MATHEMATICAL PRACTICES IN GURUNG COMMUNITY: AN

ETHNOMATHEMATICAL STUDY

A DISSERTATION

BY

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LETTER OF CERTIFICATE

This is to certify that Mr. Dilkrishna Gurung, a students of academic year 2074-2076 B.S. with thesis number 1635 Exam Roll No. 7328349, Campus Roll No. 702 and T.U. Regd. No. 9-2-284-334-2013 has completed this thesis for the period prescribed by the rules and regulations of Tribhuvan University, Nepal. This thesis entitled "**Mathematical practices in Gurung community: an Ethnomathematical study**" has been prepared based on the results of his investigation. I hereby recommend and forward that his thesis submitted for the evaluation as the partial requirements to award the Degree of Master of Education.

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LETTER OF APPROVAL

A thesis by Dilkrishna Gurung entitled "**Mathematical practices in Gurung community: an Ethnomathematical study**" has been approved in partial fulfillment of the requirements for Degree of Master of Education.

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RECOMMENDATION FOR ACCEPTANCE

This is to certify that Mr. Dilkrishna Gurung has complete his M.Ed. thesis entitled "**Mathematical practices in Gurung community: an Ethnomathematical study**". Under my supervision during the period prescribed the rules and regulation of Tribhuvan University, Kritipur, Kathmandu. I mentioned and forward his thesis to the Department of Mathematics Education to evaluate in final viva-voce.

……………………..

Prof. Dr. Bed Raj Acharya

(Supervisor)

Date…………………………

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July, 2022

DEDICATION

I would like to dedicate this dissertation to my Gurus and parents Mr. Lal Man Gurung and Mrs. Aasa Maya Gurung. Who modeled for me the joy of learning, for their unflagging support and devoted their lives for making me who I am now.

DECLARATION

I hereby declared that the work presented in this thesis has been done by myself, and has not been submitted elsewhere for completion of Master Degree. All source of information have been specifically acknowledged by reference to the author.

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ACKNOWLEDGEMENTS

ABSTRACT

Nepal is a country of diversity in terms of geography, language, cast, ethnicity, and culture and so on. There are at least 125ethnic/cast groups, more than 10 religion groups, and more than 129 mother tongue language are spoken in Nepal (CBS, 2011). Gurung people are one of the ethnic groups of Nepal. This research has focused on the Ethno-mathematics in Gurung community which is situated in Dhading district in the northern part of Nepal.

The main objectives of this research were as to explore mathematical practices in Gurung community in their day to day activities and to explore the pedagogical implication of different artifacts used in Gurung community. In this research, I have attempted to find out the response of main research question: What are the mathematical practices of Gurung community in their day to day activities? And How mathematical practices of Gurung community be incorporated in the school mathematics? And this study has mainly focused on the mathematical practices related to number sense, counting system, measurement system, games, and geometrical shapes at Gurung community.in this study, I have used, quality with ethnography research design. In-depth interview guideline, classroom observation guideline, and photographs were the main tools of this study. . Ruby valley rural municipality ward no. four and six was the study site of my inquiry. Sample was selected by purposive sampling method.

Being a member of Gurung community, I have my own perception towards cultural mathematics at school level mathematics. I have found four major finding of this research study. The first finding was about exploring the number sense and counting system in the Gurung community. The second finding was about exploring the measurement (length, mass, quantity) system in the Gurung community. The third finding was about different games in Gurung community. The four finding was about exploring different cultural artifacts and geometrical shapes practices in the Gurung community.

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Chapter-I

INTRODUCTION

Context of the Study

Nepal is a landlocked country nestled in the foothills of the Himalayans. It occupies an area from 26º20' to 30º10' north latitude and 80º15' to 88º19' east longitude. It shares its northern border with the Tibetan region and its eastern, southern, and western borders with India. The well-known quotation about Nepal by Toni Hagan "I never hesitate to say that Nepal is the most beautiful as well as the diverse country in the world" (K.C., 2019, P.712). So, we can say that Nepal is a country of diversities in terms of geography, language, caste, ethnicity, religion, and culture. Obviously, it is multi-culture, multi-religions, multi-racial, multi-lingual country in the south-East Asia. There are at least 125 ethnic/cast groups, more than 10 religions groups, and more than 129 mother tongue language are spoken in Nepal (CBS, 2011). Nepal has three different geographical regions which are known as Himalayan, Mountain, and Tarai. Each regions has various religions, cultures, languages, ethnicities, etc. and also different way of living life styles. Even though Nepal is rich in socio-culture aspects, we can find various educational disputes and obstacles associated with mathematics.

I was born in one of the most beautiful places called Chalish (name of the village), which is situated in Dhading district in the northern Himalayan region of Nepal. My village is located closely to china border. It is one of the rural areas of our nation. In our society, all the people are from Gurung, Tamang, and Dalit community. Thus, all of them have their mother tongue language as a means of communication within community. Hence, the majority of the people from Gurung community have

difficulty communicating in Nepali language. Nevertheless, then can more or less understand it.

My educational journey started from community school situated in my village. I started my primary schooling at the age of 5 years from Shree Kanya Devi Primary School in 2002. I did not face much challenges to get the primary education, because most of the teachers were from my own (Gurung) community, and the medium of communication and teaching was also in my own mother tongue while the curriculum was prescribed in Nepali language. At that time, Mathematics subject was stress-free for me and I could comprehend the mathematics without any difficulty. At the time of my primary schooling, my teacher would teach mathematics primary depending upon the textbooks. They would teach us contents of the textbooks without using any teaching materials. Consequently, they were unable to connect school mathematics with the local practices in the process of the teaching. So, my ability to solve the mathematics problem was limited to gaining theoretical and procedural knowledge, because there was no any option other than solving the algorithmic problems of the textbooks. That's why; I had not the mathematical problems conceptually by linking them with my practical life. For example, I could prove theoretically that the sum of the interior angles of the triangle is 180, but had no idea how it can be proved practically.

After completing my primary education, at the age of 10 in 2007, I was admitted in grade six in another school is called Shree Mukrap Devi Secondary School running classes up to grade 12 and having huge number of students among fifteen neighboring primary schools around. In my community, there were only a few local teachers acquiring master's degree in some subject such as a Population, Social studies, Health, and Nepali etc. in secondary school, the most of the teachers were

from out of my community. The teacher for subjects like Mathematics, Science, Economics and English used to be appointed from other communities. It was difficult for students including me too adjust with them at the preliminary phase of secondary schooling because of language differences. My mathematics teacher was from Terai region. Hence, it was a challenges for me communicate freely with my mathematics teacher in the beginning of the class. Most of my classmate were week in mathematics and it is hard to get adequate marks/grade in examinations. They used to think that, mathematics was toughest subject for them and use to consider that this subject wasn't for them. Gradually, I started interacting with my mathematics teacher and he constantly encouraged me in and outside the classroom. So, finally I was able to stand as the "class toper" in mathematics. Since my primary teacher would focus on book-based teaching, the same problem was repeated in the secondary level too. Our mathematics teacher always used to tell that mathematics can be improved by only by practices method and using rules and formula. Therefore, I started to learn mathematics through memorization with numerous mathematical symbols, multiplication tables and formulae, etc. when, I reflected those procedures, I realize that my school's teachers were guided by the notation of behaviorist model of teaching. Behaviorism is simply the position that the phenomena of psychology may be exhaustively treated as behavior events and that behavior is significant in its own right, rather than simply as a manifestation of some more fundamental process (Malone & James, 1975).

In my classroom, my mathematics teacher would not use the mathematical objects or cultural artifacts to link mathematics with day to day life-words because he was from another community (not from Gurung community). In my whole secondary schooling, I never felt that mathematics could be learned by connecting it with the

local artifact sand traditional technologies. For instance, my teacher used to teach us simple interest in the class seven just by using the formula I=PTR/100 but only a very few (probably three/four) students used to understand the problem while most of the students could not find the solution. One day my mother asked me that she had taken Rs. 10,000 as loan from neighborhood at the rate of saikada 1(Rs. 1 per Rs.100 per month, traditional system of taking loan in Nepal) and she asked me to calculate the interest rate. At that time, it was a great challenges for me, and I felt guilty because I couldn't figure out that sort of problem even when I was a class topper in mathematics in grade eight. In the meantime, I realize that mathematics should be connected with practical problem and can't be isolated from the social artifacts. Such a consciousness, moreover, raised in me during my master's study. Mathematics is always taught in school as a culturally free subject that involved learning supposedly universally accepts facts, concepts, and contents (Rosa & Orey, 2011). But I think, mathematics in interconnected with the social phenomena.

Being from Gurung community, I was motivated to search several issues interconnected to mathematical problem based on my culture. There are many cultural artifacts which are associated with mathematics *such Paanighatta, Mera, Gurung's home, Doko/Raangye/Gyamjaa, Ghum, Goba, Raadi/Bakhu, Honey hunting, Gyasi, Parma, Nanglo, Kool, Daura syang, Dhyangro, Halo/Juwa, Chorten, Cupboard, Jaato, Ghaar* etc. mathematics is found in every ethnic group. The idea of mathematics culturally inclusive is associated with the notation of social justice that puts emphasis on equitable opportunities in mathematics education with fair treatment of all individual and ethnic group (Luitel & Taylor, 2007). When teachers explore the ethnomathematics is our classroom practices, than pupils take ownership and they attempt to explore their own cultural mathematics in the classroom. In this research, I

explored the mathematics study for valuing culture mathematics is Gurung community. According to D' Amborsio (1994),"ethno-mathematics is the arts or techniques developed by different cultures to explain, to understand, to cope with their environment" (p.1184). I contemplate that it can promote the social justice and equity because they intent to endorse their own culture mathematics in teaching and learning in Gurung community.

In current teaching and learning system, mathematics is being taught just by focusing on memorizing several mathematical symbols, using algorithm and problems are solved by applying specific formula. Throughout my research, I have attempted to explore the mathematics problem in connection with social-cultural artifacts in community. I have to explore the cultural artifacts from Gurung community and how ethnomathemtics incorporate such cultural mathematics in the school level of the Gurung community.

Statement of the Problem

Since I joined Tribhuvan University (TU) for my master study and I have been taking classes of teaching and learning in mathematics as well as ethnomathematics. When the facilitator shared about ethnomathematics, I realize at the completion of the class that actually mathematics can be seek from social phenomena and cultural perspective. According to Rosa and Orey (2011), "cultural mathematics can be related to conventional mathematics system and vice versa through mathematical thinking" (p.45). In my opinion my entire school and in the beginning day of college life, I was absolutely unknown that mathematics is also contextualized subject and hard to isolate from the social phenomena. When the facilitators of T.U. shared about ethnomathematics, at that time I came to know that mathematics is also found in cultural phenomena. Generally, ethnomathematics has been practiced in different

cultural aspects like traditional artifacts, creating and designing, own way of measuring system, counting, playing the traditional games and way of living knowing or unknowing.

The center point of the problem in Nepali context, less use of cultural artifacts in teaching and learning, ignorance's the cultural mathematics, less knowledge about the cultural practices of certain community by the teacher from another community. As I belong to Gurung community, I have to explore the various issues of ethomathematics based on my own social-cultural. There are numerous cultural artifacts which are connected to mathematics. Hence, Gurung community is culturally enriched and there are voluminous possibilities to seek the ethnomathematics is the most appropriate to link the abstract concept of mathematics to the concrete concept of it.

In Nepal, most of the student's achievements in mathematics are very low because recent SEE result show mathematics are very insufficient in grading. According to ERO (2019), the grade 5 mathematics students, in mathematics, students below minimum learning level have quite inadequate knowledge and skills in mathematics. Around 50% of them do not have any sense of reading and writing number and number operations. With this limited knowledge and skills, they unable to calculate and solve mathematical problems. Mostly, they are unable to perform any mathematical subjective calculations independently. Due to lack of quality education, illiteracy, deficiency of socio-cultural and educational structure and development are the major factors of problem related to the mathematics education in Nepal. Then, I started to realize that our structure of teaching mathematics is more theoretical in one hand and on the other hand, our recent mathematics education is greatly influenced by the Western European culture because our curriculum was mostly influenced by

Western society. So, it needs to be linked with the local artifacts and cultural artifacts of the students inside the classroom. I think, it was more beneficial to teaching and learning.

