaged community' conducted by Kathmandu University were my recent past experiences in the research field.

The principal, director and vice principal were my previous professional recognitions. Similarly, project expert, in Lions Clubs International District 325 B Nepal and research trainer in SPC Nepal, New Baneshwor are my ongoing identification. My present settlement is in Kathmandu valley (the capital city of Nepal). The following address is mentioned for the contact purpose:

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