Chapter I

INTRODUCTION

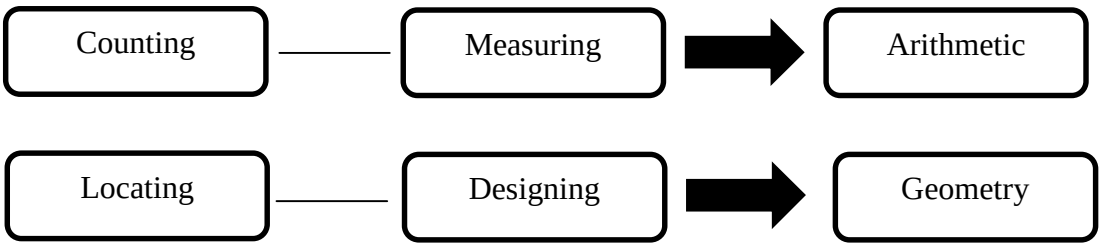
Background of the Study

When researchers investigate knowledge possessed by members of distinct cultural groups, they may be able to find unique mathematical ideas, characteristics, procedures, and practices that we consider ethno mathematics, which is used to express the relationship between culture and mathematics. In this regard, the term *ethno* describes characteristics related to the cultural identity of a group such as language, codes, values, jargon, beliefs, food and dress, habits, and physical traits while the term *mathematics* expresses a broad view of mathematics, which includes ciphering, arithmetic, classifying, ordering, inferring, and modeling (D'Ambrosio, 2001).

Therefore mathematical ideas, concepts and contents can't be universal because inhabitants have their own values, beliefs, reality, cultural practices and traditional knowledge. Students must learn the relevance of culture and personal experience because all people have their own realities. In this context, Barton (1996) stated that ethno mathematics is not only the study of mathematical ideas because it is also the study of anthropology and history. Therefore, a teacher should be aware of the diverse identities of students or multicultural classroom.

A classroom is a community of multicultural students where each student has his/her own values, cultures different from others. So a facilitator should start the class or course content from their cultural background which helps interlink students learning with real world. The cultural background or ethnicity of students can be used as resource for learning. The activities can be addressed by ethno-mathematics. I studied the Tamang community for my research in ethno-mathematics.

Bishop identifies “universal” activities which can be characterized as mathematical activities. In addition, he also specifies for each activity some “organizing concepts” which should provide a “knowledge frame” for the mathematics curriculum. The activities and their “organizing concepts” specified by Bishop are:



Counting refers quantifiers, finger and body counting, tallying and operations on numbers. Measuring is concerned with comparing, with ordering and with valuing, all societies value certain things. Locating means chosen to characterize the activities relating to findings one’s home area, travelling without getting lost and relating objects to each other. Designing refers universal and important source of mathematical ideas are the many aspects of designing pursued by all cultures where the locating activities refer to locating objects and orienting oneself mainly in the natural environment (Bishop, 1998).

Mathematical knowledge has commonly been used as universal truth that exists independently of people and that are discovered by mathematics through a process of formal reasoning. Mathematics exists in each and every social and cultural aspect of human socialization of different culture and society to the modern society. The construction of big cities, temples, roads, pyramids, canals, ponds, agricultural instruments, houses etc. in the ancient period required mathematics. So mathematics is the mirror of civilization. These societies use their own mathematical ideas in solving their daily problems. These cultural and sociological ideas of mathematics are known as ethno mathematics.

Human beings can't be separated by mathematics because it helps the individual to understand and interpret quantitative and qualitative aspect of concept. It has been developed for fulfilling the daily life problems of men like counting, calculating and remembering. It is believed that the mathematics and the development of human civilization go along. Mathematics was introduced later in the formal education system; it has been developed simultaneously with the development of society. Mathematics is not only the theories and problems of formal education system, but also it had been practicing in the contemporary society with their own ideas and belief systems. Being a member of Tamang community, I have seen ethno-mathematical knowledge in our social activities such as estimating time, games, musical instruments, domestic materials or domestic activities.

In the M. Ed. first semester class, teachers have autonomy to make curriculum and assessment system is not dependent on final examination (3 hours paper pencil test). Internal assessment system is available (presentation, project works, discussion on classroom, attendance). When I observed facilitators, the facilitator gives interesting examples which is related with student’s context and easily can understand those things, whatever hard students can understand and students do not forgot those things. I found, some facilitators are more creative and they focus on student's creativity. They link subject matter with our context and culture. From my experience, I can say that "how to make subject matter contextual and how to link with our own culture and own everyday life" is essential 'art' for teachers. It motivates students to seek mathematics in their own culture and day-to-day life and it makes mathematics easy.

Then I started to seek mathematics in my culture and day-to-day life. When I reflect my childhood's games, I also found mathematics there. I found mathematics in my mother's cooking, estimation, and ornaments, father's artifacts and brother's local

business. I think Tamang community has numerous mathematical patterns in their culture specially, in farming, children's games, artifacts, local business, rituals and ornaments. Question rises in my mind what are the (ethno-mathematics) mathematical practices in my own culture. How do Tamang communities use mathematics in their day-to-day life? How can we relate those mathematical practices with school mathematics? I am interested to know about mathematics practice in Tamang community and I would like to explore and interpret deep understanding about it. Therefore, my research explored the mathematics practice in Tamang community.

In the educational field, according to my experience, I really enjoyed those classes, teachers who relate mathematics with our culture and context and relate theories with interesting contextual examples. From this way, I can easily understand, and I do not forget these things. Culturally relevant mathematics pedagogy makes mathematics easy and students feel mathematics is in our culture and real world situation. So that I believe that knowing about student's culture and real-world situation is more important for teachers, educators, curriculum experts and all educationists.

Introduction of the Tamang Community

Tamang are an ancient and major indigenous people of Nepal. During the 8th century the Tibetan King employed Tamangs as border patrol to protect the people and lands of Tibet. In Tibetan, the word Tamang means: 'Horse Warriors'. As such, they lived around the southern Himalayan region (Blon, 2007). Before the creation of Nepal, Tamangs occupied the Terai, Hills in the 7th century. Nepal was formed later in the 18th century and saw a slow assimilation of the Tamang group with other communities in the region (Gole, 2015). Around the 18th century following conquests from other communities, the land owned by Tamangs were taken away and distributed to the new rulers of the region.

Tamangs are mostly believed in 'Bon' Dharma which is one of the Buddhist religions and are known as Buddhist cultural and cultural system. Which have a system of six types of societal leaders: Tamba, Ganba, Bonbo, Labonbo, Lama and Choho to keep the Tamang society continuously alive and dynamic. The six have their respective and important roles to play in the development of Tamang society. The Tamba looks after the cultural aspect and has a very important role to play in marriage ceremonies. The Lama carries out death rites (Ghewa) and undertakes activities related to the Buddhist religion. The Bonbo propitiates the local gods and goddesses and assists by providing treatment to the sick and needy in the village.

The Labonbo(Laptaba) keeps alive the history of the clan and lineage through the worship of clan deities. As each thar, or subgroup, has its own Phola or clan deity, there are different Labonbos for each and every subgroup. The Choho looks into cases and dispenses justice and maintains peace, security and wellbeing in society. The Ganba participates in all types of social, political and religious activities. Thus, the six societal leaders or actors continue to make the Tamang society aware of its duties and responsibilities. There are also in Tamang society traditional institutions like Nhangkhor active to undertake socio-cultural activities (Gole, 2015).

Their traditional area is the hilly region between the Budhigandaki River and the Likhu River. At present, they live in large numbers in the district mans which is surroundingly spread (Kathmandu valley) of Rasuwa, Nuwakot, Dhading, Makwanpur, Sindhuli, Ramechhap, Dolakha, Lalitpur, Sindhupalchok and Kavrepalanchok in the Central Development Region. The total population of Tamang in Nepal, according to the census of 2011, is 1539830, (Census, 2011) i.e. 5.8 per cent of the total population of the country. The Tamang language occupies fifth place in the country in terms of the

number of speakers speaking any one language and first place among the Tibeto-Burman languages.

As this Tamang people should be ahead in nation but unfortunately, many years of marginalization and discrimination have hindered the progress of the Tamangs. But despite facing several hardships they have survived to maintain their distinct identity and recent years have seen some developments. Tamangs generally follow a form of Tibetan Buddhism, speak a language derived from Tibetan-Barmeli and the culture is almost identical to that of Tibet. Tamangs are divided into 240 families but have no class or social status differentiations based upon the family groups. Every family has clans (Swagen Bhai). Marriage between their clans is restricted by Tamang traditions.