In Nepali context, ethnomathematics is new areas for research. There are a few research studies has been undertaken of the field in ethnomathematics. As well all known that Nepali is the country of diversity in terms of geography, language, cast, ethnicity, religion, and culture etc. it is also the country of having multi-culture, multi-religion, multi-racial and multi-lingual. So, there are numerous probabilities to explore the ethnomathematics in our country and teacher can emphasize that use of local artifacts in the classroom activity. Teacher are also conscious that ethnomathematics is very effective and useful if teacher implement it in the classroom delivery system. When teacher explore the ethnomathematics in our classroom practices then pupils are feel to ownership and they are try to explore the their own cultural mathematics in classroom is essential and important role to achieve the mathematics knowledge and also encourage the students teaching and learning in mathematics. We, as a teacher, need to promote the cultural mathematics in classroom teaching activity.

Objectives

The objectives of the study are as follows

1. To explore mathematical practices in Gurung community in their day to day activities.

2. To explore the pedagogical implication of different artifacts used in Gurung community

Research Questions

1. What are the mathematical practices of Gurung community in their day to day activities?

2. How mathematical practices of Gurung community be incorporated in the school mathematics?

Rationale of the Study

Ethno-mathematics is the most essential to promote the mathematics education in every level because all the mathematics is connected to culture and some particular social phenomena. So, Ethno-mathematics plays vital role at mathematics. Gurung community is vastly rich from cultural perspective which haven't been yet explored in the formal education system in the community. It means, in my community, mathematics subject is still considered as a very tough subject. Majority of the people shared with me that mathematics subject is tough in higher level of education. Therefore, at the moment, I feel that my mathematics teacher failed to connect any mathematical object or social artifacts to link with the subject matter because he was from other group of community and different caste.

Now, I have realized mathematics can be seek in culture and indigenous community because they have an explicit culture and social artifacts. Teacher have been able to connect the local materials to our teaching and learning process. So, it can be worthwhile to teacher and researcher also because I explore the mathematics in cultural phenomena. In my research, I have discovered cultural artifacts of Gurung community and attempted to associate with the cultural artifacts in primary school linking with some particular primary content to it. And I hope this research would be very beneficial and valuable to link the mathematics and culture in teaching and learning in classroom. Cultural mathematics is very effective and interesting for

classroom activity. When teachers use the cultural artifacts in classroom. It might be very helpful to promote the student's interest in mathematics and also it supports in understanding the concept of mathematics.

Delimitation of the Study

The main objective of this research was to find out the traditional mathematics practices in Gurung community and how to use those ethno-mathematics practices in school level in Ruby valley rural municipality ward no. 4 and 6 only, Dhading district. Due to the time constraint and financial issue, the study was delimited in Gurung community group only. My study was limited to arithmetic, geometrical and sets practices in Gurung community and also to explore and incorporate diverse ways of teaching and learning in the basic and secondary level of school.

Definition of the Key Terms Used

Gurung. Gurung refers to an indigenous ethic group of Nepal who lives in mid-western region of the Nepal.

Daily life activities. The work which is doing day to day by Gurung people.

Mathematical concept. Mathematical concept refers to the abstract idea and concept of counting, calculating, measuring etc**.**

Ethnic group. A gurung community or population made up of people who share a common cultural background or descent.

Ethnography. The scientific study of people and cultures.

Measurement system. In this system, it refers to the technique of measurement practice in the Gurung community. This includes: Length, distance, weight.

Counting system. In this system, it refers to the technique of the counting practice in the Gurung community. This includes: number, days, months and yesrs.

Sagun: especial drinks in the Gurung community.

Chapter summary

In this chapter, I have explained my personal journey and my past experiences. I have attempted to explain my primary and secondary education journey in context of the study section. Likewise, I have endeavored to show some particular problem in statement of problem section. I have explored the possible ethnomathemtics practices in Gurung community. Similarly, I have carried out the two research question in research section. Eventually, I have explored to clarify the significance of the study and delimitation of it in my research.

Chapter-II

LITERATURE REVIEW

The literature review is the most essential part of every academic writing. In this section, I reviewed different articles, thesis, and theories and explored literature related to my research.

Thematic Review

The thematic literature review is based on different key variables of the study and it elaborates on the major themes which are related to the research issue. Those ideas can be elaborated and connected to the other author's journals, articles, books, papers, and supplementary related documents taking a key concept of related research. Creswell (2012) remarked that in literature, the researcher identifies a theme and briefly cites literature to document the theme and technique. The writer discussed only the major ideas or results from studies rather than the detail of any single study. My reissue is "The mathematics practice in Gurung community ethnomathematics study". In the research, I engaged in cultural practices in the Gurung community as mathematics is always connected with culture. Hence, I explored the ways the combination of cultural artifacts of mathematics in teaching mathematics in the classroom**.**

Culture and Mathematics Education

Culture is the practices of a group of people are connected in day-to-day life knowing or unknowingly. The entire human being s cannot be isolated from any culture. According to Creswell (2012), a culture is everything having to do with human behavior and belief in our society. Then, a culture is the practices of human being is social phenomena and it's considered as a central concept in anthropology. Mathematics can be seen in the culture. Hence, ethnomathematics is found in the

culture phenomena. In regards of it, Valero (2004) points out that mathematics education is clearly identified as a key element in educating citizens who are competent in dealing with the basic challenges of current societies. Evidently, research and practices have to face the facts of underachievement and exclusion of some group of students because it is desirable that all students around tha world. According to D' Ambrosia (2001) culture is define as:

Culture of every life group, of families, tribes, communities, associations, profession and nations takes place in different region of the planet, in different ways and at different paces, as the result certain priorities, among many factors, due to environmental conditions, model of urbanization and production, system and communication and power structure. (pp. 9-10)

So, culture is always found around our daily phenomena. However, mathematics education is discussed only as the practice of teaching and learning of mathematics in a way of solving problem by involving the learning of algorithms and formula necessary for computations. Therefore, mathematics subject is linked to social and culture creations. Culture mathematics are interconnected to each other. We cannot segregate the culture and mathematics individually. As my perspective, mathematics is the sub-area of culture.

Ethno-mathematics

The Brazilian philosopher of mathematics, D' Ambrosio (1985), first time noted the term "ethnomathematics " to describe the mathematical practices of identifiable culture groups and may be regarded as the study of mathematical ideas found in any culture and mathematics which allows us to identify several practices which are essentially in their nature. Mathematics cannot be exclude from any socio-

culture practices. Mathematics is survived by culture because mathematics is developed by some particular cultural and social phenomena, and is found in our daily cultural practices.

D' Ambrosio has defined the term ethnomathemaics by dissecting it into ethno as 'all of the ingredients that make up the culture identify of a group: language, codes, values, jargon, beliefs, food and dress, habits, and physical traits' and mathematics as 'ciphering, arithmetic, classifying, ordering, inferring, and modeling' (p.n30.as cited in Tutak, Bondyb & Adamsb, 2011). According to Skovsmose (2015), "Ethnomathematics" refers to the different practices that include mathematics, and often it denotes to practices of marginalized groups. It can also refer to a research approach, and one can talk about the ethnomathematical research programme (p. 18). D' Ambrosio focused on the cultural artifacts like food, dress, physical traits etc. and Skovsmose focused on the practices of culture with mathematics. In the holistic view, ethnomathematics is how teacher can adopt the culture practices in mathematics education. Ethnomathematics is emphasizing socio-cultural factor in the teaching and learning mathematics filed. Gurung community have a lot of social cultural mathematics which are allied to ethnomathematics. D' Ambrosio focused on the cultural artifacts like food, dress, and physical traits etc. Skovsmose focused on the practices of culture. In the teaching and learning process, but both teacher and student have developed and able to identify the mathematics and culture. Hence, the culture is the powerful tool and technique in teaching mathematics.

Culturally Relevant Pedagogy

There are large diverse and heterogeneous group of Nepal because of the diversity in regards of geography, language, cast, ethnicity, religion, and culture etc. all people are practicing ethnomathematics knowingly or unknowingly in their culture

and interconnected too. According to Nickson (1994), "one of the major shifts in thinking in relation to the teaching and learning of mathematics in recent years has been with respect to the adoption of differing views of the nature of mathematics as a discipline" (p.10). consequently, culturally responsive pedagogy has developed a knowledge base about cultural diversity, including ethnic and cultural diversity content in the curriculum, demonstrating caring and building learning communities, communicating with ethnically diverse students, and responding to ethnic diversity in the delivery of instruction' (Gay, 2002). Through culture in our classroom, teaching and learning can be very effective, communicable, real life problem based and enjoyable in classroom practices. And also, pupils may feel it as their real self-culture practices has been carried out in classroom diversity and teaching and learning process. The inclusivity that lies at the heart of a culture-sensitive mathematics curriculum aims to provide multiple educational outcomes, empowering with meaningful mathematical knowledge and skills for a range for possible social roles in CRP (UNESCO, 2008).

Procedural and conceptual Knowledge

Procedural knowledge is the knowledge exercised in the performance of some task. Procedural knowledge is as the ability to execute action sequences to solve problem and that kind of knowledge is tied to specific problem types and its now openly generalizable (Johnson, Siegler & Alibali, 2001). Hence, the procedural knowledge helps to solve the problem by some specific process and steps.

Conceptual knowledge refers to the knowledge of, or understanding of concepts, principles, theories, models, classifications, etc. according to jonson & Schneider (2015), conceptual knowledge should be defined as knowledge of concepts. Conceptual knowledge should be defined as knowledge of concepts. Conceptual

knowledge as implicit or explicit understanding of the principles that govern a domain and of the interrelation between units on knowledge in a domain (Johnson, Siegler, & Alibali, 2001). Teachers learn conceptual knowledge through reading, viewing, listening, experiences, or thoughtful, reflective, mental activity in some particular social and cultural phenomena.

In the mathematics, I contemplated the conceptual knowledge is more used because when teachers explore the examples and concept of some geometrical shapes. Conceptual and procedural knowledge are always interconnected and are accepted by some particular social and cultural phenomena. Teachers can use properly etnomathematics in mathematics teaching and learning process through local materials in classroom activity which makes them easy to gain the conceptual knowledge. I think, when teachers teach mathematics in classroom, class environment should be more contextual by the use of local materials.

Cultural Artifacts

Cultural artefact is an object made by people having traditional, chronological or cultural significance. A cultural artefact has thus to be negotiated with the owner, the museum curator, archaeologist, conservator or restorer, and conducted as far as possible by non-destructive observations and analyses from its surface as it appears when it comes to the laboratory (Marc & Evelyne, 2007). In our country, there are various cultural, traditional, religions artifacts. In each and every place, there is various artefacts with distinct significance. People involve in different activities to express their cultures and traditions. They make different handmade cultural artifacts to illustrate own traditions. Cultural artifacts are different types of crafts which people make using only their hands and basic local tools. Development studies along these lines promises to other important insight into the origins of the categorization

strategies the underlie artifacts concepts (Barretta, Laurenceb & Margolisc, 2008). In gurung community, there are lot of cultural artifacts. Teacher can use cultural artifacts in the classroom as teaching materials and encourage students to explore mathematical knowledge and skills.

Theoretical Lenses

Theoretical literature review is the most significance section in my research because it indicates the theoretical perspective for my research. In my research, I have discussed two theories related to my research issue.

Constructivism

Constructivism is a theory of learning or meaning that an individual can create their own new understanding on the basis of an interaction between what they already have known and believe, ideas and knowledge with which come into contact (Richardson, 2003). Constructivism has rejected that knowledge is static, absolute, final, pre-existing and reliable, and has fixed value. It believes that the knowledge is not readymade; it is constructed by the learner in some particular phenomena.

According to Husen and postlethwaite (1989), constructivism is based on the belief that knowledge is not passively received but actively up by the cognizing subject and that function of cognition is adaptive and serves the organization of the experiential world, not the discovery of ontological reality. Constructivism believed that a learner can construct knowledge interacting with the social aspects such as language, culture, everyday practice, material objects, interpersonal interactions, peer interaction, tools and symbols. So, when teachers use the cultural mathematics in classroom, students construct their knowledge in their prior knowledge. Pupils have

been constructing and generating the new idea according to their cultural and take its ownership. Hence, new idea should be developed.

