# MATHEMATICS IN THE GURUNG COMMUNITY: AN ETHNO-MATHEMATICAL STUDY

Mira Gurung

A DISSERTATION

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AN ABSTRACT OF THE DISSERTATION OF

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**Abstract Approved**:…….

Binod Prasad Pant, Dissertation Supervisor

This dissertation entitled "Mathematics in Gurung Community" is an ethnographic study. The purpose of this research was to explore mathematical practices of Gurung community and incorporating these practices in the primary level of our formal education. Through this study I tried to find out the answer of two research questions and they are: "What are the mathematical practices of Gurung Community?" and "How can we integrate or incorporate these practices in the primary level of formal educational system?" To get the answer of my questions, I chose Ghandruk as my research field. I used observation and interview as my data collection tools and tried to capture the real practices of Gurung people to sort out mathematical practices. I found various mathematical practices in Gurung community, but due to time and other constraints, I focused on the mathematical practices related to number system, arithmetic operation, games, and way of making rectangle and so on. I tried to see how these practices are incorporated in the primary level of formal curriculum. I also tried to present possible ways to incorporate them in teaching. Based on the literature which I reviewed during the whole period of research, I tried to reflect my own perspective towards ethno-mathematics and ethno-mathematical curriculum. The glimpse of my perspective is just a step toward searching contextual mathematics.

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Mira Gurung, Degree Candidate

# DEDICATION

This dissertation is dedicated to my parents.

## DECLARATION

I hereby declare that this thesis has not been submitted for candidature for any other degree.

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Mira Gurung January 15, 2014

**APPROVED**

Master of Degree in Mathematics Education Dissertation of Mira Gurung presented on January 15, 2014.

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I understand that my dissertation will become part of the permanent collection of Kathmandu University Library. My signature below authorizes release of my dissertation to any reader upon request for scholarly purpose.

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Mira Gurung January 15, 2014

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## ABBREVIATIONS

| | |
|---|---|
| ARNEC | All Round National Education Committee |
| BPEP | Basic and Primary Education Program |
| CDC | Curriculum Development Centre |
| CERID | Resource Centre for Educational Innovation and Development |
| CMS | Cultural Mathematics Syllabus |
| DOE | Department of Education |
| EDSC | Educational Development Service Centre |
| KU | Kathmandu University |
| NEC | National Education Committee |
| NESP | National Education System Plan |
| MOE | Ministry of Education |
| MKO | More Knowledgeable Others |
| PNG | Papua New Guinea |
| SLC | School Leaving Certificate |
| TU | Tribhuvan University |
| VDC | Village Development Committee |
| ZPD | Zone of Proximal Development |

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# CHAPTER I

## Chapter Overview

This chapter includes short history about why I chose Mathematics in Gurung community as my research topic. This chapter also discusses the importance of my research in statement of the problems. The objectives of the research, rationale of the study and finally I will outline the delimitation for my research are also discussed.

## Context of the study

I would like to start the context of study with my own story of how I learnt mathematics. At present I have forgotten how I got the concept of addition and subtraction. But still remember the way I learned multiplication. Our teacher wrote multiplication tables on the board and we had to copy and recite them. Our teacher taught us the process of doing multiplication and division and we copied the process and tried to solve the related problems. Our teacher neither linked multiplication and division with our daily life nor did he explain to us the meaning of division and multiplication. He simply introduced to us different signs and taught us the process. Since, then whenever I hear about multiplication, my mind has an image of arrangement of numbers with multiplication sign. During my school days, if two pure numbers were given, I could easily solve those divisions. But if word problems were given, then I was always confused. I couldn't make out which number was to be divided by which number. When I shared this problem with my teacher, he simply told me to compare the numbers and divide the greater number by the smaller. That day I thought that I had conquered the world. But to my dismay, this way didn't work while dividing the decimal numbers. Again the word problems were puzzles to me. Now I feel that was just the starting of mathematics moving one step away from my daily life. After that flood of abstractness came to my mathematics learning. I always liked algebra and geometry. Until my lower

secondary level, mathematics used to be a subject of interest to me. I found the problems very interesting. I solved them correctly and remembered the processes for solving different questions.

I could solve problems correctly and fast on a paper but doing the same mentally was tough for me. Whenever I went shopping with my mother, she could calculate faster than me she could even solve problems related to simple interest faster than me. But I depended on paper and pen. One day she asked me, "What do you study in school, dear?", "What is the worth of studying mathematics when you can't solve simple problems without using a pen and paper?" These questions troubled me a lot and made me think about the application of mathematics we study in our secondary level. Question like, what is the application of algebra, geometry, trigonometry etc. in our real life appeared before me (or, I wanted to know the real application of algebra, geometry, trigonometry in our daily life). I could only see the application of arithmetic. This scenario of school level only worsened when I reached the higher level and had to encounter the real analysis, topology, calculus, etc. These situations forced me to regard mathematics as an abstract subject which had no link with our daily life. My teachers and parents always told me that mathematics is a very important subject whenever they told me that, I immediately asked them the relevance of mathematics in our daily life Every time, I got the same answer: "it's the base for further studies". Their answer didn't satisfy me. I reached the conclusion that use of mathematics was to pass the exam, make base for further studies and to teach.