Tamangs are one of the most populous of the Hill People of Nepal (Tamang, 2006). Most Tamangs are farmers, engaged in agriculture as small holders and day labour. Due to the lack of irrigation at higher altitudes, their crops are often limited to corn, millet, wheat, barley, and potatoes. They often supplement their farming income with manual labor. They also work as porters and Guides on a trek. Due to the discrimination experienced by the Tamang people they have remained on the whole poorly educated, and the majorities have been limited to working in farming, portering, mountain trekking, and driving in Kathmandhu. They also work in construction of Tibetan rugs, Thankas (Tibetan painting), driving, labor and trekking.

Statement of the problem

Nepal is multi-cultural, multi-lingual and multi-religious with 2.6 billion populations of 125 ethnic groups and their 123 mother languages (National Population Census , 2011). Tamang community is very rich in culture and there are many different kinds of ethno-mathematical knowledge in the way they measure, count, do local business, estimate, way of farming, storing grain. But students of this community is

failed to tackle same problem of course book. Mathematics was for a long time regarded as a neutral and culturally- free discipline removed from social values (Bishop, 1993; cited in D'Ambrosio, 1990). So, there is no connection between school and cultural knowledge.

This means, ethno-mathematics has zero space in curriculum and classroom. It defines mono-cultural teaching methodology which isn't more effective in teaching method. According to Phuyal (2009), "geometry is problematic for both teacher and learners globally because of the proper identification of teaching method." To overcome problem, curriculum should include ethno mathematics. This can be helped to create a trend of multicultural classroom and the classroom supports in social justice, self-esteem and raised the standard of children or people who are dominated. Thus, this study is focused on the ethno-mathematics (especially geometrical part) of Tamang community. So I carried out this research to find out the ethno-mathematical practices of Tamang people and have tried to link these practices with the primary level's formal education.

Objective of the study

The objectives of the study are as follows:

- To explore the ethno-mathematical practices of geometry in Tamang community.

Research Questions

Research questions are as follows:

- What is the measurement systems practiced in Tamang community?
- What are the geometrical concepts embedded in Tamang community?

Significance of the Study

This study would reflect the indigenous mathematics knowledge and skills. This study helped the teachers, students, and their parents to use the knowledge to environment. The rationale of this study was to know what they know and how they learn mathematical knowledge in their every activity. This study focus on the how is geometrical knowledge embedded in Tamang community and how they link to formal education system. Ethno mathematics, if explored systematically could be used in the curriculum; this study in the direction would be very significant. The significance of this study is listed below:

- It would be an ethno mathematical study,
- This study would help the curriculum designer, educational planner, politicians, and parents would also be obligated to think about the ethno-mathematics and it's incorporating in the school curriculum,
- To find different kinds of teaching materials, teaching methods which are locally available,
- The contribution in ethno-mathematics can be helped to promote, explore geometrical knowledge and skill of the Tamang community and to make the content of mathematics of Tamang language for school level education.
- The study helps to remove geometrical anxiety, practicing multicultural curriculum. As well as the students develop habit to research geometrical knowledge surrounding them and they try to link school and daily applied knowledge.

Delimitation of the study

Delimitations of this study are as follows:

- This study was based on qualitative design.
- This study was based on only Tamang ethnic group.
- This study intended to study the geometrical knowledge and hidden mathematical culture in Tamang Community.
- This study was conducted in Lurpung Village, Kavrepalanchowk District and tried to find measurement system and the ethno mathematics (geometrical part) practices of cultural things such as ornaments, foods, dress, and artifacts in Tamang community.
- All the participants of the study was Tamang people, among them one is leader of the society and other are professional people, teacher, women of the village.
- This study has been circled around the geometrical knowledge and hidden mathematical activities used by Tamang in their daily life.

Definitions of the Key Terms

Ethnic group: A type of group contained within the national boundaries defined by race, religion or national origin.

Ethnographic: The scientific study of different races and cultures.

Ethno-mathematics: The study of the interrelationship between mathematics and culture.

Mathematical Knowledge: The study of numbers, quantities and space used knowingly and unknowingly.

Practices: Systematic use by repetition in behavior.

Tamang: Tamang are one of the indigenous inhabitants of Nepal. They have their own distinct culture, language and religion.

Chapter II

REVIEW OF RELATED LITERATURES

In this chapter, different literature relevant to the ethno-mathematical knowledge of diverse communities and cultures has been reviewed in order to know their incorporation and implementations in school mathematics or curriculum. To conduct any research, a researcher needs to review the related literature so that s/he gets the guide lines and ideas for his or her research. This study is mainly concerned with teaching school mathematics with the help of ethno-mathematical knowledge. And my research topic is “Geometrical Knowledge Practiced in Tamang Community”. Some related literatures which I have reviewed as follows:

Empirical Review

CERID (1990) conducted a research in title “The Elementary Process of Learning Mathematical Concepts and Process of Rasuwa Tamangs”. The main purpose of this study was to study the basic mathematical concepts used by Tamang adults with no formal mathematics education, to identify traditional Tamang method of mathematics operation and to find out the implication of Tamang process. The study concluded that Tamang numeration system is in base twenty and Tamangs have their own distinct concept for calculation, measurement and other mathematical work.

Paudel (2008) has done research on the topic “Ethno-mathematics in Tharu community”. In his study it was found that numeration system of Tharu is on base twenty and they have their own measurement system, volume estimation system and through their artifacts we can easily introduce with parallel lines, intersecting lines, triangles, quadrilaterals and angles. With the help of *Jal* weaving we can teach arithmetic addition and subtraction. The children games like *cheri* and *vidi* can be used to teach co- ordinate system. But he has found that formal mathematics education and

traditional mathematical knowledge are not connected. As well, in this study he concluded that ethno-mathematical knowledge can be used as their cultural identity. He also found that ethno-mathematics and culture are interconnected. Hence we can incorporate cultural mathematical knowledge in the school curriculum.

UNESCO (2008) has done a study on "Developing Culturally Contextualized Mathematics Resource Materials: Capturing Local Practices of Tamang and Gopali Communities". In this study it found that they have prepared five sets of curriculum resource materials for mathematics teaching and learning as well encouraging parents to help their children for understanding of the mathematical concepts from their household activities. In third position they have also prepared materials for geometry named as 'Grand Tour of Geometry' where they have explored the geometrical concepts dealing with various artifacts such as *doko* (wicker basket), *ghum* (locally prepared rain shield/cover), structure of house and temple. Through this study, they found that parents, teachers and students were very positive towards culturally responsive teaching, learning and curriculum materials.

Shrestha (2003) presented some ideas on his M.Ed. dissertation based on measurement system in Newar Civilization with the objective to identify the numeral systems and its trends of gradual development. His findings show that all the numerals of Newar civilization were found to be developed from the Brahmin. The ciphered numeral system was used during the Lichhavi period, and the symbol zero was introduced during the dark age of mathematic development.

Gurung (2014) has researched on titled, "Mathematics in the Gurung community". In where, she finds that Gurung community have their own mathematical practices such as counting number, number system, measuring system, addition, subtraction, multiplication, division and properties of rectangle. Those are possible to

incorporate in the school mathematical curriculum. The empirical research in diverse community, the researchers find that there are several ethno-mathematical practices and able to incorporate in school mathematics curriculum.

Knowledge gap

From the above discussion of related literature, very few studies have been carried out around the field of ethno-mathematics. Among these practices, some were directly related to learning strategies of mathematical concept of different ethnic group. But this study tried to find indigenous knowledge as culturally responsive teaching, learning methodology and resource for curriculum designing and also the teaching material which is locally and easily available at surrounding of the student that makes teaching learning effective and purpose oriented.

Nepal is one of the multi-cultural country, where different ethnic groups are living and they have their own cultural system. These cultural groups perform their mathematical problems by their own style. After that I had tried to link ethno-mathematics and education. The review of above literatures motivated me to study the Geometrical Knowledge Practiced in Tamang Community. Therefore, on this ground, I am motivated to carried out this study.

Theoretical Review

Ethno-mathematics

Ethno-mathematics is to seek to understand mathematical knowing/doing throughout the history of humanity, in the contexts of different interest groups, communities, peoples and nations (D'Ambrosio, 2001). Ethno-mathematics is the application of mathematical ideas and practices to problems that confronted people in the past or are encountered in present contemporary culture. Much of what we call modern mathematics exploitation, colonization, communication and other problems

solving techniques that arose from specific communities. Ethno-mathematics may also be regarded as a program that seeks to study how students have come to understand, comprehend, articulate, process and ultimately use mathematical ideas, concepts and practices that may solve problems related to their daily activity.