In this research, I explored how students and teacher construct their knowledge through ethnomathematics and cultural artifacts in Gurung community. It is more beneficial to construct the knowledge of local and cultural knowledge in teaching and learning activities in basic level school in Gurung community. There are a lot of ways of teaching mathematics in the classroom. According to constructivism, students construct their knowledge from their own culture. According to Tayler, Fraser and Fisher (1997), a classroom learning environment shaped by practical and emancipatory interest in which a major emphasis is placed on facilitating student's involvement in active negotiated with the teacher and peers. The object of negotiation is to make learning relevant to student's out-of –school lives, encourage students to assume control of their learning and to produce a critical awareness of shared cultural values and belief that restrain constructivism reform of teaching and learning.

Constructivism is about how to gain and acquire knowledge and learning in an active cognitive process of the leaners then just teaching and fulfilling the objective the objective of the curriculum. The learners are viewed as constructivism participants believing that each learners has special attributes, and assessment should identify such unique attribute for further enhancement in a regular basis (plant, 2015). The knowledge acquired by learners cannot be permanent and objectives; it can be temporary, development and subjective. Constructivism believes that every knowledge can be constructed socially and culturally, and knowledge is not objective, rather it is development and acquired by the learner himself or herself by active process of their own cognition with the help of more knowing others.

Social Learning Theory

According to Bandura (1977), social learning theory is a theory of learning and social behavior which process that the new behaviors can be acquired by observing and imitating other. Social learning theory is founded on the thesis that social process are central to learning and cognition development. Social learning links subjective and objective knowledge in a cycle in which each contribute to the renewal of the other. A social learning perspective directs teacher to situate learning activities in the context of student's out-of-school lives, thereby enhancing the meaningfulness of learning sciences. Applying sciences to contexts that are familiar to students, such as testing water quality in a nearby river or monitoring energy use within the home, gives sciences a perceived relevance that is often missing when it is conned to the school laboratory or textbook(Taylor, 2014).

In this context, social learning emphasizes the mutual relationship between social characteristics of the environment, how they are perceived by individual, and how to encourage and enable the students to reproduce behaviors they find happening around them. Social learning is the most appropriate theory in the mathematics learning and learning in classroom. Social learning believes that every knowledge and new information can be conducted socially, culturally, locally with the help of adults or more knowing others.

So, social learning emphasize the culture mathematics because mathematics is found on the social phenomena. And when teacher practices the cultural artifacts in mathematics classroom, pupils take ownership of their cultural value. In this research study, I have explored how ethnomathematics is incorporate through social and cultural phenomena, and Gurung people practices the social artifacts in basic level social mathematics in teaching and learning in the classroom.

Empirical Review

In this literature review, I have identified the research gap after reviewing some research papers to my research issue.

Gurung (2014) conducted a research on "mathematics in the Gurung community: An ethnomathematical study". The research was conducted on the issues of mathematics curriculum of primary level focused on the mathematics practices related to number system, arithmetic, operations, games, and ways of making a rectangle and so on in the Gurung community. The research presented the cultural nature of mathematics. This research has explored and implementation to the ideas that mathematics is being practiced in Gurung community culture and inculcates the numerous ethnomathematical practices in school level.

Paudel (2008) has conducted a research on "Tharu culture: An ethnomathematical perspective". The research was conducted to explore the possible ethnomathematical practices perceived by Tharu culture in different cultural practices and has found out the aspects of potentiality of an ethnomathemtics aspects of the community to be incorporated in the school level (primary) mathematics curriculum, and the study focused on the perception of mathematical knowledge in different cultural activities of Tharus. This research tries to find out the ethnomathemtical practices in primary mathematics curriculum.

Rai (2016) has carried out research on "Mathematics practices in Rai community and pedagogical Use". The research conducted in the Rai community has presented the cultural artifacts as mathematics learning materials in the classroom. This research was based on ethnomathematics and explored the mathematical practices of Rai community and culture. The research presented the various

geometrical practices as an ethno-mathematics in Rai community. This research has explored many ethno-mathematical practices in Rai community culture which can be incorporated in school mathematics.

Shrestha (2018) has conducted a research entitled "Embodiment of Geometry in Traditional Newari Art: An Ethnographic Enquiry". He conducted the study on Newari cultural and explored the cultural integration in mathematics classroom to uncover its potentiality in enhancing mathematics learning. This research was carried out in geometry that is manifested in traditional Newari arts and explored the possible integration of 'ethno-geometry' in the basic level school mathematics teaching and learning approach. It has tried to put forward the ideas that mathematics is being practiced in every culture and it's possible to incorporate such cultural mathematical capitals in school curriculum so as to make the learning process more culturally contextual, meaningful, enjoyable, and effective. It means that the ethnomathematical practices in various cultural aspects have profound potential implications on mathematics education.

Research Gaps

All the aforementioned research studies were carried out on some particular cultures and ethnic groups in Nepal. Most of the researches have been interconnected to an ethno-mathematics and mathematics education in classroom practices. I went through all these research projects. During this time, I could not find any research studies which attempted to explore culture of mathematical practices in Gurung community. Therefore, I have intended to conduct a research study on ethno-mathematical practices in Gurung community. I have also attempted to explore the teaching and learning practices in the school level in Gurung community.

Conceptual Framework

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                    Mathematical practices in the Gurung community


    Theories                                                      Methodology

                            Key focus


                                          Counting                Design:
      • Constructivism                                           Ethnography
      • Social learning
        theory                           Measurement

                                                                 Tools:
                                         Linking pedagogy           • Interview
      • Empirical                                                   • Observation
        review


                            Key findings
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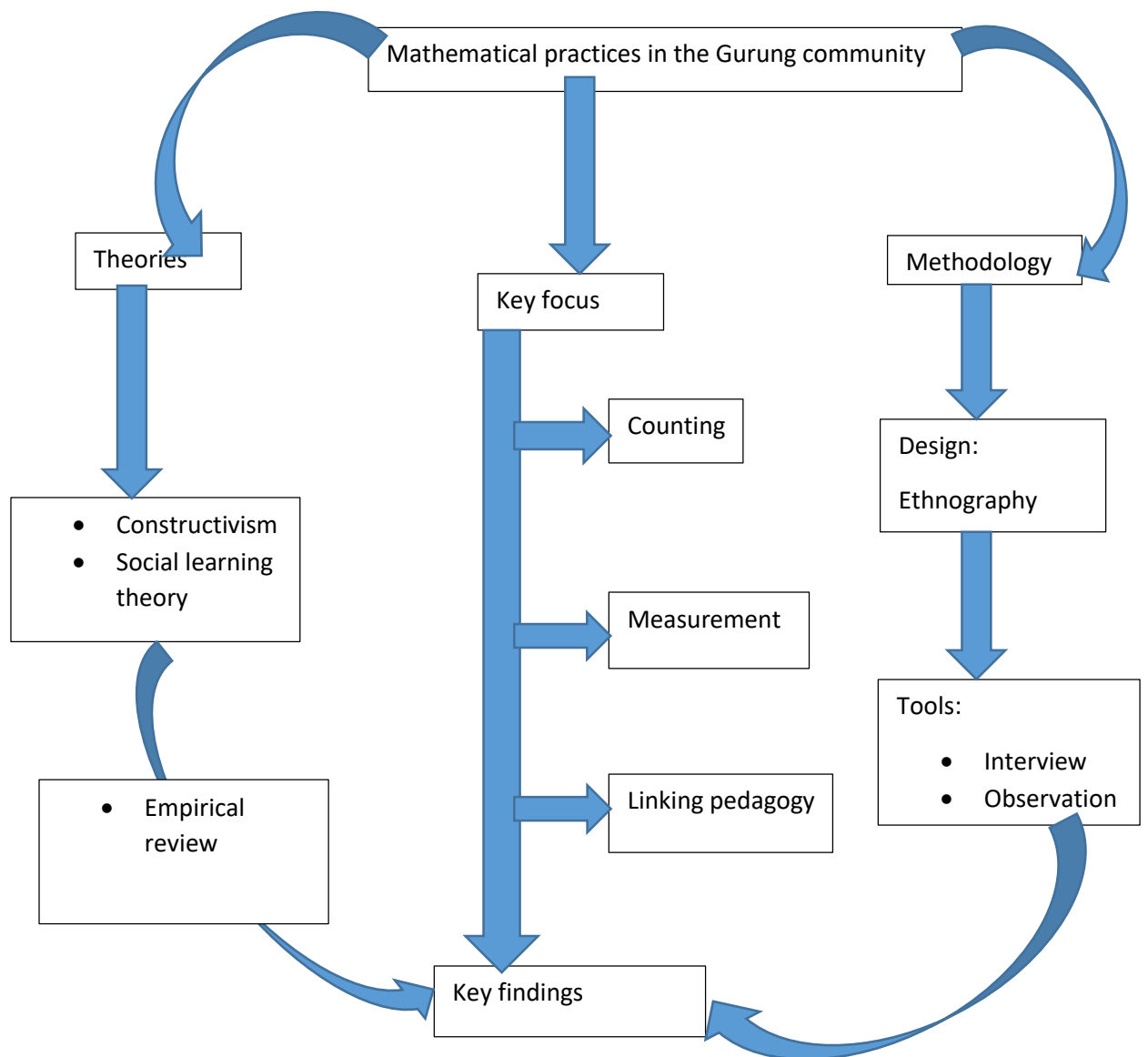
A conceptual framework is used in the research to outline possible course of action or to present a preferred approach to an idea or thought. Conceptual framework is a type of intermediate theory that attempt to connect to all aspects of inquiry (e.g. Problem definition, purpose, literature review, methodology, theories, key focus, key findings). It is the road map for conducting research.

Conceptual framework devised through the literature studies facilitated attain research work as a whole smoothly (Acharya, 2015). Mathematics was originated

along with the human civilization. Human begins themselves created mathematics in the field for application for counting, measuring and other concept of mathematics. Mathematics, culture and society are interrelated. Mathematics is developed in the culture. People and culture from the society. There can be found counting, measuring, calculating and other concept of mathematical knowingly or unknowingly which are the parts of mathematics. The activities can be found by observation and interview.in the above figure Gerung's mathematical practices is the main issue of this study. Also it shows what my research design, tools for data collection is, theory which is blended in the study has shown clearly in the framework.

Chapter Summary

In this section, firstly, I have explored the culture, mathematics education and ethnomathemtics which are linked to my research theme. Secondly, I have presented how theories (constructivism and social learning theory) guided me in my research study. I have reviewed empirical literature-based researcher carried out in the Nepali context. Hence, the entire three literature sections are considering as the most significant in my research.

Chapter-III

METHODS AND PROCEDURES

In this study, I choose ethnography as research methodology with the framework. It interpretive research paradigm. It consists of research design, selection of the research site, sampling procedure, data generation of the research. It also contains ways of maintaining the quality standards in research with ethical considerations.

Research Paradigm

Research paradigm is a comprehensive belief system that explain the research process. The whole research work is based on the concept, how the researcher defines the truth and reality and the method applied while conducting the research. I have linked an interpretive research paradigm for it would explore real social problem, spectacle the reality and study of human culture, religion, people beliefs system etc. interpretive knowledge others is produce through a prolonged process of interaction under taken by ethnographers who immerse themselves within the culture they are studying (Taylor & Medina, 2011). This paradigm has subjective kind of knowledge and also some belief and value system in Gurung community and it believes in multiple realities. Hence, I used the qualitative research. Qualitative research is an inquiry or process of understanding based on distinct methodology tradition of inquiry that explore a social or human problem (Creswell, 2012).

Research Design

My research is based on the qualitative research design with ethnography research design. According to Reeves, Kuper, and Hodegs (2008), "Ethnography is the study of social interactions, behaviors, and perceptions that occur within groups, team, organizations and communities and ethnographers typically gather participations observations, necessitating direct engagement and involvement with the

world they are studying" (p.512). Ethnography is a core study in our culture and it is originated from the cultural phenomena. This research has also explored the cultural phenomena. Ethnography research has strong emphasized on discovering the real social phenomena. The aim of ethnography is to describe and interpret the culture and the critical ethnography aims to change it by analyzing, hidden agendas, 'taken for granted' assumptions and working towards disrupting the status quo by bringing into light systems of power and control (Baumbusch, 2011). This research is based on the social interaction in Gurung community culture. Hence, I have attempted to study the mathematical practices in Gurung community visiting their community. It was easy for me to gain the deep understanding because I am also from the Gurung community in order to have deeper understanding, I spent sufficient time with Gurung community and observed their every culture practices very genuinely and naturally. Then, I explored and generated the mathematical practices in Gurung community.

Study Site

I selected my research site Ruby valley Rural Municipality ward no. 4 and 6 in Dhading district. Being a member of the gurung community, it was easy for me to collect data.