At this point I would like to ask one question to my dear reader as to how you learnt mathematics and whether your story is similar like mine? Actually the scenario I have presented above is not only my story; it's a very common story of students all over the world. At present, mathematics is considered as a difficult subject. The achievement in mathematics is getting worse day by day. According to EDSC (1999) overall mean performance of the

students in primary level at national level in mathematics was found to be 27.25 with standard deviation 17.08. According to the Department of Education [DOE] (2009), national mean achievement of the grade five students in mathematics was 47.64 with the standard deviation 20.77. The mean achievement of secondary students was 42.02% CERID (1988).

Now I would like to share a short history behind Mathematics. How and why was Mathematics born? Who created it? Mathematics is the subject which developed in order to address the daily need of human beings and many more. History of mathematics is as old as human civilization. As we know that human civilization started in the different parts of the world, so did mathematics. Here at this point, I would like to raise a question: If Mathematics was a subject developed to address our daily life problems, then how come it has turned out to be so abstract to us now? What is the reason behind it? There may be several reasons but among them, the nature of mathematics is a very strong problem. For a very long time, much of the mathematics classroom practices and curriculum development activities throughout the world have been dominated by the view that mathematical knowledge is both culture and value-free knowledge (Bishop, 2002; Ernest, 1991). That means the properties of mathematics can't be changed according to the context or in other words, this nature is called universal nature of mathematics. Hence relevance of culture has been significantly absent from the mathematics content and instruction. This view of mathematics has led many students and teachers to unquestioningly believe that there is no connection between mathematics and culture, thus increasingly leading them to the view that mathematics is cultural, a discipline without cultural significance (D'Ambrosio, 2001). So people limited mathematics inside the school only or in other word they limited it inside the pile of books and exercise books. This nature forced students and teachers to become passive. They were unaware of the application of mathematics and were happy in rote learning. The teaching and learning of mathematics disregard the application part. Students couldn't find the use of

studying mathematics. The applications of mathematics limited to passing the examination and preparation for the higher level. Here I want to share an instance. A student of age 10 can find out the price of some chocolate bars if the cost of one chocolate bar is given. Similarly she/he is able to find the cost of one chocolate bar; if the cost of some chocolate bars is given. But they find it difficult if they have to solve the same problem in schools. This example shows that there is a huge gap between school mathematics and mathematics in daily life and this gap is getting bigger and bigger day by day. At present students have started to view mathematics as a very difficult subject without any application in real life. Mathematics is being alien day by day. So the achievement of students in Mathematics is going down. Many students fail in mathematics and this is due to "the mechanism of schooling that replaces these practices by other equivalent practices which have acquired the status of mathematics, which have been expropriated in their original forms and returned in a coifed version" (D'Ambrosio, 1985, p.47). If we can't fill the gap as fast as possible the situation will get worse. Before it's too late, we have to find out some alternatives. Among various alternative ways to rid of the present situation, ethno mathematics is one of them.

## Statement of the problem

Students' achievement in mathematics is very low in Nepal (CERID, 1999) and the condition is worse for indigenous students. So at present the students, parents, educators, government and populace are worried about not only persistent poor achievement of students in mathematics but also for alienating the subject from their practical life. People developed mathematics to solve daily life problems but now it's becoming a problem to us. This shows the present situation is very treacherous. If we observe the present scenario, it can be expressed as a gap between cultural mathematical practices and formal mathematical practices. Among different causes for the present scenario, the most important is the nature of mathematics. For more than two thousand years, Mathematics has been regarded as a culture

and context free subject, which is known as the universal nature of mathematics. Because of this nature of mathematics, the relevance of context is missing gradually and rote learning has become an important method for learning mathematics. Such an approach of mathematics learning not only discourages many school children from meaningfully participating in formal mathematical discussions, but more importantly undermines their natural abilities to make important mathematical connections between the school mathematics and their everyday mathematical practices, thus also failing them in their effort to fully understand and appreciate the power of mathematics (D'Ambrosio, 2001). To improve the present situation, we have to search ways to link daily life or culture to formal education. For this, we have to respect the prior knowledge of students which comes with them when they enter the school. Our country is culturally diverse so we have to find out mathematical practices of different cultures before bringing them in the classroom. So I carried out this research to find out the mathematical practices of Gurung people and have tried to link these practices with the primary level of formal education.

## Objectives of the study

The main purpose of this study is to explore the possible mathematical practices in the Gurung community of Ghandurk V.D.C. which is located in Kaski District. These mathematical practices have been analyzed from the perspective of ethno mathematics and presented ways in which to incorporate them in the mathematics curriculum of primary level.

## Research Questions

My research questions are as follows:

1. What are the mathematical practices of Gurung community?

2. Which practices can be integrated or incorporated in the primary level of formal educational system? (How can we integrate or incorporate these practices in the primary level of our educational system?)

## Rationale of the study

Although Gurung are considered as culturally rich, they are still away from the mainstream of educational development. In the present context, mathematics is considered as a very difficult subject in our country. This situation is even worse for Gurung students. Till date, very few research studies have been done to address this problem (Kathmandu University, 2008; Luitel & Taylor, 2010). I am going to carry out my research with the notion that different cultures have different mathematical knowledge systems and cognitive structures (Sternberg, 2007). If we can link our daily mathematical practices with our school curriculum then it is likely to be a milestone for improving the achievement in mathematics. This research is equally helpful for strengthening the policy that gives an impetus to the local curriculum in primary education. Moreover, this research gives an emphasis on promoting cultural and so called mainstream civilizations. This research can also offer insights into how cultural diversity can be used as an asset for country's educational growth and development.