Ethno-mathematics is the study of mathematics, which takes into consideration, the culture in which mathematics arises. We all have some notions of what ethno-mathematics is, but should it be influencing school mathematics. An important change in mathematical instruction needs to take place in order to accommodate the change in the demographics of students towards students of different cultures. This study describes why and how mathematics is important in mathematics education and focuses on the way the culture plays an important role in a child's life. The prefix 'ethno' is today accepted as a very broad term that refers to the social cultural context and therefore includes language, jargon and codes of behavior, myths and symbols (D'Ambrosio, 1990).

The derivation of 'Mathema' is difficult, but tends to mean to explain, to know, to understand and to do activities such as ciphering, measuring, classifying, inferring and modeling. The suffix 'tics' is derived from techne, and has the same root as technique. In other words ethno refers to members of group within a cultural environment identified by their cultural traditions, codes, symbols, myths, and specific ways used to reason and to infer (Rosa, 2010). 'Mathema' means to explain and understand the world in order to transcend, manage and cope with reality so that the members of cultural groups can survive and thrive and 'tics' refer to techniques such as counting, ordering, sorting, measuring, weighing, ciphering, classifying, inferring and modeling.

Rosa and Orey (2003) stated that the mathema develops the ‘tics’ within the context of ethnos because it consists of daily problems people face, larger problems of humanity and endeavors of humans to create a meaningful world. According to D’Ambrosio (2001) the search for solutions for specific problems that help the development of mathematics are always embedded in a cultural context: in order to understand how mathematics is created, it is necessary to understand the problems (mathema) that precipitate it.

The Brazilian philosopher of mathematics, Ubiratan D’Ambrosio, first coined the term “Etho-mathematics” in the 1970’s in speeches emphasizing the influence of socio cultural factors on the teaching and learning of mathematics. Since the field Ethno-mathematics is new, so I couldn’t find a definite definition for it. Definition varies from philosopher to philosopher and the same philosopher also makes his/her place strong by adding new dimensions to it. D’Amrosio firstly defined Ethno-mathematics as “the mathematical practices of identifiable cultural groups”.

Ascher and Ascher (1997), two researchers of African counting cultures, define Ethno-mathematics as “the study of mathematical ideas of non-literate people”. In the same year Ronald Eglash described Ethno-mathematics as “the study of mathematical concepts in cohesive social group, with an emphasis on small scale or indigenous cultures.” Zaslavsky (1998), described Ethno-mathematics as “the meeting of cultural anthropology with mathematics and education. Similarly Ascher describes Ethno-mathematics as ‘the study of mathematical ideas of traditional people.’

Rosa & Orey (2010) described ethno-mathematics as the “study of culturally related learning styles, historical developments in mathematics, and technology, prominent people in various cultural contexts who have made contributions to the field

of mathematics, cultural applications of non-traditional mathematics and various forms of mathematics that draw upon the interests, abilities and talents of teachers and students." Most of the countries in the world are multicultural, multilingual and multi-religious. Mathematics is now considered as social creation.

Culture is the contributing factor for the development of mathematics. Mathematics play a vital role in the development of culture and civilization since ethno-mathematics refers to the mathematics practiced in cultural group. It is different from one cultural group to another cultural group. Ethno-mathematics is recognized as set of mathematical practices which are known to culturally differentiated groups. Although mathematics is considered as a universal language, the way of teaching and learning mathematics such as simple operations, counting, estimating, calculation, measuring etc are culturally dependent and therefore different.

Ethno-mathematics also develops the study of mathematical ideas practices of socio-cultural groups, but how this is realized in the class-room is still problematic because much of ethno-mathematical research and investigations identify ethno-mathematical forms of mathematics but do not continue to develop the pedagogical actions for this program. Classroom research about ethno-mathematics and its role is a crucial aspect of this perspective because this program should be implemented in classrooms. Ethno-mathematics emphasizes the communal and tends to be brought together then ethno-mathematics may be conceived as an overarching aspect of the curriculum because mathematics may be humanized, that is ethno-mathematics may be viewed as a philosophical, contextual and affective approach to curriculum.

Ethno-mathematics seeks idea about how to make mathematics understandable and easy related with students day-to-day activity, culture and society. It also helps to

preserve students unique cultural values, activities, develop students unique way of seeing the world and cultural transmitted from one generation to another. It also helps to respect own culture as well as others cultures. In my research, I use the notion of ethno-mathematics to explore the mathematics practice in indigenous group Tamang community. I use the term ethno-mathematics to understand the mathematical practices especially geometrical parts in Tamang culture. Ethno-mathematics helps me to seek mathematics practice in Tamang community from inside and how can we use those ethno-mathematics in teaching and learning mathematics in the classroom.

Constructivism in the Learning Mathematics:

Constructivism holds that there is no knowledge that exists outside of the person, there is no objective reality. Constructivism claims that knowledge must be actively constructed by learners as they are already "knowing beings" who bring previous knowledge and experience to any learning events (Acharya, 2015). Constructivist teaching is based on constructivist learning theory. Constructivist teaching is based on the belief that learning occurs as learners are actively involved in a process of meaning and knowledge construction as opposed to passively receiving information. Learners are the makers of meaning and knowledge.

Constructivist teaching fosters critical thinking, and creates motivated and independent learners. This theoretical framework holds that learning always builds on knowledge that a student already knows; this prior knowledge is called a schema. Because all learning is filtered through pre-existing schema, constructivists suggest that learning is more effective when a student is actively engaged in the learning process rather than attempting to receive knowledge passively. A wide variety of methods claim to be based on constructivist learning theory. Most of these methods rely on some form of guided discovery where the teacher avoids most direct instruction and attempts to

lead the student through questions and activities to discover, discuss, appreciate, and verbalize the new knowledge. There are number of different forms of constructivism, but underpinning all versions are three premises:

1. Rather than being passively received, knowledge is actively constructed by learners.
2. Mathematical knowledge is created by students as they reflect on their physical and mental actions. By observing relationships, identify the patterns and making abstractions and generalizations, students come to integrate new knowledge into their existing mathematical schemas.
3. Learning mathematics is a social process where, through dialogue and interaction, students come to construct more refined mathematical knowledge. Through engaging in the physical and social aspect of mathematics, students come to construct more robust understanding of mathematical concepts and processes through process of negotiation, explanation and justification.

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

Vygotsky's social constructivism

According to the social constructivism, knowledge is the best constructed when learners collaborate together. Vygotsky states " Every functions in the child's cultural development appears twice, first, on the social level and later on individual level; first between people (interpsychological), and then inside the child (intrapsychologocal). This applies equally to voluntary, attention, to logical memory,

and to the formulation of concepts. All the higher functions originate as actual relations between human individuals."

In social constructivism, there are three main things which are presented in below:

I. Making meaning:

Learners built up any things meaning from the society. So, there is great role of society in learning.

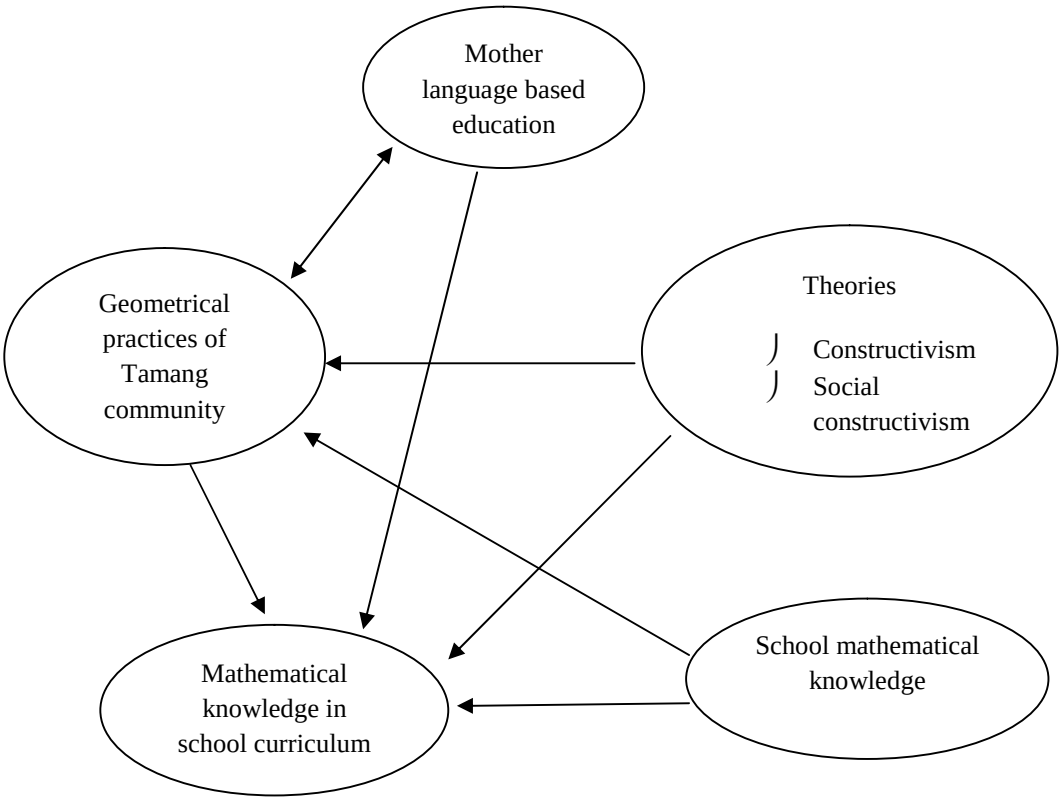
II. Tools for Cognitive Development:

Culture, language and ancestors are the tools of knowledge from them a learner can get a lot of knowledge in learning their mobilization and their nature towards education affects the learning.