Sampling Procedure

My research is qualitative. So, I used the purposive sampling. According to Ross (2005), purposive sampling is based on the assumption that the researcher is able to select elements which represent a 'typical sample' from the appropriate target population. The quality of samples selected by using this approach depends on the accuracy of subjective interpretation of what constitutes a typical sample. I have selected research participations from Gurung community.

Sample Size

For my research, sampling is also very important. I have selected one mathematics teachers (basic and secondary school) with one headmaster, two students (basic and secondary level) and three local Gurung people.

Among three local people, first one is Mr. Lalman Gurung of 54 years. He is well known about the counting and measuring system in Gurung community. Second one is Mr. Narsing Gurung of 51 years, who is good artist and well known about the cultural artifacts in Gurung community, and the third one is Mrs. Dhansuba Gurung of 67 years. She is well known about the history of Gurung community and all the three local people have not attendance the formal school but somehow, they speak Nepali. I randomly selected the one Gurung mathematics teacher with ages ranging from 25 to 50 years who are currently teaching in basic and secondary level mathematics is different schools. And I selected two Gurung students from grade five and grade ten from two sample schools, and all the students.

Data Collection Tools

Data collection tools and instruments are the most essential aspects in my research. This research was undertaken using qualitative ethnography methodology. My research was based on both types of data that were primary and secondary. The primary data were taken from in-depth interview, filed visit, observations, photography and filed notes. For interview, I developed the semi-structured questionnaires and then I asked those questions to my selected research participants and collected the participant's experiences through interviews, which were recorded in my mobile. For observation, I developed observation checklist and filed note. I also observed those things which could not be covered by my interviews. I spent three weeks of time in observing their daily activities. Then, I recorded daily observed

things in my filed note. I consulted with my supervisor while developing tools and finalize them.

Data Collections Approaches

Data collection is the core sources of information of any research. Interview, observations and taking field notes are the essential approach for data collection in the research. In my research, I developed the open-ended questions for the teachers, students and local people. I spent three weeks in the field. Then, I took formal and informal interview with the participants. At that time, I interviewed my participants day by day based on my questionnaires. I repeated the interview my two local people and three students. While I took the interview of each teacher one by one. Then, I took video of their interviews and also noted down the relevant points in my diary. I also took photographs with mobile with other different photos which are relevant to my research. I developed journals of my whole day's works every night. Moreover, my interview focused to incorporate the mathematical practices and the participant's views towards mathematics from the lens of ethnomathematics. The video recording of those demonstrations was transcribed for further analysis. Therefore, the entire information was valuable for me to investigate the mathematical practices in the Gurung community.

Method of Data Analysis

I used the data analysis approaches as suggested by Creswell (2012). The first step was to organize and prepare the data for analysis. Second, transcribing the data that means converting audiotape recording or field notes into text data to gain a general sense of the information and reflection on the overall meaning. Third, conducting the analysis was based on the specific theoretical approach and method involved in coding or organizing the related segments of data into categories. Fourth,

to generate a description of the setting or people and identity themes from the coding to search theme connection. Finally, I interpreted the extensive meaning of the data. I attempted to get the entire information by listening to the audio records, video records of the interview, and other field notes. Those audios, videos, and photographs were the most significant tools for me as an ethnographer to study the cultural mathematics in the Gurung community. Hence, I collected the entire data by visiting the field, and I also transcribed the entire field data and then separated those data into different forms. Then, I generated the themes and sub-themes from the transcribed documents. I developed and analyze those transcribed documents in my fourth chapter. When I was writing the fourth chapter, I also used my exercise in the data analysis process. As a result, I drew findings and conclusions.

Quality Standards

Quality standards are necessary for my research. A quality standard is a set of criteria that is assumed to be observed in research that she/he claims to be very effective. My research is based on the interpretive research study. The key quality standards include trustworthiness and authenticity (Taylor & Medina, 2011) as it is qualitative research that focuses on contextual meaning-making. I have considered the min my research credibility, transferability, and trustworthiness.

Credibility. Credibility refers to the prolonged immersion of the researcher in the field. To maintain the credibility of my research, I spent three weeks during the process of data collection in the field. I have strongly maintained credibility in this research. I attempted to find authentic documents which are related to the Gurung community.

Transferability. Transferability refers to the thick description of the research process so that the context in the research report can be comparable with another context. I have maintained this quality in the standard of the thick description or rich details of the cultural practices in the Gurung community which can be used as a database to make judgments about another social setting. For this, I have adequately explained the ethno-mathematical practices in the Gurung community related to the basic and secondary levels of school mathematics. And, I also have included valuable and authentic photographs of the Gurung community in my research.

Trustworthiness. The major ways that the researcher adopted while drawing the conclusion from the data must be taken under proper consideration to ensure that the research study can be relied on (Graneheim & Ludman, 2003). I have maintained the trustworthiness of my research through the careful collection of data during the field visit in the Gurung community. In my research, I have kept my effort in maintaining trustworthiness during both the data collection and writing the research report.

Ethical Consideration

According to Orb, Eisenhaure, and Wynaden (2000), "potential ethical conflicts exist in regard to how a researcher gains access to a community group and in the effects the researcher may have no participants" (p.93). In my research, I was influenced to focus on the places in Ruby Valley Rural Municipality, and my research would be beneficial to all Gurung communities. Being a part of the Gurung community, it would be easy for me to share the purpose of the research with participants to get the sufficient information that I need. For this, I shared the purpose of the share with my participants by convincing them the research was conducted only for academic purposes; all the given information was destroyed after finishing my

research. During the data collection, I did not force them physically and mentally and also did not have any bias among the participants. They supported me fully during the data collection process. Finally, I explored and generated the natural phenomena of mathematical practices in the Gurung community.

Chapter Summary

In this section, I have explained the research methodology. , I have explained the research paradigm from the ontological, axiological and epistemological lenses. Similarly, I have discussed the research design, research site, data and tool techniques, sampling procedure, and method of data analysis. Likewise, I have also discussed the quality standards of research. Eventually, I have also included ethical considerations in my research.

Chapter-IV

ETHNO-MATHEMATICS IN GURUNG COMMUNITY

In this chapter, I have explored the mathematical practices in the Gurung Community from the lens of ethnomathematics tips and how they can be incorporated into different dimensions of mathematics curricula at the school level. I have also generated four themes based on the four basic areas of the mathematics practices by the Gurung community. They are Number Sense and Counting System in Gurung community, Measurement System in Gurung community, Geometric Shapes in Gurung community, and Ethno modeling in Gurung community.

I began my journey with the process of data collection from Kathmandu to my birthplace on 15th January 2020. On the way to my village from Kathmandu, my first day ended in Dhading Bensi of the Dhading district. Early in the next morning, I continued my journey towards my hometown via a local mustang jeep, after continuously 6 hours of driving and reaching the Borang village which is the gateway of the Ruby Valley Rural Municipality, I stayed there overnight. The next morning, I started to walk, 2 hours later, reached my hometown Chalish village.

Number Sense and Counting System in Gurung Community

Number Sense in the Gurung Community

Gurung community has got their own language for counting system. During the interviews with my neighbors, Mr.Lal Man Gurung and Mr.Dal Bahadur Gurung, they shared their counting system, which they had gained from their ancestors without attending formal schooling. They counted *khaa* for zero (0), *krii* for one (1) , *ngih* for two (2), *sho* for three (3), *pli* for four (4), *nga* for five (5), *Tu* for six (6), *ngi* for seven (7) , *pre* for eight (8), *ku* for nine (9), *chyu* for ten (10) and so on. Moreover, the local number system comforts the indigenous people in learning the system easily rather

than learning it using national language (Nepali) or international language (English) because being from the same community, I have also realized that the mother-tongue helps people (students) learn everything conceptually, so far.

When I took an interview with another participant called Roshani Gurung, a one-grader student, it was very interesting that he was more much confident in counting numbers in his own (Gurung) language unable to count in Nepali and English systems. Similarly, another student from grade three mentioned that if his teacher had taught him in his own (Gurung) language and own number system, he could have learned and understood easily but he found it difficult to learn Nepali and English because he cannot speak in Nepali and English. I was surprised how the teachers can teach mathematics and even other subjects to the students who are unable to speak and understand Nepali and English. Therefore, in order to enhance the quality of education, it would be far better to teach mathematics in the mother (local) language first, and then gradually they can be taught mathematics in Nepali and English languages. According to Pant (2015), cultures have their own standpoints in promoting and improving the teaching and learning of mathematics through different approaches. In this regard, in my heart and mind, based on my own experience I have developed a belief that teachers can teach mathematics conceptually in the local language based on the cultural practices far better than in any (imposed) languages, especially in the basic level schooling, because such people run their lives with their own mathematical knowledge and practices, which is one of the goals of ethnomathematics (D'Amboise, 1997). Moreover, ethnomathematics as a program values every nature of mathematical knowledge that has been practiced formally/informally by certain cultural groups. I have presented in Table 1 the details

about the counting system in the Gurung community, which I explored during my field visit to my village.

Table 1

Counting System in Gurung community

Unit	Name	Ten	Name	Hundred	Name	Thousand	Name	Hundred thousand	Name
0	khaa	10	Chyu	100	pra	1000	Haang	100000	Laang
1	krii	20	Ngihchyu	200	Pra Ngih	2000	Haang Ngih	200000	Laang Ngih
2	Ngih	30	Shochyu	300	Pra sho	3000	Haang Sho	300000	Laang Sho
3	Sho	40	plichyu	400	Pra pli	4000	Haang pli	400000	Laang Pli
4	pli	50	Ngachyu	500	Pra Nga	5000	Haang Nga	500000	Laang Nga
5	Nga	60	Tuchyu	600	Pra Tu	6000	Haang Tu	600000	Laang Tu
6	Tu	70	Ngichyu	700	Pra Ngi	7000	Haang Ngi	700000	Laang Ngi
7	Ngi	80	prechyu	800	Pra pre	8000	Haang Pre	800000	Laang Pre
8	pre	90	kuuchyu	900	Pra kuu	9000	Haang kuu	900000	Laang Kuu
9	kuu	99	Kuuchyu kuu	999	Pre kuu kuchyu kuu	10000	Haang chyu	10000000	Kaang

During the process of research, I came to know that the Gurung community has their own script and language, which is called the Khema script the Language Commission of Nepal recognizes the Khema script as the official script of the Gurung language, and the writing patterns of number in the khema scrip is from left to right, the record which has been kept safely by some particular Gurung people. But due to some constraints, I could not produce the scripted number practices of the Gurung community in my research. I have mentioned the photo of khema script in below.

Khema script

Vowels

অ	আঁ	আঁঁ	আঁঁ (ঝৢ)	আঁঁ	আঁঁ
a	ama	ema	uma	yema	yaima
[ɑ]	[aː]	[i/iː]	[u/uː]	[e]	[ɛ]

আঁঁ (আঁৢ)	আঁঁ (আঁৢ)
oma	ouma
[o]	[ɑu]

Diacritics

◌̄	◌̊	◌̿	◌̊	◌̈	◌̇	◌̈
ā	i	u	e	ai	o	au
[aː]	[i/iː]	[u/uː]	[e]	[ɛ]	[o]	[ɑu]

⌊◌	⌊◌	◌	◌̆	◌	◌
-w	-y	-ḥ	ṅ	-ra	mutes vowel
[w]	[j]	[../ː]	[~]	[rɑ]	

Consonants

ক	কা	য	যা	ৱ	য	যা	য
kakhe	khake	gakhe	ghake	ngakhe	chake	chhakhe	jakhe
[kɑ]	[kʰɑ]	[gɑ]	[gʰɑ]	[ŋɑ]	[tsɑ]	[tsʰɑ]	[dzɑ]

যা	ল	ড	ডা	ব	বা	ৱ	৲
jhake	hakhe	ṭakhe	ṭhake	ḍakhe	ḍhake	wakhe	takhe
[dzʰɑ]	[hɑ]	[tɑ]	[tʰɑ]	[ɖɑ]	[ɖʰɑ]	[wɑ]	[tɑ]

যা	য	যা	ᴣ	৬	ৱ	ৱ	যা
thake	dakhe	dhakhe	nakhe	pakhe	phakhe	bakhe	bhakhe
[tʰɑ]	[dɑ]	[dʰɑ]	[nɑ]	[pɑ]	[pʰɑ]	[bɑ]	[bʰɑ]

৵	৲	র	৳	ই
makhe	yakhe	rakhe	lakhe	sakhe
[mɑ]	[jɑ]	[rɑ]	[lɑ]	[sɑ]

Numerals

ᔑ	C	Ͻ	U	∩	S	Ü	∩	ω	ᔑο
1	2	3	4	5	6	7	8	9	10

In our country, there are more than 129 languages. Each community has its own numbering and counting system. Therefore, the basic concept and knowledge were gained in their particular community. According to Ascherand D'Ambrosio, (1994), "People from different cultures, particularly those westernized by such an important mode of thought as mathematics, do not recognize in reasoning any form of logic, mainly because syllogisms are intrinsically both form and content for them" (p.39).In the Nepali context, Nepali language is considered a second language in most communities like *Gurung*, *Tamang*, *Newar*, *Tharu*, *Rai, Limbu, Magar,* etc. As I am from the Gurung Community, I know very well that there are a lot of numbering and counting practices in daily life in the Gurung Community. Therefore, it is essential to provide the opportunity of learning their own number system for the students of such communities.