## Delimitations

My objective was to find the mathematical practices within the Gurung community and incorporating them in the formal curriculum. So this study was focused on the Gurung Community of Nepal. Cultural practices of Gurung people all over the Nepal are not the same. According to places, we may find some differences in their cultural practices. The study was carried out with the inhabitants of Gurung Community of Ghandruk V.D.C, Kaski District. Due to time constraint and cost, the study limited me from exploring the ideas far and wide. My research tried to find the ethno mathematics practices of Gurungs but its

possibility of educational implication is limited to the primary level only. This study is qualitative in nature, so I chose ethnography as the research method. This it is a delimitation of this study. During my field work I found difficulty in identifying the specific cultural practices in mixed culture like ours, so I couldn't exclude those practices.

## Chapter Summary

In this chapter, I have presented my experience of learning of the mathematical concepts to relate it to the present scenario and this has become my research background. After then I had presented my statement of problem for this research. Based on it I had elaborated the purpose of the study and I presented research questions for my research. On topics significance of the study I tried to show importance of my research by taking different reference. At last I created boundary for my research in delimitation section.

# CHAPTER II

# LITERATURE REVIEW

## Chapter Overview

This chapter presents the review of relevant literature relating to the various aspects of my research topics. I reviewed articles related to situated cognition and constructivism to make a strong theoretical base. I reviewed some literature related to ethno mathematics and presented it by dividing it into different sub topics like definition of ethno mathematics, ethno mathematics and mathematics education. I read relevant articles and research done at the international level and national level.

## Situated Cognition

Situated cognition is a theory that poses that knowledge and skills are learned in contexts that reflect how knowledge is obtained and applied in everyday situations. This is a radical shift from many traditional approaches to pedagogy, where educators provide instruction in a classroom environment and expect student to acquire knowledge and skills in the classroom that they can apply elsewhere. This theory has its origins in research dating back to the late 19$^{th}$ century, and became especially popular in the late 20$^{th}$ century. John Dewey and Lev Vygotsky both advocated similar approaches but Jean Lave is often credited with starting the situated cognition movement. According to Lave and Wegner's (1991) situated cognition was based on the premise that learning normally happens during an activity that occurs in a context and a culture, that is, people build knowledge structures and learn skill set in a specific physical and social context. Hansman and Wilson (1998) further highlighted two important components of situated learning emphasising "setting" and "activity" as dialectically integrating people, tools, and context within a learning situation. This is further explained by Wilson (2001) that "Learning is an everyday event that is social in nature

because it occurs with other people, it is a tool dependent because the setting provides mechanisms that aid, and more important, structure the cognitive process, and finally it is the interaction with the setting itself in relation to its social and tool dependent nature that determines the learning" (in Hansman and Wilson, 2002, p.1).Wenger (1998) in Driscoll (2005, p.164) summarizes the basic premises of situated cognition theory as follows:

**1.** We are social beings. Far from being trivially true, this fact is a central aspect of learning.
**2.** Knowledge is a matter of competence with respect to valued enterprises, such as singing in tune, discovering scientific facts, fixing machines, writing poetry, being convivial, and growing up as a boy or a girl, and so forth.

**3.** Knowing is a matter of participating in the pursuit of such enterprises, that is, of active engagement in the world.
**4.** Meaning - our ability to experience the world and our engagement with it as meaningful - is ultimately what learning is to produce.

## Constructivism

The roots of constructivism began with the developmental work of Jean Piaget, who developed a theory (the theory of genetic epistemology) that analogized the development of the mind to evolutionary biological development and highlighted the adaptive function of cognition. Constructivism is an epistemological belief about what "knowing" is and how one "come to know." Constructivists believe in individual interpretations of the reality, i.e. the knower and the known are interactive and inseparable. People construct their own understanding and knowledge of the world, through experiencing things and reflecting on those experiences. When we encounter something new, we have to reconcile it with our previous ideas and experience, maybe changing what we believe, or maybe discarding the new information as irrelevant. In any case, we are active creators of our own knowledge. To

do this, we must ask questions, explore, and assess what we know. To understand it easily I have presented the general set of constructivist learning principles and they are: (a)that learning is an active process, ( b) that learning is a social activity, (c) that learning is contextual, (d) that learning consists both of constructing meaning and constructing systems of meaning, (e) that prior knowledge is needed for an individual to learn, (f) that learning involves language, (g) that learning is a longitudinal, adaptive, recursive process, (h) that the development of meaning is more important than the acquisition of a large set of concepts or skills, and (i) that motivation is essential for learning (Vygotsky 1986). The constructivist paradigm which is made up of two major strands, Cognitive Constructivist Theory (Jean Piaget) and Social Constructivist Theory (Lev Vygotsky) each with its own core emphases. Cognitive constructivism is structuralizing learning theory that explains how a learner develops knowledge of his or her world through staged, mental adaptation (Piaget, 1970). It asserts that knowledge is a result of a mechanism of self-construction that processes existing mental representations to obtain equilibrium between the existing mental representations and new environment (Huitt, 2004). Piaget (1970) believes that individuals learn by finding, organizing, and assimilating knowledge into the information they already have.