III. The Zone of Proximal Development(ZPD):

ZPD means the difference between capacity of solving problem by learners themselves and solving problem from the support of others. The full development of the ZPD depends upon social interaction, in that the range of skill can be developed with social guidance or collaboration, thus it often exceeds what can be attained alone. To ensure development in the ZPD, the assistance given must have certain features and they are inter-subjectivity, scaffolding and guided participant (Acharya, 2015).

Conceptual framework for the study:



The framework was formed by different factors such as mother language based education, theories, school mathematical knowledge, geometrical practices of the Tamang community and mathematical knowledge in school curriculum with the purpose of systematic study on ethno-geometry. The interlink of mother tongue based education and geometrical practices of the Tamang community suggested that Mother tongue based education encouraged to research on ethno-geometry and showed the way of incorporation in curriculum. And geometrical practices of the Tamang community helped to implement mother tongue based education in school by making aware the community.

Likewise, theories help for systematic research on ethno-geometry. As well, the interlinking between school mathematical knowledge and geometrical practices of Tamang community involved to research on the relationship between them. Here school mathematical knowledge means the course which provide current existing curriculum.

But mathematical knowledge in school curriculum refers the implement of new curriculum to make education inclusive and mother language based education system. At last, all factors were linked with mathematical knowledge in school curriculum implies that to formulate new curriculum, we must care background of ethnic group, different theories, current mathematics curriculum.

Chapter III

METHODS AND PROCEDURES

This chapter presents the procedure carried out to achieve the objectives of the study. In this chapter, I discuss the various aspects of the study linked to research methodology. I begin with design of the study, study site, sample of the study, tools of data collection, data collection procedure, data analysis and interpretation.

Design of the Study

The design of the study is qualitative. Qualitative research is multi method in focus, involving an interpretive, naturalistic approach to its subject matter. Creswell (2012) divides qualitative research into five main approaches. They are phenomenology, grounded theory, ethnography, narrative inquiry, action research and case study. My research method is qualitative because it helps me for systematic and scientific study of socio-culture of the Tamang community. And, it involves studying subjective data of social world through people's daily life activities, life events, culture and perception. Therefore, I conduct qualitative research design with ethnography approach.

Being a member of same community, I need qualitative research methodology to interpret, support and develop the Tamang community's natural performance on socio-cultural activities in a research form because "qualitative researchers are interested in understanding what those interpretations (of those studied) are at a particular point in time and in a particular context" (Merriam, 2002). Therefore, "qualitative research involves the study used and collect of a variety of empirical materials, case study, personal experience, introspective, life study, interview, that routine and problematic moments and meaning in individual lives" (Denzin, 2011).

So, qualitative research methodology guides me to capture each and every moments of my research area. Likewise, “qualitative research is multi method in focus, involving an interpretative, naturalistic approach to its subject matter” (Creswelll, 2004). This means, it helps me to reach natural socio-cultural activities of the community by using multi method where it concerns people’s belief, lives experience, context of particular time. Thus, ‘interpretivist approach focuses on context-dependent descriptions’ (Hilson, 2008).

Study site

Tamang people are mainly found in surrounding districts of Kathmandu Valley. Among them, Kavrepalanchowk is also known as the local residence of Tamang people. There we still can find the cultural heritage of Tamangs. So my research site was Kaverpalanchowk district. My intention for this study was to find out the mathematical practices in the Tamang community.

Sample of the Study

I used purposive sampling for my study. I had been chosen 18 Tamang people from Lurpung village. Among them, 3 are professional to make artifact, 2 are leading to social activities and cultural rituals, 1 is teacher, 10 are students and 2 are housewife. This study was an ethnographic based qualitative enquiry.

Tools of Data collection

In qualitative methods, there are many kinds of procedures to get information during the research. The following are the main tools used to collect the information for the study:

Observation

Observation is one of the data collecting methods in qualitative research. During research, especially on observation the researcher has made very close relation with participants by listening them, speaking their language and participating their ceremonies such as teacher-ethnographers: look, listen, ask questions, take part, learn the language, learn and record any specialized kind of language or argot, make inferences from what people say, locate informants, develop relationships, become friends, and experience different ways of life.

I prepared observation check list and observation sheet before going to the field. My observation started with my presence in that place. I tried to act as a complete participant and took on an insider's role in the Tamang community. It was easier for me because I am also a member of the Tamang community. First of all, I tried to capture the practices of Tamangs as much as I could. In the second stage, I turned my focus on the mathematical practices that are useful as per the objectives of my research. During this phase, being a member of the Tamang community helped me lot and so did my observation check list. Lastly I became more selective and focused more on the mathematical practices that could be incorporated in the primary level formal education.

I also concentrated on the practices which I could relate with Mathematics. After observation, I filled the observation sheet and I read my own conclusion again and again. By observing the similar practices and by taking interviews with people, I tried to summarize my findings. Observation gave me information about the context and also provided me a context for developing interview guidelines. So observation helps me to collect the information.

⟩ Participant Observation

In participant observation the researcher shares as intimately as possible in the life and activities of the setting under study and the purpose of such participation is to develop an insider's view of what is happening. The aim of this observation is that to collect primary data and reach the depth of research because I am a member of the community. After reached the Lurpung village, I met the leader of society Mr. Lhakpa Tamang and gave my introduction. Them I cleared objective of my study and asked permission to involve in the celebrating festival, daily life practices. He accepted my permission.

As a member of same community, I participated in celebrating Losar with the people of Lurpung village and observed mathematical knowledge in every cultural activity such as what they wear? How they celebrating the festival? What types of food are referred for celebration? And what types of ornaments, musical instruments used in Losar. Similarly in making doko, I also make with the Mr. Chhetra Bahadur Lama with his guideline. It is new for me, so I didn't make it easily. I also involved in daily life activities of people of Lurpung village capture local practices where I involved. At that time I took photo, made fieldnote.

⟩ Interview

According to Fontana and Frey (2005), "interviewing is not merely the neutral exchange of asking questions and getting answers. Two (or more) people are involved in this process, and their exchanges lead to the creation of a collaborative effort called the interview. The key is the 'active' nature of this process…that leads to a contextually bound and mutually created story – the interview". In this regard, interview (unstructured) is a powerful method in qualitative research for exchanging ideas,

understanding belief, creating mutual understanding and leading conclusion of interviewer and interviewee. This kind of interview helps to understand participant's subjective belief of consciousness and experience as much as possible.

I met the Tamang people individually. Moreover, I strengthened the bond of relationship with the interviewees with the help of the social worker. So before taking the interview, I made them clear about my research, purpose of research and importance of their help. I interviewed the selected respondents on the basis of the interview guidelines and on the basis of my observation. The interviews were quite natural because I took their interview wherever I found them. By looking at the context and interest of my participants, I took notes. I tried to ask similar types of question to every participant and I tried to ask the same thing repeatedly to make myself confident about summary I made.

The data from observation consisted of detailed descriptions of people's activities, behaviors, actions and full range of interpersonal interactions and organizational processes that of observational process, human experiences. The data from interview consisted of direct questions to people about their experiences, opinions, feelings and knowledge.

Data collection Procedure

I visited the selected area after selecting the title of the proposal. As for data collection, it was easy for me because the social environment is not new for me. So I didn't need to adjustment time with people. Then I discussed with the Tamang leader, professional people, teacher, farmer, senior adults and students. I also had visited their workplace, house, farms, schools etc for detail information. At that time, I took photos and made field note. The data was collected by participant observation, interview.

Data Analysis and interpretation

I collected the information by using tools through field visit. He himself was observed culture phenomena and made a field note. I used unstructured interview and observation form. By using these tools, I had code, categorize and organize the collected data according to the objectives of the study. For the exploration of measurement system I asked the senior adults and professionals, for the cultural dresses and ornaments I asked to old women of the village, for artifact I asked professional people and prepare a field note by visiting local village. Furthermore, I had observed the daily life of the local people and taken interview according to objectives.