Using the cultural number system in teaching pedagogy can help students develop their number sense. For instance, during my field visit, I asked one of the participants of one graders, "Can you tell the numbers from one to twenty both in Nepali and English?" and he could tell in Nepali *ek* (1), *dui* (2), *tin*(3), *chaar* (4), *panch* (5), *chha* (6),*saat* (7), *aath* (8), *nau* (9), *das* (10),*eghara* (11), *tehra* (13),*satra* (17), *bis* (20), *unnaais* (19), and an English one, two, three, four, five, seven, six, ten. I then promptly asked him to tell the number system in his own language. He could tell confidently from 1 to 20 as *kri* (1), *Nghi*(2) , *sho* (3), *pli*(4), *Nga* (5), *Tu*(6), *din* (7), *Ngi* (8), *ku* (9), *chyu* (10), *chyu kri* (11), *chyu Nghi*(12), *chyu sho*(13), *chyu pli* (14), *chyu Nga* (15), *chyu Tu*(16), *chyu Ngi*(17), *chyu pre* (18), *chyu ku* (19), *Nghichyu*(20).

Therefore, I realized that cultural contextualization is missing in our mathematics teaching and learning system in Nepal. In this regard, a teacher should

promote the local number system in teaching activities so as to help students develop their number sense. Hence, the role of ethnomathematics in mathematics education has now predominantly become an empirical matter, and comment on some preliminary results from recent studies that indicate a positive role for culturally based curricula and ethnomathematics recognizes the uniqueness of traditional cultures by highlighting aspects of their complex knowledge systems and showing them to be living and dynamic and valuable and valid in their own terms and context(Adam, Alangui, & Barton, 2003).In my point of view, the number systems being practiced in school are connected with cultural number systems and hence teachers can use the local number system to give the number sense to their students. Mathematics education incorporates contextual mathematical resources exploring the mathematical practices of students such as household activities and professional activities (Shrestha, 2018a).In my opinion, mathematics is always interconnected with cultures and teachers can teach mathematics using cultural skills and techniques. In this 21st century, meaningful teaching and learning have become one of the major issues in the context of Nepal to be addressed. Based on my field visit experience, I gained that ethnomathematics and our own cultural practices are funds of knowledge for mathematics education. Although it may be difficult for most teachers to explore indigenous (culture) mathematical knowledge and the ways of incorporating them into mainstream mathematics education, we as teachers should not forget that cultural tools are the most powerful tools to learn mathematics effectively and meaningfully.

Besides the number system, while teaching the concept of "set" as a group or collection of objects, teachers can also use the local system first and connect it with the textbook mathematics. For example, days in a week form a group of seven days – Sunday, Monday, Tuesday, Wednesday, Thursday, Friday, and Saturday. Instead.

Years/Months/Lho Counting In the Gurung Community

One day during my field visit, I visited Mrs. Dhansuba Gurung, she told me about the year, month, and day system of the Gurung community. In my query, she told me that, the Lho(year), *tiiyeha*(day), and *khundo*(month) for measuring their ages. She first explained the system, in which there are 12 *khundo* in a year in the Gurung community. Further, she also shared an example that this year (the year 2020 while taking the interview) was *Musalho* (Mouse year) and her year was *Charalho*(Bird year) and told that, she became 62 years running at that time. I asked her to make it clear to me and she told me that five times of twelve is equal to sixty as they count the years as *Kukurlho*(Dog year; one), *Mirgalho(some part of the gurung community, it is called Badhellho as well)* (Deer or Pig year: two) count

12 Lhos cycle of gurung community

12 Chinese zodiac signs

Accordingly, sixty plus two gives sixty-two. Twelve years is a cyclic system in the Gurung community. I requested to calculate my age through the Lho system, she asked me "what is your lho?" I told I don't know. Immediately, I went the home to ask my mother about my Lho. I got to know, my lho is Mirga Lho(Badhel Lho), I backed to that place and I told my Lho to her, she did calculate about my age. Finally, she told me you are one of twenty and five, it means twenty-five. It was exactly right, I am 25 years, in the Gurung community, and the old and uneducated people add or

subtract is based on the twenty. The Lho changed every 15 Poush of the Nepali calendar which falls on/around 30 December of the English calendar, that day Gurung people celebrate as a New Year is called Tamu Lhochchar it is associated with the natural phenomena, and the morning sunrise on of 15 th Poush is the Ney Year. It makes the beginning of the Tamu Sambat or Gurung Calendar year. Lhochchar also heralds the change in "Lho". Gurung divided time into cycles of twelve years, to each year of which a special name is given, which is known as barga(lho)

Bhakari

Scarecrow

according to the oriental astrological system, there are 12 Lhos- Garud, Serpent, Horse, Sheep, Monkey, Bird, Dog, Deer(Pig), Mouse, Cow, Tiger, and Cat. So, therefore, each year, each month, and each day is marked by a particular animal and they are arranged in a single circle, following closely the Tibetan calendar with 12 animals. However, these animals may vary in the Tibetan Losar and Chinese New Year. The Lho returns after the twelve-year cycle. Poush 15 heralds the end of the winter and the start of the spring and traditionally it is celebrated by having 'ban bhoj', merry-making with, songs and dances, and playing traditional games. In the gurung calendar, the name of the month will different from previous year, in the year of (2021) Poush is the month of lho(cow), and this year, Poush is the month of too(Tiger). they count the day as the same way using this 12 lho, which is called Nghima in Gurung culture, if people are going to do new things or some special things, they check first Nghima, for example; my mom picking corn from the Bhakari(traditional store), she will take out in Tiger Nghima, Cow Nghima, and other Nghmi but she do not take out the Mouse Nghima, they believe that, if they take out

in the Mouse Nghima, all corn will eat by Mouse and if some farmer who belongs to the gurung, going to planting the rice, they do not plant in Mouse Nghima and Bird Nghima. One more interesting thing, is very hard to get married Mouse Lho vs. Cat Lho, Tiger Lho vs. Cat lho, and Tiger lho vs. Dog Lho because naturally, they are not friendly and not accepted each other. So, the Gurung people practice their own cultural number system for calculating their ages.

I have presented the details of the *Khundo*(Month), and *tiiyeha*(day) system shared by Mrs.Dhnasuba Gurung

Khundo(Month) System in Gurung Community (Name of the month of the 2021);

S.N.	*Khundo*(Month) in Gurung Community	Month in Nepali	Month in English
1	*Loong lho*	*Poush*	December/January
2	*too lho*	*Magh*	January/February
3	*Hii lho*	*Falgun*	February/March
4	*Pupri lho*	*Chaitra*	March/April
5	*Sapri lho*	*Bhaisakh*	April/May
6	*ta lho*	*Jestha*	May/June
7	*Lhu lho*	*Asar*	June/July
8	*Pra lho*	*Shrawan*	July/August
9	*Chhay lho*	*Bhadra*	August/September
10	*Khi lho*	*Aswin*	September/ October
11	*Pho lho*	*Kartik*	October/November
12	*Cyu lho*	*Magsir*	November/December

The connection of mathematics with culture is very important. When teachers connect the local and global knowledge to each other in the classroom activity, then it can be much beneficial to the learners. Teachers can teach different cultural practices in the classroom. So, culturally responsive pedagogy has been developing a knowledge base about cultural diversity, including ethnic and cultural diversity content in the curriculum, demonstrating caring and building learning communities, communicating with ethnically diverse students, and responding to ethnic diversity in the delivery of instruction'(Gay, 2002).

Making Local Alcohol (Narepa) in the Gurung community

At the time of my field study, I asked research questions housewife Dhansuba Gurung about her ideas for making local alcohol then she said that at first to make alcohol she must have yeast (marcha)(made by the local herbs) which was a sphere in shape and constructed by millet flour and dry green herbal creeper, which is found in the dense Jungle above 2000m above the sea level. First, they cooked hard porridge mixing of corn and millet flour, after that within 1 hour, they mixed Marcha and they put it in the bamboo basket, they keep 4-5 days near the local oven, covered by a warm blanket. Then, placed in the circular place, is called Gaito or Drum. They kept at least half of the month in the Gaito. Then it is ready to make local alcohol. I got that, she arranged the oven and bring the necessary pot for making alcohol. After that, she placed the Hada Batta(local name of the pot) on the oven with keeping the Jad in Hada, there an empty pot inside

Gaito

Marcha (Herbs)

Drum

Making Narepa(Bhati)

the Hada with the small oven is called Hadi(pot for storing alcohol) and on the top, they put Batta for putting water, it must have a parabolic shape, not for licking the air between Hada and Batta, they put around 3-meter wet cloth, is called Mathero. They put cold water in the Batta, so when it became hot they change the normal

Pong (wooden

water, this process is Paane. Normally, people do 5-6 Paane and 3 Paane is very strong and very famous all over Nepal. For the clearance of confusion about the Paane, they draw the line in Haada or on the wall, in the above picture 2nd one is 3 Paane, 3rd one is 2 Paane, last and second last is one Pane respectively. Most of the people draw the line on the wall by coal and some of them draw on the Hada. In Hada, they are covered by ash because it makes, it easy to clean after making alcohol. According to science, it is a method of fermenting. It is still illegal to sell in the open market but we can get it all over Nepal.

In the Gurung community, Narepa(local alcohol) is considered a sagun. On every occasion like a Marriage ceremony, Funeral ceremony, every Puja, Argung ceremony, parties, every festival, invitation, or gathering Narepa is needed. If we are inviting some guests or relatives, we have to send the Pong with keeping three drops of pure cow butter on top, Pong is a special type of wooden pot filling up the 3 Paane Narepa. Without Pong, the invitation is kind of domination and funny. It does not matter, whether you drink or not but you must have 3 drops of sagun on keeping two hands.in the Gurung young generation "why you drink?" they answered; "jaatle paako khaako".

Playing Cards Game in the Gurung Community

On special occasions or at the festival, they used to play a card game with at least three players, which is called marriage. In that game, number plays a vital role, to count the number and for easy to calculate, they used Corn seeds, or Bean seeds, or pieces of card, or small stone pebbles. They do consider one Corn seed or one Bean seed or one piece of card or one small stone pebbles to

Marriage game

be equivalent to one point, and one point is equivalent to Rs.1 or Rs.2 or Rs.3 or….in this game, the point is directly connected with the game and determine by the Mal, which is specific cards in that game. Every round, they change the position picking the single card that got the greatest number only he/she chose the position rest of the numbers auto-fill with anticlockwise patterns. In the end, they calculate with a base of seeds or a piece of card or stone pebbles, which has a huge seed, he/she won the money.

Measurement in the Gurung Community

In this section, we discussed the measurement system in the Gurung community

Distance Measurement

Betta, Muri, Haata and Arm Span System

In the gurung community, they have their own traditional measurement ideas which have been practiced many years ago, when I interviewed with Mr. Lal Man Gurung about the measurement system of length in the Gurung community, he told that Gurung people measure the length of any object without using
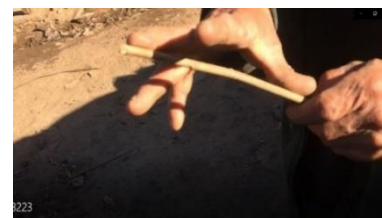
standard measuring units such as centimeter, meter, and kilometer. They have their own measurement system. For example Betta *(see figure 1), Muri (see figure 2), Haat(see figure 3), Arm Span(see figure 4)*etc. *Betta* means

Haata

the distance between the thumb finger and middle finger, and *muri* mean a total distance of one hand when your hand makes fist, and *haat* means total distance of one hand from the elbow, and *Arm Span*

Arm Spam

means the distance between the left hand to right hand. It can be expressed as two *betta* is equal to one *haat* and nine *bitta* is equal to one *Arm Span.* In the Gurung community for the construction of everything such as houses, bridges, schools, cottage, etc., this local measurement system is applied.