Now let's discuss about social constructivism. The Russian educational psychologist Lev Vygotsky (1896-1934) is considered as founding father of social constructivism. Social constructivism is based on social interaction that plays a fundamental role in the development of cognition. According to Vygotsky (1978)

> Every function in the child's cultural development appears twice: first, on the social level, and later, on the individual level; first, between people (interpsychological) and then inside the child (intrapsychological). This applies equally to voluntary attention, to logical memory, and to the formation of concepts. All the higher functions originate as actual relationships between individuals.

There are two main principles of Vygotsky's work. More knowledgeable other (MKO) refers to same one who has a better understanding or a higher ability level than the learner, with respect to a particular task, process, or concept. The key to MKO is that they must have more knowledge about the topic being learned than the learner does. Another principle is Zone of Proximal Development (ZPD) which is an important concept that is related to the difference between what a child can achieve independently and what a child can achieve with guidance and encouragement from a skilled partner. The full development of the ZPD depends upon social interaction, in that the range of skill can be developed with social guidance or collaboration, thus it often exceeds what can be attained alone. To ensure development in the ZPD, the assistance given must have certain features and they are inter-subjectivity, scaffolding and guided participant. Inter-subjectivity is the process where two participants who begin a task with different understanding arrive at a shared understanding (Newson& Neweson, 1975). This creates a common ground for communication as each partner adjusts to the perspective of the other. Scaffolding is adjusting the support offered during a teaching session to fit the child's current level of performance. This captures the form of teaching interaction that occurs as individuals work on tasks such as puzzles and academic assignments. The final feature, guided participation is a broader concept than scaffolding that refers to shared endeavors between expert and less expert participants.

## Policy review

In the context of Nepal few number of education policy related documents have made provision for "ensuring children's rights to learn in their own mother tongue" (MOE, 2009) The Constitution of Kingdom of Nepal (1990), after the restoration of democracy, has accepted Nepal as a multiethnic and multilingual state and accordingly, included the right to preserve ethnic culture and operate schools up to the primary level in mother tongue for the first time. Part 3, Article 18 of this constitution has written: (a) "each community residing in

Nepal shall have the right to preserve and promote its language, script and culture". (b) "Each community shall have the right to run schools for the children in its mother tongue up to the primary level". After this The Interim Constitution of Nepal (2007) has fuse and acknowledged the practical importance of multilingual education in their mother tongue as provided for in the law. Part 3, Article 17 of this constitution writes: (a) "each community shall have the right to get basic education in their mother tongue as provided for in the law" (b) "each community residing in Nepal shall have the right to preserve and promote its language, script, culture, cultural civility and heritage". In 12 April 1994, the government formulated National Language Policy Recommendation Commission that submitted its reports to the Ministry of Education (MOE). After that various plans like All Round National Education Committee (ARNEC, 1962), National Education System Plan (NESP, 1971), National Education Committee (NEC, 1992) etc. focused in the implementation of mother tongue and different languages. As a result Basic and Primary Education Program (BPEP), phase I and II (1991-2001) developed educational materials in seven languages and in the second stage they developed education material for 12 more languages. Gurung language is one of the 12 languages. At present in different places, text book of Gurung language is taught as a subject at primary level (Class one to Class five).

## Review of Research on Ethno mathematics

Ethnomathematics itself is a new field, so is it for us. I have tried to present as much information as needed of Ethnomathematics in my literature review section to make my research objective clear and to give a strong base for my research.

### Definition of Ethnomathematics

The Brazilian philosopher of mathematics, Ubiratan D'Ambrosio, first coined the term "Ethomathematics" in the 1970's in speeches emphasizing the influence of socio cultural factors on the teaching and learning of mathematics. Since the field Ethnomathematics is new

so I couldn't find a definite definition for it. Definition varies from philosopher to philosopher and the same philosopher also makes his/her place strong by adding new dimensions to it. D'Amrosio firstly defined Ethnomathematics as "the mathematical practices of identifiable cultural groups". Ascher and Ascher (1997), two researchers of African counting cultures, define Ethnomathematics as "the study of mathematical ideas of non-literate people". In the same year Ranald Eglash described Ethnomathematics as "the study of mathematical concepts in cohesive social group, with an emphasis on small scale or indigenous cultures." Zaslvsky, in 1998, described Ethnomathematics as "the meeting of cultural anthropology with mathematics and education. According to Ronald Eglash, it is "the study of mathematical concepts in cohesive social groups, with an emphasis on small scale or indigenous cultures." Similarly Ascher describes Ethnomathematics as "the study of mathematical ideas of traditional people." Orey (2004), described ethnomathematics as the "study of culturally related learning styles, historical developments in mathematics, and technology, prominent people in various cultural contexts who have made contributions to the field of mathematics, cultural applications of non-traditional mathematics and various forms of mathematics that draw upon the interests, abilities and talents of teachers and students."