Regarding data analysis and interpretation, I study recorded data several times to develop a deeper understanding about narratives supplied by research participants. It helps me to develop a detailed description of their behavior, cultural setting. I translated audiovisual and recorded data in written form. While interpreting the data, I create rich environment of the field and express reality. I interpret participant's behavior, activities, culture in reflective way. “The foundation of ethnographic analyses is the belief that informants have cultural knowledge. By systematically examining an informant’s words and environment, one can see the relationships among the parts. It is the examination of these parts that helps the researcher to understand the overall culture of the informant” (Leech & Onwuegbuzie, 2008 as cited in Lama, 2014 p.44).

Then the collected data was analyzed by the help of different theories review in the literature review section. My analysis process started with my first observation in fieldwork. To make data analysis process easy, I tried to keep record of the primary data. After getting the information, I tried to summarize. I read the information again and again, and tried to making meaning from that. I tried to sort out the information under different headings. I had read some articles and thesis related to incorporating

cultural practices to formal practices. I tried to link these practices with formal education by observing the cultural practices. I sorted all information into different headings and wrote the cultural practices linking them with every class of the primary level.

Quality Standard

Lincoln and Guba (1985) propose four criteria for 'naturalistic' research. As their work to 'formalize rigor' has been particularly influential in the social science generally, and in the occupational therapy field specifically, it is worth focusing on their categories in depth.

Credibility: Credibility is achieved by addressing such aspects as immersion in the environment, accurate interpretation of the data, triangulation and member checking (Lincoln & Guba, 1985 as cited in Smyth, 2006). To maintain credibility of my research, I tried to spend more time with participants for the research. The data were collected from multiple sources such as observations and interviews and got several information related with research problem. After getting information, I again met participants to make results realistic in the perspective of participants about their culture when I got that participants were eager to hear their cultural activities and experience in the form of research.

Transferability: Transferability refers that findings of the research are applicable and similar to other educational setting. In the field of research, the data generating process can be useful and similar to other researcher in the similar area. To maintain transferability of the research, I captured the daily life activities, culture, profession, and social activities of the Tamang community by observation, interview and include photos in this research. Also this study encouraged to linking reader's culture and

geometrical knowledge of socially available and make education process effective and object oriented through ethno mathematics.

Dependability: To maintain dependability, I had observed and taken interview with the participants and include in this study. If repeated the study, the result of research would be same from the involvement in same place, same participants and same methodologies, when social environment is changing due to modernism.

Confirmability: For Confirmability, it is also important to ensure that the findings of the investigation are the result of the experiences and ideas of the participants and not the preferences and characteristics of the researcher (Shenton, 2004 as cited in Vandeleur, 2010, p. 127). So to the quality of the results produced by an inquiry in terms of how well they are supported by the informants (members) who are involved in the study and by the events that are independent of the inquirer. So all collected information was based on participant's views, ideas, experience and interpretation. Thus this help to make the research findings are true and exact on participant's practices. In this study, I had presented idea, view and practices of the participant's found same in their daily life activities.

Chapter IV

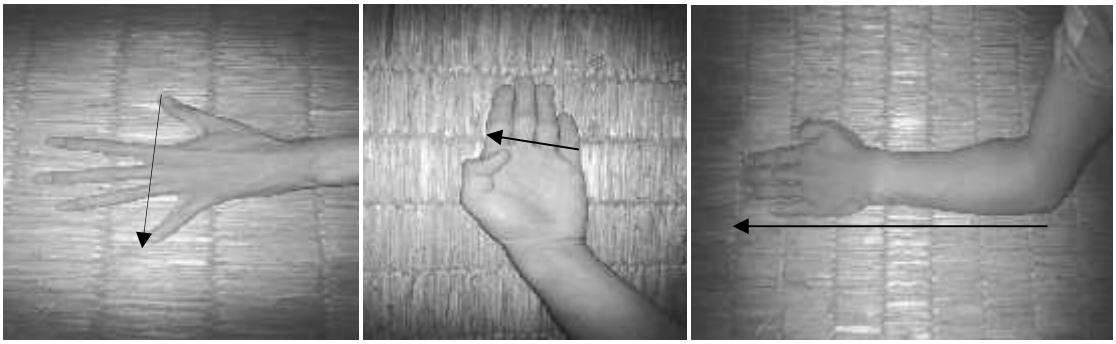
DATA ANALYSIS AND INTERPRETATION

This was an ethnographic study related to the Geometrical knowledge practiced in Tamang community. This chapter deals with the ethno mathematical knowledge of Tamang community collected by observation and informal discussions. I have included whole information on a narrative way through their measurement system, cultural dresses and ornaments, cultural food, cultural tradition, artifact etc. and those social activities are analyzed and interpretation through the collected information. How Tamang inhabitant practices mathematics in the culture (daily activities)?

Measurement System

Measurement of Length and Distance

Most of the Tamang people are adopting the traditional measurement system. Length measuring systems used by Tamang people are not different from what other people but I would like to include it because in my perspective these types of practices are found in every culture. No one can claim it as their personal practice, so I have included it. To measure the length of anything's, they used their hands as units is called 'Haat' (from elbow to the top of the middle finger). They measure the short length by distance between the tip of the thumb to the tip of the little finger is known as 'Bitta'. Similarly if the length is shorter than Bitta then they used Kuret for measure. Kuret is the distance between the tips of the thumb to the tip of the index finger, when the palm is stretched. Also they used Ammal for shorter length, Ammal means measurement by the fingers. (According to professional people Kami Singh Dorje Lama 45 years)



Bitta Nang Ammal Blee Haat Nang

They have been using the length conservation system as mentioned below:

2½ cm = 1 Ammal = 1 inch

8 inch = 1 kurret

1 Kurret + 2 inch = 1 Bitta

1 Bitta + 2 inch = 1 pit

1 pit + 8 inch = 2 Bitta = 1 Haat

2 Haat + 10cm = 1 meter

These measurement systems are followed by Tamang people, so these cannot be universal, that mean the measurement system of other community may be different. To measure the lengths and breadths of house, land, fields and other construction related to measure, they follow the given measurement system. Most of the Tamang people follow traditional measurement system, but nowadays some literate people follow the standard/modern measurement system.

Volume measurement

Suku Maya Lama is an old woman of village. She is also housewife and farmers too. She explained about volume measurement system embedded in Tamang community. Volume measurement if mostly used to measure the ghee, floor, rice, paddy, corn, wheat, cereals etc. The units of volume measurement widely used are: Chakanchi, Muthi, Chauthai, Pala, Mana, Kuruwa, Pathi and Muri. The smallest unit of the measurement is Chakanchi and bigger is Muri. Besides these units, they used ‘dalo’ as a volume measurement to measure rice, corn, cereal etc. They made ‘dalo’s are different measures. Some of them contain one pathi, some contains three pathi, and some contains four pathi.

The measurement system of volume as shown below:

2 Chakanchi = 2½ muthi = 1 Chauthai

4 Chauthai = 2 pala = 1 mana (10 muthi)

2 mana = 1 kuruwa

4 kuruwa = 1 pathi

20 pathi = 1 muri

These are the most popular measurement of volume systems that are used in the Tamang community. They use the wooden materials, bamboo, nigalo bamboo, choya etc for make a device of measurement.

Pathi

Kuruwa, Mana, Pala

Area Measurement

Tamang people measured the area by estimating of anything. They use their own traditional measurement system for construct house, farm land, goth, khor, baranda, nanglo, doko, mat, chakati, etc. A house plan is drawn right on the site by stretching-bending a rope to the required shape. Measurement of lengths and breadths with the hand as standard may follow, especially to estimate the size of logs required, in a remote village, one may find an over-hanging stone used as a house-roof.

Generally, they made house by 8 × 14 Haat. Goth and Khor are made by looking the size of pet animals (Kami Singh Dorje Lama, Professional people). Chini Maya Lama is a housewife and farmers also; she made mat, chakati and mandro by the size of another appropriate artifact in consideration of the place which it has to cover. They tie a lengthen rope in a parallel form to make gundri. They have no idea of geometry so they make any instrument by using rope.

Weight measurement

Tamang people use to weight the food, grains; they used ‘Umal’. According to Ram Bahadur Lama, there are two types of Umal used by Tamang people in their

everyday life. One kind of Umal is made from iron bar and has a fixed blob of mass on one side of that bar and the other side carries a Nigalo or a plate of thin iron, suspended by strings. The suspension could be shifted at different measure marks on the iron bar to balance the weight. A different measures mark in the iron bar is called Phulos. If there is not Phulos at iron bar, they measure the weight using different measured stones.