Gurung people usually use this measurement system. *Arm Spam* is also used while playing traditional Archery (Dhanush BaaNa) games for measuring the distance between one points to another point. Knowingly and unknowingly mathematics was taken as a contextualized body of knowledge and there is relation between mathematical knowledge and human society. According to D'Ambrosio (2001), "The use of day-to-day shopping to teach mathematics reveal practices learned outside the school environment, a true ethno-mathematics of commerce. An important component of ethno-mathematics is making a critical view of reality possible using instruments of a mathematical nature (p.13).According to Borda (1920),"Ethno-mathematics can be seen as a field of knowledge intrinsically linked to a cultural group and to its interest, being in this way tightly linked to its reality and being expressed by a language, usually different from the ones used by mathematics seen as science. This language is umbilically connected to its culture, to its ethnos" (as cited in Borba, 1987a, p. 199).

So, students can learn better knowledge of mathematics through their own culture, and community practice and may be by utilizing social artifacts. In my perspective, in classroom activity, if teachers connect the local measurement system with standard measurement system, the teaching and learning processes would be more effective. The teaching-learning approaches such as peer learning, social learning, collaborative learning and cooperative learning, etc. are substantially important approaches to teaching and learning mathematics effectively and meaningfully.

Weight Measurement

Tulu

Tulu is a famous traditional measurement system in the Gurung community to measure the weight (mass) of objects. It is made of wood, iron sheet, and rope. In the Gurung community, it is widely used for selling meat but not in the international measurement system (e.g. kg, gram, etc.). It is very useful and helpful in measuring the weight of any kind of object. Tulu is divided into nine parts and each part is at an equal distance from the other on the above straight part such as *Dharni, Shaser, Hamali, Taga, Naubodi, Bisauli, Athara pole, Pandra pole, and Baara pole*. Therefore, teachers can use this tool to contextualize the measurement system at the school level. It helps students, link-local knowledge with global knowledge and also increases their critical thinking and creativity. In general,
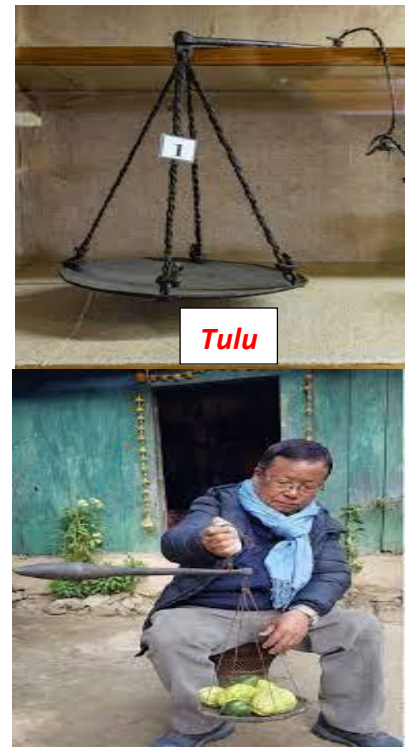
Tulu

> One Bisauli = 1.25 kg (approximately)
>
> One Dharni = 2.50 kg (approximately)

From the above illustration, we as teachers can come to the conclusion that most of the concepts of mathematics are somehow related to our cultural practices. Actually, there is cultural congruence between the community of students and the school and the role of the teacher is that they should respect the students' cultures. Now, I came to realize that the mathematical problems at the school level should be connected with our cultural contexts, and they should be taken from the day-to-day practices of human culture (Pant, 2015). In this situation, ethnomathematics gives us a place where teachers can connect all the cultural practices existing in culture with our formal discipline of mathematics. This is especially possible in the highly diverse context in Nepal; because every student comes to the classroom with their own cultural roots and prior knowledge in relation to particular phenomena.

So, the culturally responsive pedagogy is most suitable at the school level. Schools should develop a local curriculum in coordination with local resource persons incorporating various physical exercises of local experience and involving them in such exercises. The curriculum which is developed by the Curriculum Development Centre has also tried to incorporate games of various localities. Therefore, 20 percent weightage has been given as part of the local curriculum. This part should include the games and activities that are played and performed at local festivals, fair, and other events (CDC, 2006). It means that local curriculum is mostly related to our culture. So, mathematics cannot be separated from contextual teaching and learning.

Quantity Measurement

Maana and Paathi

Maana and *Paathi* are widely used in Gurung community still in these days. These materials are made up of wooden materials, bamboo materials and iron materials. It is a very popular tool in the local system of liquid and solid measurement. In the measurement system of *Maan a*and *Paathi.*

Paathi & Maana

Five Mutthi= one *Maana*

Eight Maana= one *Paathi*

Twenty *Pathi* = one *Muri*

In the classroom teaching activity using own (local) measurement system, the class will be more effective, and students would feel ownership too.

Contextualization of mathematics is about mathematics applicable to our daily life as well as mathematics for living meaningful life. Ethnomathematics has provided indigenous mathematicians a platform to understand the role that is played by mathematics in colonization, as well as understanding how we can engage with the discipline constructively(Adam, Alangui, & Barton, 2003).Since teaching through their own cultural and community practice is a key to involve more and more learners into mathematics and it helps us to understand the genuine meaning of the mathematical knowledge directly and indirectly in human life. In school, teachers can link those local measurement systems with global measurement system. It is helpful to promote the ethnomathematics in the classroom activities.

According to Borba (1990), "Ethnomathematics is probably going to be more efficient than the models stored in textbooks and written in codes may not always be accessible to a given cultural group, because it is connected to the culture where the problem was generated. Hence, ethnomathematics should not be misunderstood as "vulgar" or "second class" mathematics, but as different cultural expressions of mathematical ideas (p.41). So, in my view using local measurement and traditional practices of Gurung community can be used in classroom for meaningful teaching and learning of mathematics.

Games in the Gurung Community

In this section, I have discussed the games which have played in the Gurung community for around 500 years ago.

Chhelo

Chhelo is one of the popular games in the Gurung community. During the field visit, I interviewed Mr. Lal Man Gurung, he said, at Dashain or any special occasion Gurung people used to play this game. In this game, they use around five kilograms of rounded stone or iron, who can through far among the participants, he/she will win the game, and this is a kind of physical game who has good power or strong

Chhelo Game

muscle he /she can through very far. Here, the teacher can connect the distance between two points or objects of coordinate Geometry which will be very fruitful in mathematical learning.

Tir Hanne (Archery)

Tir Hanne game is popular games in the Gurung community. During the field visit, I have seen someone carrying small lengthy bag with some small stick and hanging curve shape materials on hand. After that, I interviewed with Lal Man Gurung, he told me this is Tir Hanne game. Especially, it plays at Dashain. Here, they

Tir Hanne (Archery)

determine the distance to through the Tir and another side, they put a circular shape. Who through the Tir center of the circle, he/she will win the game, if all participants through Tir on the center of the circle all are a winner of the game. In the Gurung Community, our ancestors used Tir for hunting in the Jungle. While mathematics teachers teach circle, line, point, and distance in the classroom, he/she can connect concepts of Tir Hanne game in the classroom. When teachers taught through this method, students feel that mathematics is in our society, in our culture, in our daily life, and so on. After that mathematics classroom will be more interesting, and students active and have long-term learning.

Khita Tanne (Rope pulling)

Khita Tanne game is another popular game in the Gurung community. During my field visit time, I have seen some people carrying ropes and crowed on the ground. I interviewed Mr. Dal Bahadur Gurung, he

said, this is the Khit Tanne game in the Gurung community. Here, participants were divided into two teams with some rules and basis of the strangeness. After that, they determine the mid-point of the rope and equal distance between two teams from the

midpoint. In this game, they make a small court that is equal distance from the mid-point of the rope. They started to pull rope, whose team pulled, that mid-point of rope crossed the court, and the team is a winner. While mathematics teachers teach straight lines, mid-point of the Co-ordinate Geometry and sets, he/she can link with this game. Students feel that mathematics is in the game.

Gaai Baaga (Baaga chaala)

Gai Baaga is a very common game in the Gurung community. During my field visit, I have seen, some young and some old men playing games on the flat stone moving some pieces of stone and wood, when I reached there only two men are playing rest of the people are the audiences of

Gaai Baaga (Baaga chaala)

that match. I interviewed Mr. Ram Gurung, he told me that, there is a rectangular shape of the outline, and there are 25 places inside the rectangular. They have 23 pieces of wood and stone among them 4 pieces are from wood is considered a Baaga and another 19 pieces are from stone considered a Gaai.
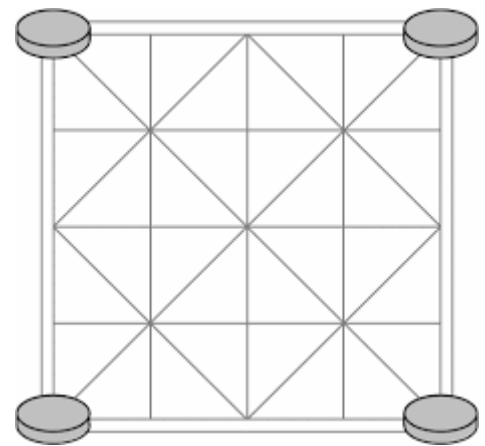
The Baaga is put first on the four corners of the rectangular. They move Baaga and other competitors and put Gaai inside the Rectangular with certain rules and regulations, repeating until the finished of Gaai of the game. If Baaga killed 5 Gaai then the game-winner by Baaga and if Baaga cannot move or Gaai blocked all possible ways the Gaai is a winner. Gaai and Baaga in a rectangle can move in a straight line without jumping. In this game, Gaai tries to block the possible ways and Baaga tries to eat Gaai. If Baaga is in some point of straight line and next point of

Baaga, there is Gaai and next of that point is vacant then Baaga jumps to the third point of after Gaai points then Baaga killed Gaai. While mathematics teachers teach geometrical shapes in the classroom, he/she can link or teach through the Baaga chaal game. It is easy to teach the concept of straight lines, diagonals, angles, squares, points, triangles, right-angle triangles, parallel lines, perpendicular lines, rhombus, and rectangles. We can teach mathematics gaming with learning.

Langadi

Langadi game is also a famous game for children of the Gurung community. During the field visit, I have seen some kids playing Langadi game on the ground making 6 rectangular courts joining each other. They are playing 5 kids turn by turn and throwing a

circular base stone in the rectangular court and only one leg is allowed to push that circular stone and not touch the line of the rectangle. If that lie on the line and if your leg touched the line of the court of the rectangle then you will be out of the game. While mathematics teachers teach the square, rectangle, and straight lines, he/she used this concept in the classroom of mathematics, students will learn very vast and durable. That's why every teacher should link knowledge with cultural artifacts.

Jhandi Burja

Jhnadi Burja is also a famous game in the Gurung community. During the field visit, I have seen the number of people playing in that game. And then I interviewed Mr. Lal Man Gurung, and he explained in this way, during the 18th century, the British Navy used to play a game called Crown and Anchor. It was perhaps during this time game spread to areas where they frequented the most. Fast forward a few hundred years, and now this game has become popular in Nepal as well as India. Jhandi Burja and Langer Burja is not so different from the original version of the game.

The names are more localized, but the rules remain the same almost. Jhnadi Burja is more than a just a game here. It is a cultural tradition to play it during Tihar, the festival of lights and Dashain in Nepal. If you are walking down a street in Nepal during this time, don't be surprised when you see people playing it on the streets. Groups of people stand around the players at the crossroads eagerly awaiting their turns to have a go. If anything, it adds to the celebrations during this festival time.

Jhandi Burja is a simple dice game that involves a canvas, six dice, and a bucket. The game consists of six symbols, apart from the traditional spade, cube, diamond, and heart, it also contains two more, anchor and crown. The same signs appear on the six faces of each die as well. one of the players chooses to be the host while the others place their bets. Usually, they put their money on the different signs on the canvas. The house or the host uses the bucket to shuffle the dice. At the end of

the round, the host lifts the bucket. The six faces on the die reveal the winnings of each player. So for example, if a player bets on the spade and three spades come up, the player wins thrice the amount they bet. But, if no spade or one spade comes up, then they lose their bet as the game progresses, and you get your chance of being the host. Then, it is your turn to earn money from other people's bets or lose money if they win. The game itself is straightforward, but often it boils down to chance and skill. While mathematics teachers teach the concept of probability, set, and many more mathematical concepts, we can do this clearly through this game. And we can teach multiplication through this game. While teachers teach the concept of probability, he/she can describe it through this game.