I respect all these definition of Ethnomathematics which helped Ethnomathematics to flourish as new field. My research takes the definition of Ethnomathematics given by D'Ambrosio in 1990

> The prefix ethno is today accepted as a very broad term that refers to the social cultural context and therefore includes language, jargon and codes of behavior, myths and symbols. The derivation of 'mathema' is difficult, but tends to mean to explain, to know, to understand and to do activities such as ciphering, measuring, classifying,

> inferring and modeling. The suffix ‘tics’ is derived from techne, and has the same root as technique (p.81).

In other words ethno refers to members of group within a cultural environment identified by their cultural traditions, codes, symbols, myths, and specific ways used to reason and to infer (Rosa & Orey, 2007). ‘Mathema’ means to explain and understand the world in order to transcend, manage and cope with reality so that the members of cultural groups can survive and thrive and ‘tics’ refer to techniques such as counting, ordering, sorting, measuring, weighing, ciphering, classifying, inferring and modeling. Rosa and Orey (2003) stated that the mathema develops the ‘tics’ within the context of ethnos because it consists of daily problems people face, larger problems of humanity and endeavors of humans to create a meaningful world. According to D’Ambrosio (2001) the search for solutions for specific problems that help the development of mathematics are always imbedded in a cultural context: in order to understand how mathematics (tics) is created, it is necessary to understand the problems (mathema) that precipitate it. D’Amborsio (1993) argued that it is necessary to understand those problems (mathema) by considering the cultural context (ethnos) that drives them.

## Ethnomathematics and Mathematics education

Ethnomathematics itself is a new field of study, so Ethnomathematician are still working on different dimensions of Ethnomathematics. Among them, the role of Ethnomathematics in mathematics education is an emerging issue. We can get different views regarding this by different mathematics educators. So I am going to present some views. Ethnomathematics is considered as ways that various cultural groups mathematize because it examines how both mathematical ideas and mathematical practices are developed and used in daily activities. It can be also described as the arts or techniques developed by different students to explain, to understand and to cope with their own environment (D’Ambrosio, 1992). Gerdes' early work

(1988) links ethnomathematics to 'folk mathematics' and 'indigenous mathematics', which is distinct from 'world mathematics'. Grades (1988) reference the term Ethnomatheamtics to D'Ambrosio's definitions but he never defines ethnomathematics as separate from mathematics to the extent that D'Ambrosio does. For example he retains the universal characteristics of mathematics in his explanation of how symmetry in design has originated not by copying nature but as an inevitable consequence of the techniques being used. The resultant forms are universally valued because of their practicality. This happens in all cultures. However, he then defines mathematics as the union of all Ethno-mathematics and describes the educational task as "to look for effective brides between Ethnomathematics and world mathematics" (1988, p4). According to Barton (1996), Ethnomathematics embraces the mathematical ideas, thoughts and practices as developed by all cultures. According to his perspective, a body of anthropological research has come to focus on both the intuitive mathematical thinking and the cognitive process that are largely developed in minority cultural groups. Ethnomathematics may also be regarded as a program that seeks to study how students have come to understand, comprehend, articulate, process and ultimately use mathematical ideas, concepts and practices that may solve problems related to their daily activity. Barton has summarized different views of Ethnomathematics and mathematics education of different Ethnomathematician in his article which I am going to present. According to D'Ambrosio, Ethnomathmatics is a theoretical construct for the radical overhaul of education. According to Gerdes, Ethnomathematics is a tool for the political revitalization of mathematics and mathematics education in developing countries. Ascher believes Ethnomathematics is a theoretical construct for the radical overhaul of education. Ethnomathematics is a theoretical construct for improving the teaching and learning of mathematics for Bishop. Zaslavskys' opinion is that Ethnomathematics may provide material for improving motivation and reorganization in mathematics education. Finally for Pompeu,

ethnomathematics is an ideological approach to curriculum development (Barton, 1996). After presenting some views of intellectual people, I also want to present my view. For me Ethnomathematics is the practical aspect of mathematics that is used by different groups of people to solve the problems of their daily life by using their intuition to cope with the environment. My view is also similar to that of Gredes, for whom Ethnomathematics is not different than mathematics. Ethnomathematics is multiple solutions of mathematical problems. Mathematics may represent practical and theoretical aspects but Ethnomathematics only represents the practical aspect. In my opinion, at present we have a problem in the way we view mathematics, not in the mathematics. The link between daily life mathematics and formal mathematics is missing day by day. That means the practical aspect of mathematics is missing from formal mathematics. If we can bring Ethnomathematics into our schools or in our formal education, it will help to build a bridge between mathematics and students' interest and output. So incorporating Ethnomathematics in our daily life means enriching the present mathematics for me.

**Views Related to Ethnomathematics Curriculum**

In our context 'the curriculum' means the sets of aims and specific objectives to be achieved by learners, the knowledge, understanding, skills and attitudes learners must develop, possible strategies and activities for successful teaching and learning and evaluation processes for assessing students' performance. Here in this part of my research I am going to present the different Ethnomathematical curriculum and the perspectives of different Ethnomathematicians.

**Curriculum suggested by D'Ambrosio**

According to D'Ambrosio, Ethnomathematics is a theoretical construct for the radical overhaul of education where Ethnomathematics should be part of a mathematics curriculum in order to take account of students' social context. According to him Ethnomathematics

communicates through informal education and learned mathematics through schools. D'Ambrosio's curriculum strategy (1985, p.474) is "to take different cultural from compatible." One of the consequences – this strategy would be to broaden the idea of what constitutes mathematics. Another consequence – mathematics would become more creative rather than performance oriented. It offers a means by which a learner can cope with the rapid changes in quantity and quality of knowledge, a change for which the old transference model would be inadequate.