Most of the Tamang people use traditional types of measurement are Chhatak, Pau, Aathpol, Kg, Bisauli, Dharni, Pathar etc. These are still used but nowadays, most of the young literate people used today's standard measurement system to measure weight. Tamang people have been using the following traditional measurement systems for weight according to Ram Bahadur Lama:

1 Chhatak = 50 Gram

200 Gram = 1 Pau

3 Pau = 1 Aathpol

1 Aathpol + 2 Pau = 1 Kilogram

1 Kilogram + 200 Gram = 1 Bisauli

2 Bisauli = 1 Dharni= 1Pathar

Umal

Geometry in Cultural Dress and Ornaments

I went to my research site at the occasion of Sonam Losar on 25th Magh, 2072 from Kathmandu at noon. I had reached Lurpung Village of Kaverpalanchowk District at evening after taking 6 hours travelling by bus. When I reached there, people are prepare to manage celebrate Losar. On 26th Magh, people are celebrating Losar, at that time I met LhakpaTamang (social leader of the Lurpung Village, 64 years) and request to explain about Sonam Losar. According to him Sonam Losar falls on different dates each year in Bikram Sambat and English calendar. This calendar is ancient Tibetan/Chinese lunar calendar.

The New Year usually falls on the second new moon after the winter solstice. That is it is on Magh Sukla Pratipada, under eastern lunar calendar. Tamang has a tradition of counting year with association of symbols of 12 different animals. It starts with Rat, Ox, Tiger, Rabbit, Dragon, Snake, Horse, Goat/Sheep, Monkey, Rooster, Dog, and Pig/Boar. The last day of 12th month of the year is a time to clean and prepare a welcoming atmosphere for New Year. The monasteries perform a special ritual with mask dance to expel negative forces. The New Year celebration varies. People go to Monasteries, Stupa, and Chaityas and perform ceremonial rituals there.

People buy new dresses and decorate their house according to their living standards. Tradition is there every family member cleans their house to sweep away any bad fortune in hopes to make way for good incoming luck. Windows and doors are decorated with colorful papers and cloths and couplets with popular themes of “good fortune” of “happiness”, “wealth”, and “longevity”. People get together and have dinner with families. Also musical programs are performed with tamang selo in the beat of Damphu.

Now-a-days Tamangs in Kathmandu and nearby gather in Tudikhel to celebrate of Sonam Losar. They organized programs. The attractions are generally Pooja, Tamang Selo competitions, Food Festivals, Dramas, etc. Tamang are seen in their own costume dresses. The Tudikhel is full with the crowd with Losar celebrations. Womens and girls wear their dresses and jewelry and most of them wear a traditional hat.

Tamang dresses

On this day, Tamang women generally wear typical Tamang dresses called aangre[1], lunggi[2], kulagi[3], ke[4] with ornaments like jantar[5], cheptemhar[6], mathi[7]. The lungi is in a rectangular shape. kulagi is a cap which looks like a lidless prism having a circular base. Whereas aangre is a blouse patterned with curve and straight lines. Similarly ke is a belt in the shape of a rectangle. Their ornaments jantar is a necklace in the shape of rectangle, cheptemhar and mathi are earrings and bracelet respectively in circular shapes.

1 Aangre = blouse.

2 Lunggi = scot.

3 Kulagi = cap.

4 Ke = a sash to be wrapped round the waist.

5 Jantar = rectangular shaped necklace.

6 Cheptemhar = earring of circular shape.

7 Mathi = circular bracelet.

In this occasion, lamas[8] started to read chhyoi[9] and played the instruments like nghaa[10], syang[11] and damara[12]. *Nghaa* and *daamaaraa* are made using goat skin in the shape of a prism having a circular base. *Nhaa* is made up wood with the shape of curve line and on its top of there is a small thing looks like a sphere. *Syang* is a bell made up of metal, the shape of a cone. The lamas continuously read *chhyoi* for 2-3 hours, after the program was over and all the participants returned.

One of the culturally rich communities in Nepal is the Tamang community. In this community, Sonam Losar is the most celebrated festival. On this day, people of the community like to wear cultural dress and show their cultural identity. When we observe the cultural dress closely, we find geometrical interpretations (curve lines, straight lines, rectangle, circle, quadrilateral, prism, cuboids, sphere etc.) like mathematics is seen as a process, and as a human activity, rather than just as a set of academic content (D'Ambrosio, 2001).

This means, mathematics is a cultural product and that every culture has developed its own forms of mathematics. Therefore, these concepts help students also value and appreciate their own previous mathematical knowledge, cultural activities from a mathematical point of view, thereby allowing them to make the link between school mathematics and the real world and daily life in this globalized society.

8 Lama = priest of Buddhist.

9 Chhyoi = lama's holy books in Sambhota script.

10 Nghaa = two sided pounding drum having circular base.

11 Syang = bell.

12 Damara = dumb bell.

Traditional Foods and Solid Objects

Losar[13] is the festival celebrated by ancient Tamangs. Tamangs have realized the importance and originality of it and have started celebrating Lhochar. On Losar day Tamangs go to visit monastery and honorable Rinpoche and offer khatag to Rinpoche and others Buddhas in the monastery. While offering khatag they pray for good crops, good job, good health and better life in the new year to come. They invite relatives for feast as well as they visit the respectable people in the community. They dress themselves the best they have and dance, sing and dine together with the family members.

In Kathmandu, Losar was celebrated in open field at Tundikhel, Swayambhu, Patan, Boudha etc. Lhosar should be celebrated at open fields as it was celebrated in the ancient times with damphu. Nepal Tamang Ghedung, the most popular and powerful organization of Tamangs organize the Lhosar celebration. Distinguished Tamangs join the festival celebration ceremony guests are invited. While celebrating Lhochhar they forget all their sorrows, hardships, difficulties and celebrate in joyful and happy mood among Tamang selo and beating of Damphu the traditional musical instrument.

Losar means New Year. Altogether 12 Lho (years) in Tamang calendar are mentioned. The Lhochhar commonly are scheduled and celebrated for five days. In Losar, especially and mostly prepare different kinds of *aalums*[14] such as *chyeaalum*[15] looks like shpere, *sutumbaaalum*[16] shape as cylindrical and *timsuraalum*[18] not different of shape of triangle is made up buck-wheat.

13 Losar = New Year of Tamang community's.

14 Aalum = a meal made up buck-wheat, prepared in boiled water.

15 Chye aalum = having a sphere shape.

16 Sutumbaaalum = having a shape of cylindrical.

17 Timsuraalum = having a shape of trigular.

It is said that on this day, even anger has to be suppressed. So, a nice family environment would create. The relatives are called for a joint feast and they dance on the beats of the *Damphu*[18] which is having circular base lidless prism and *Tunga*[19]. It's strings are looked like straight lines. But they start their first day, praying of *Lamas* for the peace and prosperity of the world. *Lamas* dance in circle worshiping the god and controlling bad spirit. After this session, Darjyu[20] is hung in front of the house on vertically up on the yard. It looks like combination of cylinder (a long bamboo stick) and quadrilateral (flexible cotton of width- length of "1 x 5").

In this way, they are engaged in all of five days. As mentioned before, Losar is a great festival of the Tamang community and is celebrated for five days. On those days, people play musical instruments *Damphu* and *Tunga* and wear Tamang cultural dress and ornaments. If we observe geometrical perspective, we can find Euclidian plane geometry and solid figures on their musical instrument, *Lamas* dance and cultural food *aalum*. This shows that in culture there is deep mathematical concept, construction and knowledge which "provides an important opportunity for educators to link current events and the importance of these artifacts in the context of ethno-mathematics, history, and culture" (Rosa and Orey, 2003, p. 33).

Chhyeaalum

Sutumbaaalum

Timsuraalum

18 Damphu = similar to tambourine.

19 Tunga = it is a cultural guitar of Tamang community.

20 Darjyu = A Buddhist flag.

Geometry in Damphu

Damphu is a double-sided disk-shaped drum topped with leather and with a long wooden handle. This is a very rare musical instrument belonging to the indigenous Tamang Community. Damphu is a percussion instrument similar to a big tambourine. This instrument is used to play the melodious Tamang selo. The popular ancient folk instrument Damphu, and the original rhythm of Tamang Selo have a unique importance and influence in Nepalese culture and folk music. This instrument is very easy to play and easy to learn.

History of Damphu

There are many saying and stories about invention of Damphu in the Tamang community. It is like an ornament of Tamba. Tamba sings our historical and ritual songs with Damphu. According to Tamba - Once upon a time a man named Peng Dorje who was a hunter used to go to the jungle and kill animals. As usual, on a fine day he went hunting and killed a deer. After seeing the corpse of the deer his wife became very sad because the deer was so beautiful. Since that day she kept on weeping. Peng Dorje was worried about his wife's sadness. He tried to make her happy. He used many tricks to put a smile on her face. But he was unable to do that. Her sadness knew no bounds. Peng Dorje always wanted to see his wife very happy.