Cultural Artifacts of the Gurung Community/Geometrical shapes in the Gurung Community

In this section, I have discussed geometrical shapes found in the Gurung community. I have portrayed ….. Different shapes are related to the geometrical shapes such as *panigatta, Mera, Gurung's home, Doko/Raangye/Gyamjaa, Ghum, Goba, Raadi/Bakhu, Honey hunting, Chita, Gyasi, Parma, Nanglo, Kool, Daura syang, Dhyangro, Halo/Juwa, Chorten, Cupboard, Jaato, Ghaar*

Paanighatta

Paanighatta is made of stone, wood, and mud. It is mostly used in rural parts of Nepal, and the Gurung community also uses it frequently in their area. It is much helpful to teach geometry at the school level. Teachers can teach mathematics in various ways by using *Paanighatta* such as the concept of the pyramid, circle, radius, and also the center point of rotation. Also, it can be helpful to teach the

Paanighatta

circumference of the circle. Teachers have been continuously practicing mathematics as a universal and absolute form of knowledge for a long since the time mathematics was taught in schools. The teacher used to teach and students used to learn mathematics as a complete package and body of concrete knowledge. It's a fact that the mathematical society in Nepal is also not separated from such practices. That is, the notion of mathematics as a concrete body of knowledge has a great influence on the mathematical community of Nepal.

Mera

Mera is one of the traditional fencing systems of the Gurung community. Gurung people use it to protect whatever they grow in garden or in field. It is made by small *Nigalo*(similar to bamboo but *Nigalo* is smaller than bamboo)and some wooden materials. In the *Mera*, at first the Nigalos are adjusted in three parallel lines and then the

other *Nigalos* are adjusted in parallel lines in crossed-forms as shown in the photograph, which I took in front of my secondary school. The model of *Mera* can be used while teaching parallel, transversal and intersecting lines and different angles such as alternate angles, corresponding angles, co-interior angles, vertically opposite angles, etc., and different types of quadrilaterals such as parallelograms, rhombus, etc. and even polygons in school mathematics. Therefore, if such local materials are included in the teaching-learning activities in the classroom, students can easily connect their ideas with their previous knowledge as they have been familiar with such materials in their locality and hence construct new mathematical knowledge. Moreover, such practices in school help students become creative as well as responsible towards their own society and nation.

Gurung's House

This house is a traditional Gurung house. The house figure 1 is located in the Ruby valley Rural Municipality, ward. No 4. The house in figure 2 is located in Ruby Valley Rural Municipality, ward. No 6, which I took during my field visit on the 4th day. I think those houses are very beautiful, attractive and well designed by our ancestors. Still, In the Gurung community, most of the people live in this kind of house which is constructed from locally available materials such as *khara(one kind of grass)*. Nowadays, few

Figure 1

people have tried to replace the roof of houses with modern roofs made up of iron sheets. When I observed the houses in the Gurung community, I found a lot of mathematics and geometric concepts such as square, triangle, rectangle, parallel lines, perpendicular lines, parallelogram, cylinder, cone, angle, etc., Moreover, the house is made so artistically that different geometric patterns can be observed in different parts of the house. The doors of the houses are rectangular in

Figure 2

shape. In this regard, teachers can assign the project work to students so as to explore different geometrical shapes and their relationships found in such houses. Such project work helps students develop their creative and design thinking, so far.

Moreover, mathematics teachers should give emphasis on ethnomathematics while teaching-learning of mathematics so as to value the cultural capital of students so that it will be more convenient for students to learn mathematics meaningfully. In order to appreciate the real significance of mathematics in different cultures and in different eras, it has to be viewed through what might be termed a cultural Len s (D'Ambrosio, 2001). When teachers teach the geometric concept models of such houses in the classroom, the students can be more engaged in the teaching and learning process and would feel ownership of what they have learned. In this scenario, the classroom becomes more interactive as the students work collaboratively and share their ideas each other.

Doko/ Raangye/Gyamjaa

Doko/ Raangye/Gyamjaa is a common traditional tool used in Gurung community. It is made up by using the *Nigalo*. One of my research participants, Mr. Narsing Gurung shared about the making process of this traditional tool. He told that it can be made in cylindrical, rectangular as well as square shape. It is used for several purposes in the Gurung community such as for storing vegetables like potato, cucumber, pumpkin, shisnu (nattle), collecting grass and for collecting trees leaf etc.

Through this figure, we can give the concept of various geometrical shapes and problem in classroom activity. Especially, this tool can be used for giving the concept of square, diagonal of square, right angle triangle, sets etc.

In our country Nepal, pedagogy is still traditional in our country, and contextualized teaching approach is rarely used in our classroom practice. Using textbooks in the classroom is not a big problem but restricting the learners only to the textbook and teacher-centered lecture method are outdated and unable to fulfill the needs and demands of the 21st century learners. Nepali educational system is based on traditional textbook, teacher-centered, lecture-based method, low-resource, low-tech, large classroom contexts where learners get rare opportunities for independent learning in the classroom (Devkota & Giri, 2016). Thus, use of such local materials can contribute to enhancing engaged pedagogy in schools. For this, we need to consider and develop the contextualized pedagogical approach in teaching and learning of mathematics in the classroom activities.

Ghum

Ghum is common traditional tool used in the Gurung community.it is made up by using Malingo(which is special type of the Nigalo/small bamboo). One of my research participants, Mr. Lal Man Gurung shared about the making process of this traditional tool. He told that,

it can be made on rectangular and square shape. It use for protecting water and sun in the working season. They do make symmetry to cover on full body. Especially, this tool is very useful to give concept of the rectangle, square, lines, symmetry and many more.

Goba

Goba is common traditional tool used in the Gurung community, is made up by using wood and iron. On of my research participants Mr. Narsing Gurung shared about making process of this traditional tool. He told that, it can be

made on cylindrical shape.it is use for collecting milk from the cattle and some eastern part of Nepal in the Gurung community, they use for Tungabaa, it is especial type of Chhang made from millet. Especially, this tool is very useful to give concept of the cylinder, circle, and stes.

Raadi/Bakhu

Raadi/Bakhu is a traditional custom in the Gurung community, is made up by using sheep wool (especial black wool). On my research participants

Mrs. Dhansuba Gurung shared about making process of the traditional custom Raadi/Bakhu. She told that, it can be made on square and rectangle shape. Actually, Raadi is use for blanket and Bakhu is used for the Jacket. On the making process of

this two materials, we can give concept of the straight line, parallel line, perpendicular line, and circle.

Honey Hunting

Honey hunting is one of major profession in the Gurung community. They

do collect honey from the big cliff of Jungle Bee's in the country side of the Nepal. On my research participants, Mr.Lal Man Gurung shared about the process of traditional way of honey hunting. They make rope ladder using bamboo rope and strong wood. On the making process of materials of jungle honey hunting, we can give concept of parallel line, perpendicular line, angle, curve line, sets, distance, rectangle and midpoint.

Chitra

Chitra is a traditional tools in the Gurung Community. It is made up by Nigalo. It is use on floor as a

carpet in the cottage and home. On my research participants, Mr. Lal Man Gurung shared about making process of Chita. For one common size, 40 Nigalos are needed. On the making process of chitra, we can give concept of straight lines, perpendicular lines, right angle, rectangle and many more.

Gyasi

Gyasi is a traditional tool in the Gurung Community. It is made up by wood, pipe, bamboo. In my research participant, Mr. Lal Man Gurung shared about the making process of Gyasi. It is used the separate butter from milk. And Ghurlu is a tool, which is used for rolling milk in the Gyasi. By this, we can give the concept of the cylinder, circle, and straight lines.

Parma

Parma is a group work system in the Gurung community. In my research participant, Mr. Lal Man Gurung shared about Parma in this way, in seasonable work in the countryside of the Gurung community people, would like to work in groups, and they gather and work turn by turn on day by day. On the day who has Parma, the owner provides snacks, which is called Haarni in the Gurung culture. Reducing laziness, collaborative working, working together, and having fun is the plus thing in Parma. We can give the concept of unitary methods and sets.

Nanglo

Nanglo is a traditional tool in the Gurung community. It is made up of bamboo and nigalo (small bamboo). In my research participant Mr. Lal Man Gurung shared about the making process of the Nanglo, it is a flat circular plate on a tray used for winnowing and sifting wheat, paddy, etc.

having a diameter of about 22 inches the twisting technique is used to make the Nanglo. Around its rim a thick bamboo splint is attached using the culling techniques, thus giving it a raised border for the sewing coil either thin bamboo strip is used. Before use, the bamboo splints are scraped repeatedly on both sides to make them smooth and give them a polished appearance. It takes about 5-6 hours to make a Nanglo. From this object or materials, we can teach the concept of circles and their parts.

Kool

Kool is a traditional tool or local machine, used for making oil from mustard seeds and sesamum seeds in the Gurung community. In my research participant, Mrs. Dhansuba Gurung shared about essential materials and the making process of oil. Firstly, they put dry and beaten on okhal, and they make hot of beaten mustard seeds and sesamum seeds on Jhyanga(flat Iran pot). After that, they put in the Fudru, very tidily

and put it between Kool and flat wood. According to science, this is a simple machine whose lies in a first-class lever (effort, phalkram, and load). Through these materials, we can teach concepts of circles, rectangles, cylinders, and functions.

Daura Syang

Daura syang is a traditional way to well manage the wood in a certain space. In the Gurung community, they collect wood in the wintertime and storing in particular places with different shapes. In Nepal, the monsoon season is the season for working in the field. So that time, everyone is busy with their own duty. For the monsoon season, they do pre-plan about wood and other things in the winter season. In my research participant, Mr. Lal Man Gurung shared about the Daura Syang in the Gurung. They have put rectangular shapes, cylinder shapes, and many more shapes on collected wood in the Gurung culture in Nepal. Through this figure, we can give the concept of the sets, distance, cylinder, cone, and solid figure of joining the cylinder and the cone.

Dhyangro

Dhyangro is a traditional instrument in the Gurung community. In my research participant, Mr.Dal Bahadur Gurung shared about the making process of Dhyangro which is very important culturally in the Gurung community. Most Gurung people believe in the Bone religion which is nearly similar to the Buddhist. When you do puja at a home or on some special occasion in Gumba of Gurung society, Dhyangro is the compulsory instrument, which is rung by the lama. The Dhyangro is made up of deer skin. Through these materials, we can give the concept of the circle and cylinder in mathematics teaching.

Halo/Juwa

Halo and Juwa are traditional tools in the Gurung community. Which is made up of a special type of wood, which is called Chaapa. It is used for ploughing fields by combining two oxen, yaks, or buffaloes. In my research participant, Mr. Lal Man Gurung shared about making process and using way of Halo and Juwa. It has the main role of the angle between Haaris and Halo. According to Gurung, for narrow and slope land field ploughing, we have to make Thaade Halo, which means the angle between Haaris and Halo must

increase than normal, and for flat field ploughing, the angle between Haris and Halo must be around 45 degrees to 5o degree otherwise you will face the back pain. Through these materials, we can give the concept of the angle, parallel lines, perpendicular lines, sets, and paired orders.

Chorten

Chorten is a pyramid or triangular shapes object. In my research participant, Mr. Narsing Gurung shared about the making process of the Chorten. In the gurung culture, if people died then their family or their relative make a Chorten within one

year. They believe that, if family or relatives made Chorten, the soul of the dead body rest in peace. On every year dead day, they do Puja on Chorten. Through this Chorten, we can give concepts of Pyramid, and Triangle.

Cupboard

A cupboard is a traditional tool in the gurung community. They set up in the kitchen to well manage and

decorate the kitchen pots and other

necessary things. They are made up by joining flat wood with an iron pin. They make rectangular shapes and partition inside with numbers of rooms. In different rooms,

they manage and decorate different pots. Through these materials, we can give concepts of geometrical shapes, squares, rectangles, and sets.