**Curriculum suggested by Gerdes**

Gerdes (2001) points out that "the mathematical thinking and methods are quite different in different cultures. Teachers should look over and analyze the proper activities from different cultural backgrounds, then find the activities that are appropriate to be integrated into the class and create a really rich and inspiring environment to help students develop their potentials". Gerdes take Ethnomathematics as a tool for revitalization of formal mathematics. Ethnomathematics as Revitalization will enable students to 'own' mathematics, to see that it is a part of themselves and their culture. This will enhance their ability to learn all kinds of mathematics. He implies that the use of Ethnomathematics as an educational tool will become more elaborate as more work is done in the area. He does not argue that Ethnomathematics should take a dominant role in the classroom and yet that is the consequence of a correct interpretation of Gerde's view which says that mathematics can only be conceived through one's own Ethnomathematics. He sees it as an operation by forcing a reconsideration of the curriculum not as a component of it (1994). Ethnomathematical research will oblige everyone to reconsider the history of mathematics, to reconsider the cognitive models of learning mathematics, to reconsider goals, contents, and means of mathematics, to reconsider what mathematics is all about. This is expression of his personal commitment to revolutionary

education in Mozambique and the successes of his Ethnomathematical programme in achieving these goals.

**Curriculum suggested by Bishop**

According to Bishop, Mathematics education is enculturation, i.e. it involves value – learning, and therefore it may be improved by acknowledging this fact, by being open to the relationship of Mathematics as a particular cultural development of mathematics. There is plenty of evidence that this conflict is responsible for alienation and poor achievement in mathematics learning with discriminatory results for particular groups in society (1992, p4). His concern is to "find a rich way to conceptualize mathematics as a cultural phenomenon" (1988, p181) – rich enough to provide clues to resolve the consequences of such conflicts. So far he is interested in a concept labeled 'Ethnomathematics'.

**Curriculum suggested by Begg**

Begg's perspective of curriculum acknowledges the cognitive aspects of an individual's mathematical development. This type of curriculum is based on the idea that the development of mathematical thinking is a holistic process that occurs through concrete experience (Begg, 2001). One reason for this type of Ethnomathematical curriculum is that knowledge should be connected so that students are given opportunities to recognize the links between mathematics and other forms of knowledge (Begg, 2001). In this type of curriculum, mathematics could be integrated with other disciplines. Mathematical ideas from the students' own cultures would be incorporated so that learning experiences would begin with concepts that are familiar to the child in order to connect existing knowledge with their own cultural mathematics and hence with world mathematics (Adam, 2004).

**Reasons for incorporating Ethnomathematics in Formal Mathematics**

According to Adam (2004) incorporating the Ethnomathematics in the curriculum brings a broader understanding about mathematics into the classroom. Most classroom mathematics' curricula focus on mastery of skills, accumulation of facts, rules and algorithms that are necessary for examinations. The curriculum is experienced as a mathematical content (Begg, 2001), so most students leave school thinking that mathematics is something to be done only at school and that it has no relevance to their real lives. An Ethnomathematical curriculum introduces an understanding about mathematics as a part of mathematics education. When the students understand the nature of mathematics, they will better comprehend the relevance of mathematics in the various aspects of their everyday life. Ethnomathematical incorporated in curriculum focuses mathematics as process, rather than a collection of facts. The model is based on the idea that mathematics is a human creation that emerges as people attempt to understand their world. Therefore mathematics is seen as a process and as a human activity rather than just as content (e.g. Ministry of Education, 1992). This implies that an Ethnomathematical curriculum is not just about the application of relevant contexts in learning and teaching mathematics, but is also about generating formal mathematics from cultural ideas. Thus formal mathematics is better understood, appreciated and made more meaningful to its learner. In a summarized form, we need to incorporate Ethnomathematical practices into school curriculum to make students aware of the potential mathematical practices in their culture. This helps them understand the nature and origins of mathematics better, as well as value and appreciate the existing knowledge to the students will understand and experience these cultural activities from a mathematical point of view, thereby facilitating them to make the link between school mathematics and the real world or life in their own society. They can connect the knowledge of their mathematics to parallel experiences outside the school or culture using mathematical thinking, thereby facilitating

them to appreciate that each culture has its own way of mathematizing. Different strategies can be and were invented as needed, to learn about and learn to use conventional mathematics systems, notations and techniques. By discussing the ways in which this mathematics was also developed in response to human needs and to understand conventional mathematics better so that it feedback into and contributes to a broader understanding of culturally based mathematical principle.

## Ethnomathematical research in Non- Nepalese context

In this section, a number of studies, research results and theoretical assessments of ethnomathematics will be summarized. In the Nepalese context, we have a very few research done on the topic of Ethnomathematics, so I had to take help from a non-Nepalese context to find a base for my research.