Where there is a will, there is a way, He then went to the jungle and bought a four feet long wood called 'Ambu Sing'. He shaped it into four inches width and made a circle to give melodious sound. He made 32 sticks made up of bamboo too. Then he tightened the dry deerskin on one side of the circle with the help of 32 bamboo sticks. The circle created melodious sounds - 'Trak Dhin'. He started to sing, remembering his ancestors and gods with the beat of that newly invented instrument. All creatures began

to dance and his wife also started to dance upon hearing the wonderfully created melody.

A bird-"Danphe" was also dancing beautifully to the melody. So Peng Dorje named the circle Damphu. Then Damphu became a part of the Tamang people's culture and lifestyle. Tamang people use Damphu in each and every event, such as marriage ceremonies, special occasions, rituals and festivals. Tamang people express their happiness, sadness, remember their ancestors and tell their history through a song with Damphu. Damphu symbolizes Buddha and Bodhisatwa too. 32 bamboo sticks symbolize Buddha's 32 symbols.

Damphu

In this picture, we can see the Damphu. In this Damphu, clearly we can see different geometrical patterns. Damphu itself is circular shape. While teaching circle, we can use Damphu as a teaching material. Tamang communities child use Damphu in their festival, so that they can understand easily while teaching circle in classroom and they can relate school mathematics with home culture. Every part of Damphu is

concerned with geometry and it represents a unique geometrical shape in Tamang culture. So students can relate school mathematics with home mathematics.

Geometry in Kalli

Kalli is one of the most popular cultural ornaments in Tamang community. They wear this ornament in their festivals.

Circumference of circle = πd Centre of circle

Area of circle = πr^2

Diameter = 2r

From above figure those are cultural ornaments in Tamang community. Sir-Ful and Kalli both are in circular shaped. In Sir-Ful we can see beautiful pattern of different shaped circles and red represents exactly centre of circle.

Geometry in Jantaar

Jantaar is one of the famous ornaments wear by women of Tamang community. It is made by metal like silver, gold etc. Jaantar is tie-in with mugako mala.

Square

In Jantaar, there is square shape. When teaching the concept of square, we can use Jantaar as instructional material.

Geometry in Soli

Slant Height Height Vertex

Circle

Soli is one of the most popular cultural artifacts in Tamang community. Tamang community uses this artifact to carry Sagoon in cultural rituals. From figure, we can see Soli itself is in cone shape. It is concerned with geometry and it represents a unique geometrical shape in Tamang culture.

Geometry in Zoon

Zoon is an ornament for women wear on their front side of hair. It is made by gold and occasionally use by Tamang women to see beautiful.

Regular hexagram in Zoon

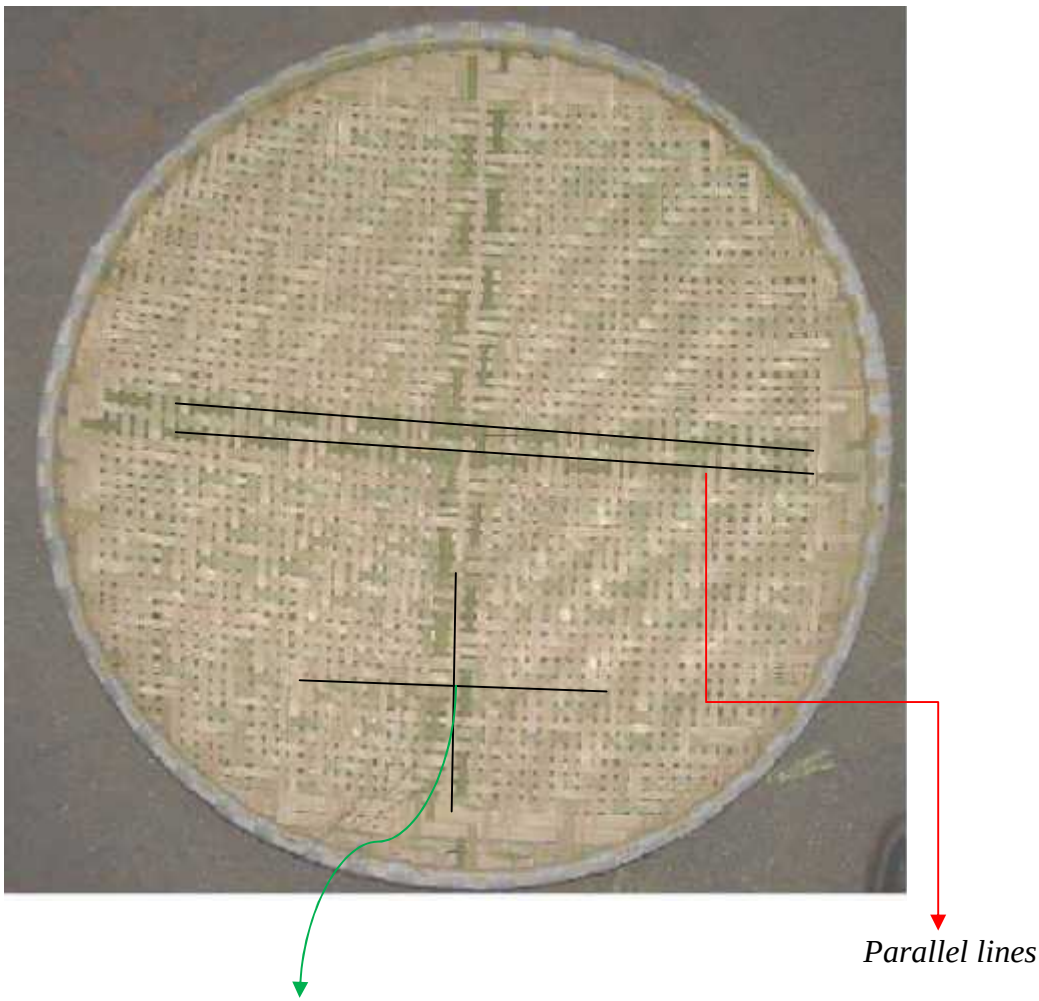
In zoon, there is a concept of regular hexagram which can be used as instructional material and can easily teach the concept of regular polygon.

Geometry in Nanglo

Nanglo is used for make floor pure from the mixture of any other unwanted thing. It is made from the bamboo. In nanglo we can see many different types of geometrical knowledge such as quadrants, parallel line, perpendicular line and nanglo itself a circle's shape. Most of the tamang student see the nanglo used by their parents, neighbours in daily life activity. But they did not interlink nanglo with geometrical knowledge. They only know nanglo is daily life material. Also the teachers doesn't use nanglo as a material for teaching geometry in primary level.

Nanglo is a popular artifact in every rural Nepali house not only in Tamang community. As a whole it is circular disc, inside it there are various geometrical patterns and forms. It not only supports teaching simple geometry of lines, angles,

triangles, rectangles but also it supports teaching coordinate geometry too. The horizontal and vertical intersecting lines can be regarded as two perpendicular axes.



The beautiful patterns form images around a fixed line as a line of reflection. Also it can be useful in teaching line symmetry and point symmetry. The Nanglo can be rotated about a fixed point at the center or origin and can be taught the concept of rotation in geometric transformation. At the same time it can be helpful to teach reflection about axes of x and y. There are two sides of the Nanglo. The first picture given is the front or ventral side and the next one given it is the opposite or dorsal side. The two sides are not identical and both sides can be used for different purposes while teaching geometry with the help of it.

Geometry in Doko

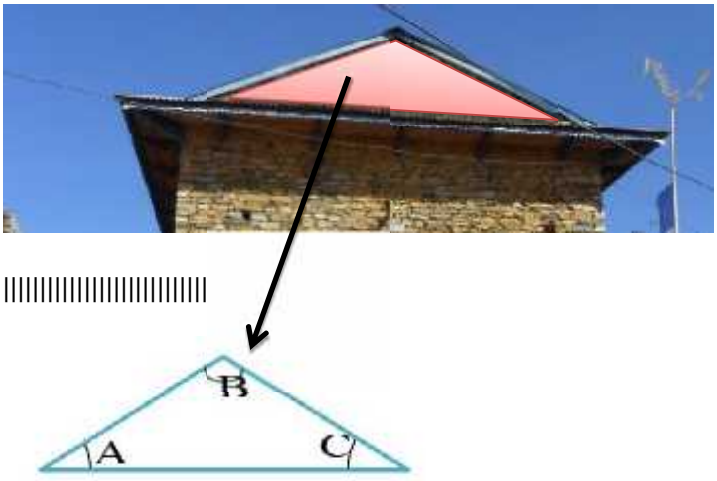
Doko was a very common artifact that we could see in Tamang community. It showed a great application of geometry in the art of making doko with bamboo pieces. A single doko carries several meaning with geometry, arithmetic, measurement, logic and reasoning. It is a combination of art and mathematics in real sense that can be living context in the classroom teaching of lines, curves, polygons. Mr. Chhetra Bahadur Lama is professional to make doko, when I met him in village he was making doko, at first he make a rectangle shape's on the bottom of doko because that helps to control load when we put it on the ground.