Jaato

Jaato is a traditional tool in the gurung community. It is made up of a special type of stone. It is used for making flour from grains. It is considered a local machine, which is similar to the Paani Ghatta, which is run by force of water, and Jaato is run by hand in an anticlockwise direction. In the countryside, this is a very famous tool, we can see it in corner of every house. Through these materials, we can give concepts of the circle, cylinder, and many more.

Ghaar

Ghaar is a traditional tool in the Gurung Community. It is made of wood and used for beekeeping. In the traditional Gurung house, they keep Ghaar on the wall of the house in the eastern direction. Normally, they took two times honey from Ghaar every year. Through these materials, we can give concepts of the cylinder, rectangles, squares, and many more.

Chhapani

Chhapani is also one of the valuable tool that is used in the Gurung community. Every Gurung family has got *Chhapani* in their house. It is also made up of *Nigali*. It

is in a conical shape. It takes little bit more time to prepare it. It is used for the purpose of preparing the *Chhyang (local alcoholic fluid).*Learners can learn things from their own community and social practice. However, they need assistance of others to grasp the mathematics meaning and concepts. Another way, constructivism emphasizes the social construction of knowledge development, and assistance of more knowing others has great value in learning new things. Various engaged learning approaches such as Peer learning approach, group learning approach, social learning approach, collaborative teaching and learning approach as well as cooperative learning approach are substantially important approaches to teach and learn effective and meaningful mathematics. Finally, culture of learning mathematics includes the cultural and community practice of each learner which is significant in the construction of every mathematical knowledge. Hence, using modeling given in the given figure, teachers can teach the different mathematics such as concept of cone, height of cone and also other related mathematics.

Baranda

Baranda is a place made outside of house. It is made using wooden materials. Gurung people design themselves about its shape. The main purpose to make *baranda* is to take rest in leisure time. Only a few people make *baranda* in their houses. When I was in my basic level of school, teachers would only focus on contents and bookish knowledge. But when I joined TU for my master's degree, I knew how the cultures can
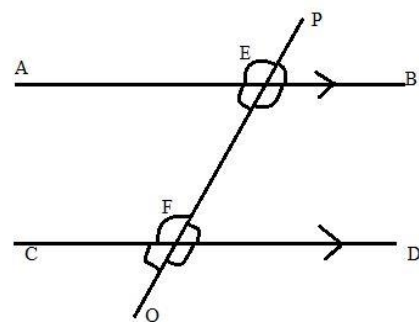
be incorporated in mathematics. I have attempted to explain the model of triangle,

By connecting the *baranda* with this figure, we can give the concepts of almost all angles to the students. Some of the angles that can be shown from this figure are supplementary angles, vertically opposite angles, alternate angles, corresponding angles, etc. and it will more effective as well. For example, $\angle AEF = \angle EFD$ being alternate angles.

Traditional method relies mainly on textbooks while the modern method relies on hands-on materials approach. But even though teachers use those materials in their classroom teaching, but still it seems that most of the time they are using the ready - made materials and demonstrate those materials and eventually go back to the same traditional process of teaching. With traditional method of teaching, assessment is seen as a separate activity and occurs through testing while with modern method of teaching, assessment is seen as an activity integrated with teaching and learning, and occurs through portfolios and observation (Armstrong, 2018). Hence, for effective teaching, proper use and development of local teaching materials is essential. We cannot neglect the culture in mathematics because culture is the foundation of every subject as well as Mathematics.

Chapter Summary

In this section, I have described about the ethnomathematical practices in Gurung community and how such practices can be incorporated in mathematics curriculum in the school level. In this chapter, I have also explained the four research themes with detail explanation. Firstly, I have discussed the Number Sense and Counting System in Gurung Community. Secondly, I have discussed the Measurement System in Gurung community. Likewise, in third part, I have discussed Games in Gurung community, and finally, I have explained the Geometrical shapes practices in Gurung Community.

Chapter-V

FINDINGS, CONCLUSION AND RECOMMENDATION

In this chapter, I have included the finding of the research where I have explained my personal journey while carrying out research. The findings have been generated in four main themes. The conclusion and recommendation parts have also been covered in it.

Summary and Finding of the Research

Formal education was known to me in my life at the age of 9. In the beginning, my perception of mathematics was always based on static, fixed, numerical solutions, and only 'smart' people can learn mathematics and solve mathematics problems at school and college levels. But when I joined Tribhuvan University for my master's degree, I began taking classes on teaching and learning in mathematics as well as ethnomathematics from the Facilitator. When the Facilitator taught ethnomathematics, my perception of mathematics was massively changed and realized that mathematics is not free from any culture.

I think cultural mathematics (e.g. ethnomathematics) links our academic mathematics with the cultures of our society and it encourages students to value their own cultures. It does not matter how successful we will be but it will be a valuable support for us to recognize our culture through mathematics (Shrestha, 2018a). Mathematics is connected to our social and cultural phenomena. During my field visit, I found ethnomathematical practices which are very rich in concepts and can be valuable for classroom teaching and learning of mathematics.

Next, I have discussed the heart point of my research which I explored during my journey of research entitled "Mathematical Practices in Gurung Community: An Ethnomathematical Study". During the entire journey of my research study, I

couldn't find any research done in the Gurung community that is related to mathematics. In that sense, I felt fortunate because none of the research has been undertaken in the Gurung community with ethnomathematics. As I belong to the Gurung community, it was a little bit easier for me to carry out the research inquiry in my own community while at the same time, there were some challenges too because there were no research papers related to the mathematical practices of Gurung community.

Generally, I know that the Gurung community has a rich and massive source of ethnomathematics. That's why; I was very excited, self-possessed and so curious to interconnect mathematics with my own socio-cultural practices. Then I set the objectives of my research and ways to find out the ethnomathematical practices in the Gurung community. For this, I started to study the journals, articles, dissertations, thesis, research papers, and books related to ethnomathematics. I also studied many papers which are related to ethnomathematics in the context of Nepal and other countries. Those papers helped me enrich my strong interest in ethnomathematics. Then, I attempted to explore the link of those cultural practices with our formal school-level mathematics.

After that, I set the guidelines for my field visit. Moreover, for the first few days, it was difficult for me in selecting my research participants but the suggestions of my research supervisor made it easy. Eventually, with the support of my research supervisor and based on those papers, I could prepare the final research proposal. In this research, I had to give a hard effort during the field visit due to the poor communication facility and lack of easy access of it viz. telephone, mobile, and internet services.

Now, I would like to present and explore the summarized form of my research. In my research, there are two research questions. In the process of my field visit, I included all the requirements which are the most important and significant in every research. Likewise, I was in prolonged engagement in the research field, interviewed the research participants, collected data, took field notes, and videos, transcribed documents, and reflected on my data and photos. Then, I found voluminous mathematical practices in the ethnic group of the Gurung community. It was challenging for me in order to build the relations between social and cultural capital and mathematics at the school level.

Now, I discuss the summarized form of my research findings. The central focus of this research was based on the social and cultural artifacts of the Gurung community and linking those artifacts with the school level. Especially more related to Number sense, measurement, and geometry. The core findings of my research were drawn within the four themes and presented as follows.

I presented the four main themes in this section. In the first theme, I presented and explored the number sense and counting system in the Gurung community. I have mentioned the counting number system in the Gurung community such as *tiiyeha*(day), *khundo*(month), *Lho* (year) and *khaa(zero), krii(one), Ngih (two), Sho(three), Pli (four), Nga(five), Tu(six), Ngi(seven), Pre(eight), Kuu(nine), Chyu(ten), Ngihchyu(twenty), Shochyu(thirty), pra(hundred), Haang(thousand), Laang(hundred thousand), Kaang(core)* system in the Gurung community. In my view, teaching mathematics at the school level in the indigenous community is a very important role in teaching and learning in the classroom.

In the second theme, I have presented the measurement system. Especially, I explored how can be used and measured the *Betta, Muri, Haat, Arm spam, Mana,*

Pathi, and Tulu systems in the Gurung community. In teaching through their own measurement system developed cultural and community practice is a key to involving more and more learners in mathematics and they were found to feel a sense of ownership and could try to find their own cultural mathematics.

In third them, I have presented the various games in the Gurung community. I have shown the three different games which are related to counting, geometrical shape, probability, and co-ordinate Geometry like *Chhelo, Tir hanne(Archery), Khit tanne, Gaai Baaga, Langdi, Jhandi Purja.* It explored that those games are important and essential to develop the contextualized pedagogy approach in teaching and learning in classroom activity.

The fourth Theme, I have presented the various geometrical shape in Gurung community. I have shown the twenty different shapes which is related to geometrical shape like *panigatta*, *Mera,* Gurung's *house*, *Doko/Raangye/Gyamjaa, Ghum, Goba, Raadi/Bakhu, Honey hunting, Chitra, Gyasi, Parma, Nanglo, Daura syang, Dhyangro, Halo/Juwa, Chorten, Cupboard, Jaato,.* It explored that those shapes are important and essential to develop the contextualized pedagogy approach in teaching and learning in classroom activity.I think, these modelling are suitable and meaningful for classroom teaching pedagogy, and if teachers teach mathematics using such types of ethnomodeling, it provides students with conceptual knowledge of mathematics.

Conclusion

Current practices of mathematics pedagogy may not be decent in learning for every child in the context of Nepal. The teacher and learning processes are still traditional. The pedagogical practices are still guided by the lecture method. Teachers

just transmit knowledge to the students as passive recipients. Thus, teacher-oriented pedagogy is dominant in the classroom and is killing the creativity of students.

Hence, our educational product is day by day declining every year due to depending on traditional teaching approach but we are human and human cognition is always changeable. Hence, we need to think the different approaches of teaching and learning system.

There are the major conclusions of my research study which are as follows:

1. Gurung community is rich in terms of mathematical practices should be incorporated in school mathematics for meaningful learning.

2. Gurung community understands the genuine meaning of those ethnomathematical knowledge directly and indirectly. Based on my research findings, local measurement system and traditional practices in the Gurung community can be used in the classroom for meaningful teaching and learning of mathematics.

3. The artefacts of the shape and games in the Gurung community can be used in teaching and learning geometry. These can be very useful and helpful to learn about the square, rectangle, hexagon, circle, point of intersecting, co-interior angles, right angle, alternative angles, horizontal lines, vertical lines, parallel lines, x-axis and y-axis, probability, etc. in geometry classroom activity and also can be used in a real application in our daily life.

4. Ethnomathematics emphasizes socio-cultural aspects in the teaching and learning of mathematics. Gurung community has a lot of social and cultural mathematics related to ethnomathematics.

During my research journey, I have explored cultural mathematics. And tried to explore ethnomathematics found in the Gurung community and discussed the possibilities of incorporating it into mainstream mathematics education. I have

discussed how the diverse geometrical practices of the Gurung community can be incorporated into school-level mathematics. The core objective of my research was to provide an opportunity for the student to feel ownership of their cultural mathematics and understand the relationship between culture and mathematics. This research was focused on the ways of exploring the mathematical practices of the Gurung community and the ways of making mathematics classrooms more culturally responsive by using locally available teaching and learning materials.

Recommendations

This research explored the cultural practices in the Gurung community with the different dimensions of geometrical shapes and ethno modeling. I have some suggestions for novice researchers and recommendation as follows:

In this whole research, I explored the practices of the Gurung community as much as I could during my research study such as I have just explored the concept of different artefacts of the Gurung community like a number, measurements, games, geometrical shapes, and ethnomodeling.

There are few Gurung people in the mathematics field in higher study. I suggest that new researchers can conduct their research further the on perceptions of Gurung people on their ethnomathematical practices.

When I visited the research field, there was a lot of problem with the language for teaching and learning mathematics. I suggest that new researchers can conduct their research on finding the effect of the local (Gurung) language on the teaching and learning of mathematics.

I also suggest that new researchers can explore the practices of ethnomathematics and the current curriculum of Nepal at the Policy level. Further, I

suggest that new researchers can explore the practice of ethnomathematics in our school mathematics.

I have a humble request to those mathematics scholars who are interested in ethnomathematics. Please, study your community and their cultural practices related to mathematics. It helps us explore mathematical practices found in cultures.

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Appendix I

Interview Guideline

- Counting system of day, months, year and number in the Gurung community.

- Measurement of length, mass and quantity.

- Games in Gurung community

- Mathematical shapes

Appendix II

Observation Guideline

- Gurung khema script

- Measuring distances using traditional way

- Using Tulo in meat shop.

- Using Maana Paathi in object exchange

- Traditional games match

- Geometrical shapes using in their daily life

- Linking the mathematics and daily activities