Matang (2008) has opined that enhancing children's formal learning of early number knowledge through indigenous languages and ethnomathematics: the case of Papua New Guinea mathematics curriculum reform experience. In his study, the results obtained so far indicate that children learning to read and write and count in their own language performed better than those learning early number knowledge in Pidgin or English only. Though the study is limited to investigating the influence of children's own mother tongue on formal number development from only three provinces, in the context of implementing the new elementary Cultural Mathematics Syllabus (CMS), the results are traditional counting systems in teaching formal school mathematics.

Yosuf, Saidu & Halliru (2007) have written research paper on topics "Ethnomathematics A case of Wasakwakwalwa (Hausa Culture puzzles) in Northern Nigeria". The main concern of this paper is on the aspect of wasakwakwala [ is puzzle played by Hausa people] that involves calculations and to highlight therein the existence of algebra, set theory, trigonometric,

coordinate geometry, arithmetic progression and geometry progression. The paper also shows how to translate verbal Hausa statement to mathematical expression and solve them.

Policar (2009) has done a project on Topic “Geometry through Mandalas: A supplemental Geometry Curriculum. The project has integrated act culture into the geometry curriculum, which will in turn create the personal connection for the students in order to motivate them to develop deeper into subjects. It’s done with the objective that students will be using critical thinking throughout the production process as well when they use their Mandala to explore new geometry concepts throughout the year.

Orey and Nguyen (2003) had researched on the topic “The Ethnomathematics of Vietnamese Algorithms”. The goal of this paper is to outline the mathematics education of children from Vietnam. In this paper they have presented mathematical algorithms other than formal way which are used by Vietnamese. According to the writers giving emphasis in these types of algorithms are constructions of a strong repertoire of mental mathematics.

A research study carried out by Barton (1996) entitled "Ethnomathematics: Exploring Cultural Diversity in Mathematics" has provided a rich explanation of meaning of Ethnomathematics. He has proposed Ethnomathematics as the study of mathematical practices within the context. He identifies four types of Ethnomathematical activities: descriptive, archaeological, mathematising and analytical activity. The definition also gives rise to a categorization of Ethnomathematical work along three dimensions: the closeness to conventional mathematics, the historical time and the type of host culture. The mechanisms of interaction between mathematical practices are identified and the imperialistic growth of mathematics is explained.

## Ethnomathematical Research in Nepalese context

Ethnomathematics is new in our context so very few ethomathematical researches are available. I am going to review ethnomathematical work that I could gather during my research period.

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

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

Kathmandu University (2007) has conducted a project on, "Developing Culturally Contextualized Mathematics Resource Materials: Capturing Local Practices of Tamang and Gopali Communities". The general objectives of the project were

i. To build a knowledge base of the ethno-mathematical practices of the economically disadvantaged ethnic communities of Nepal.

ii. To develop culturally contextualized curriculum resource materials to supplement the existing lower secondary mathematics curriculum.

iii. To make local stakeholders aware of the cultural contextualization of mathematics education

iv. To enable lower secondary school teachers to develop a culture-sensitive pedagogy based on principles of cultural inclusiveness, gender equality and student centered teaching and assessment.

v. To improve student achievement and participation in mathematics at the lower secondary level.

Paudel (2008) focused on his Masters' dissertation on the title: “Tharu Culture: An Ethnomathematical perspective”. The main purpose of this study is to explore the possible Ethnomathematical practices perceived by Tharus in different cultural practices and find out the aspects of potentiality of Ethnomathematical aspects of the community to incorporate in the school level (primary) mathematics curriculum. To fulfill the purpose of the study, he has divided his research question into two parts and they are: principle research question and subsidiary research questions. “How is mathematics perceived in Tharu culture and what are the possible implications of these Ethnomathematical practices in school curriculum?” is his principal research question and “How do Tharu people practice their own mathematics (numeric, measurement, geometric concept)?, “To what extent games in Tharu community are related with mathematics?”, To what extent artifacts in Tharu culture are related with mathematics?” and “What are the potential of ethno-mathematics aspects of the community for incorporation in the school mathematics curriculum?” are his subsidiary research questions.

Kandel (2005) has done a research entitled "The Basic Mathematical Concepts and Process of Chepang Community". The main purpose of the study was to find out basic mathematical concepts and process of Chepang community. His findings were that Chepang numeration system is based on base 20, Chepangs have their own mathematical computational process, own traditional system of measurement and own ways of perceiving mathematical concepts.

After reviewing all these Ethnomathematical research and articles, we can conclude that we can get a lot of literature that have explored mathematical concepts from different cultures but very few articles that talk about incorporating it in formal curriculum. During this period, I didn't find any article that have tried to explore mathematical practices of Gurung people. So I think this is the first research done on this topic.

## My perspective toward Ethnomathematics

Definition: Ethnomathematics is the collection of mathematical concepts that we are using to solve our daily life problems. So, Ethnomathematics contain cultural, mathematics and professional mathematics. These types of practices may be different and similar according to the context.

Incorporating Ethnomathematics in formal mathematics is an emerging issue among Ethnomathematics lovers. While thinking about incorporating Ethnomathematics in school curriculum we need to address several questions. For example: What are the reasons for incorporating Ethnomathematics? What is the area covered by the word incorporate? What types of practices can we incorporate? What may be the role of teachers? etc. Here I am going to address some questions that may arise while incorporating Ethnomathematics in formal mathematics.