It is made in such a way that an average person can carry weight. Also the ratio of the bottom of doko and size of human body must be proportional. After that he weaving increasingly in size by added new choya and at the end it shapes is circle. It is used to carry a load easily, so it's bottom shape is rectangle and top is circle shown in figure below. When I see he is easily making doko but when I requested to give me a chance to make, it was difficult. The figure below is a doko and it shows the practices of applying geometry and arithmetic in the making of artifacts. It is can provide a rich context for the children to learn parallel and intersecting lines, circle, polygons and many more.

The figure shows step of making doko. In each steps there are mathematical (geometrical) concepts. This will be an effective mathematics teaching material, which is available locally and used daily life in Tamang Community. So these can easily applied primary level geometry teaching.

Geometry in a house

This is a house in Lurpung (figure below). We can see different geometrical entities in the house the geometry of wall, the geometry of roof. The wall is made up of clay bricks and it is rectangular in shape. The roof has a slope at an angle with the horizontal line or surface. This shows a great cultural application of geometry in Tamang community. Students can explore angles, patterns and shapes at the different part of the house together with their measurements. This way we can engage students in the discovery of geometrical application in the lives of people in rural areas.



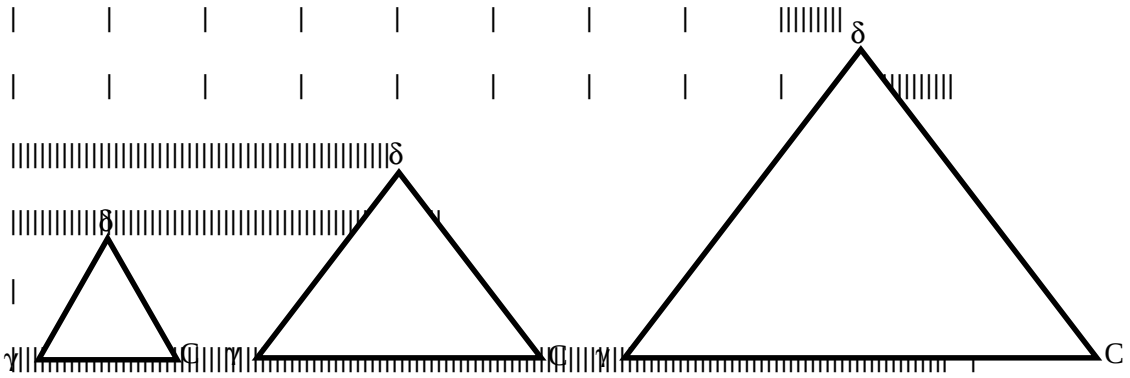


Figure I Figure II Figure III

Figure	γ |	δ |	C	γ |Γ δ |Γ C	Remark
(I)					
(II)					
(III)					

Conclusion: γ |Γ δ |Γ C = 180̊.

i.e. The sum of interior angles of a triangle is 180̊.

Chapter V

FINDINGS, CONCLUSIONS AND IMPLICATIONS

This chapter describes the major findings drawn from the analysis and interpretation and discussion of the data. Conclusion is described from the result of interpretation of data. The chapter closes with implication of the research. An implication of the study is given for the area where this study can be applied.

Findings

The major findings of the study are as follows:

The Ethnomathematical Practices Embedded by Tamang Community

- Tamang people measured lengths and breadths by using their hands and fingers like as: Ammal, Kuret, Bitta, Pit, Haat are the measuring units of length and breadth, and the Kosh is the measuring right units of distance.
- The area measurement is reflected in construction of house. The area of house is measured in terms of Haat and the area of land is measured in terms of ploughing time.
- The units of volume measurement are Chakanchi, Muthi, Chauthai, Pala, Mana, Kuruwa, Pathi, and Muri.
- The units of weight measurements are Chhatak, Pau, Bisauli, Dharni, Pather, Aathpol, K.G. etc.

Geometrical Concepts Embedded in Everyday Activities of Tamang Community

Similarly, geometrical concepts embedded in everyday activities of Tamang Community were found from the study are as follows:

- Sketch or design of cultural dress blouse as curve lines, cultural food *timsuraalum* as triangle, and surface of *jantar* as quadrangular and *mathi*, *cheptemhar*, base of *kulagi*, *damphu* and two sided drum of *bonbos* and *lamas* as circle.
- The musical instrument *damphu*, we can encourage students to draw a similar sketch in their exercise book when they learn to draw circles.
- To teach the quadrants, parallel lines, perpendicular lines, circular shapes we can sketch the knowledge from Nanglo.
- In sketching Doko, there are many geometrical concepts like square, rectangle, parallel lines, circular shape, right angled triangle, and many others.
- In the house, there are concepts of triangle and these can be effective mathematical materials for teaching geometry in primary level.

Conclusion

The Tamang people have their own traditional measurement system and artifacts they use day-to-day life. The conclusions of the study are as follows:

- The geometrical knowledge is strongly embedded in socio-cultural activities of the Tamang community.
- School geometrical knowledge can be made more interesting and worthwhile linking it with socio-culture activities such as religious ritual, cultural foods, cultural ornaments, and cultural design of clothes, artifacts.
- Teaching learning process of mathematics can make easy and effective by linking formal mathematics to daily life mathematics.
- This research helps to improve pedagogy of the teacher. Ultimately, it helps the students and teachers to improve their field.

- This research is applicable to textbook writer, curriculum planner, policy maker and me to improve my professional development.

Implications

This study conducted taking short period of time, small number of respondents and limited area. Therefore, the findings of this study may not cover all aspects of mathematics of Tamang ethnic group. So considering these limitations, the following implications have been made:

- To find teaching material available in the local community, which can get easily and students understand the concept meaningfully that makes teaching learning process effective and fruitful.
- Further studies can be done on how the children of Tamang community learn mathematics specially geometry parts in classroom and link it with daily life activity.
- School may be applied practical knowledge based activities which can promote their previous experiences.
- There are infinite mathematical knowledge in socio-cultural activities which can be used as curriculum resource and curriculum materials in the process of developing local mathematics curriculum of primary level.
- To help in the purpose of educational decentralization of the government and it can emancipate any gender, race, culture, group, class.
- To explore the many culturally diverse ways in which mathematics education can be made more meaningful for and inclusive of the lives of students worldwide.
- To find the possibility of incorporating cultural practices into the existing curriculum, this approach may be disseminated widely among school teachers so that they can incorporate the notion of cultural contextualization in their teaching.

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Appendix – A

Interview Format for Teacher – 2016

Date of interview:-…….. Sex:-……. Age:-……..

Name:-…….

Religion:-…… Qualification:-……

Experience in teaching:-……

Other:- Trained/Untrained

Address:-……...

V.D.C./Municipality:-……

Total No. of Student:-…….

The interview with mathematics teacher had taken in the following questions:-

- What are the teaching strategies of the Tamang students?
- How did Tamang student learn mathematics?
- What types of teaching material do you used during teaching?
- What are the problem of teaching mathematics for Tamang student?
- How did you encouragement of the learning mathematics?
- How did you construct relation between teacher and Tamang students?

Appendix – B

Interview Format for Students – 2016

Date of interview:-…….. Sex:-……. Age:-……..

Name:-…….

Religion:-…… Class:-……

Address:-……...

V.D.C./Municipality:-……

The interview with students had taken in the following questions:-

- Is mathematics interest?
- Have you found mathematics is useful in daily life?
- Is mathematics and your culture are related?
- What types of material used by your teacher in your class?
- Is mathematics is embedded in your community?
- If the curriculum of mathematics is on your mother language, that makes mathematics is easy and useful for you or not?

Appendix – C

Observation Sheet

Date:……..

Observation In detail form:

……
……
……...……
……

Possible Mathematical Concept:

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……...……
……

Possible ways to incorporate it:

……
……
……...……
……

Reflection of Observation

…….....
.....
.....
.....

Appendix-D

Observation form for student's participation in learning mathematics in the class.

Students Name:-……

Students attendance	Teacher activity	Topic	Students participation	Homework	Class work	Observation comment