## Chapter Summary

In this chapter, I discussed the review of relevant literature relating to the study. Initially, I discussed the literature related to situated cognition and constructivism as my theoretical base. The review of literature was based on Ethnomathematics where I reviewed literature to present the definition for Ethnomathematics. I presented the views given by different ethnomathematicians regarding ethnomathematical curriculum. After that I tried to link ethnomathematics and education. I also reviewed different research literature done in Nepalese as well as non-Nepalese context. At last I discussed literature related to situated cognition and constructivism as my own theory.

# CHAPTER III

# RESEARCH METHODOLOGY

## Chapter Overview

This chapter presents the procedure carried out to achieve the objectives of the study. In this chapter, I discuss the various aspects of the study linked to research methodology. I begin with my research paradigm, philosophical considerations, research design, selection of research site and participants, data collection technique, quality standard and ethical considerations of my research.

## Paradigm

My research is about exploring the mathematical practices in the Gurung culture. For this research I have two questions: One is what the mathematical practices of Gurung people are and how can we incorporate them in the present formal mathematics? My first research questions required me to visit a Gurung village and spend time with the Gurungs and try to understand their meaning making by collecting their cultural practices. Denzin and Lincoln (2005) define qualitative research as multi-method in focus, involving an interpretive, naturalistic approach to its subject matter. This means that qualitative researchers study things in their natural setting, attempting to make sense of or interpret phenomena in terms of the meanings people bring to them. This types of research involves collection of a variety of empirical materials, case study, personal experience, introspection, life story interview, observational, historical, interactional and visual texts-that describe routine and problematic moments and meaning in individuals' lives.

Cresswell (2004) defines qualitative research as inquiry or a process of understanding based on distinct methodological traditions of inquiry that explore a social or human problem. The

researcher builds a complex, holistic picture, analyzes words, reports detailed views of informants and conducts the study in a natural setting.

If I link interest of my research and interest of Qualitative research then we can conclude that they are similar. So my research is a Qualitative research. My research focused on knowledge generation by a Gurung community. I focused on one particular community because I had a concept that knowledge could be generated differently. In different cultural practices, humans are qualitatively different from context to context. People understand their experience through the meaning found in the symbols of their primary groups. So I used the interpretative paradigm.

## Ontology

"Ontology, literally the science or study of being is concerned with the nature of reality and their stances" (Richards, 2003, p.34). Ontological assumption concerns the nature of the world and human being in social contexts. We have two types of ontological assumption; one is Nominalism and another is realism. My research is based on the Nominalism. Mathematical practices varying between groups of individuals. For example to measure the area of land some community measure that in terms of biga[1], kattha[2] and others in terms of ropani[3], anna[4] etc. This means, for me realities are local and specific in the sense that they vary between groups of individuals. To fulfill our personal and social need, people develop different mathematical practices which mean reality is actively constructed and not discovered (Guba and Lincoln, 1994, p110).

[1] Biga - local land measuring unit which is equivalent to 6700 square meter (approximately)
[2] Kattha - land measuring unit which is equivalent to 335 square meter (approximately)
[3] Ropani - land measuring unit which is equivalent to 503 square meter (approximately)
[4] Anna - land measuring unit which is equivalent to 32 square meter (approximately)

## Epistemology

According to Cohen, Manion and Morison (2004), epistemology concerns the very basis of knowledge- its nature and forms, how it can be acquired and how communicated to the human being. To my understanding knowledge is always context bounded and context is always changeable. I view that knowledge is hard, objective and tangible which demands researcher in an observer's role, together with an allegiance to the methods of natural science, to seek knowledge as personal, subjective and unique, however impose or researcher's involvement with their subjects and a rejection of the ways of the natural scientist. My epistemological beliefs were formed according to the notions for a post-modern constructive standpoint, which describe the nature of knowledge as soft, tangible subjective and so forth. This is because the knowledge is constructed through the feelings and expression of the human beings, knowledge is not out there outside of human periphery. It is deeply rooted inside the mind of human beings. Knowledge is not injected by the second person into one's mind rather it is constructed from inside to outside.

## Axiology

Axiology is the science of how humans value and make value judgment. To value is to think, to assign meaning and determine the richness of properties. These concepts are usually considered highly subjective and therefore have meaning and understanding only to individual who holds that value. In our daily life, we can find such people who take other's ideas as granted and never try to construct knowledge themselves. So my axiological belief was that knowledge is not received or transferred, instead it is soulful. I never believed in that fact the others are always true. Since I wanted a pragmatic stance, I collected the informants' responses through observation and interviews, did rigorous study, analyzed them and created my own value.

## Research design

The design of the study is qualitative. Qualitative research is multi method in focus, involving an interpretive, naturalistic approach to its subject matter. Creswell (2012) divides qualitative research into five main Qualitative research types. They are Phenomenology, Grounded theory, Ethnography, Narrative research, Action research and case study. According to Harris and Johnson (2000), "ethnography literally means 'a portrait of people.' Ethnography is a written description of a particular culture- the customs, beliefs, and behavior- based on information collected through fieldwork." In this research I tried to capture mathematical practices of Gurung people. For that I had to spend time with Gurungs' and have to observe their every cultural practice closely and carefully, after then I had to distinguish mathematical practices of Gurung people. Since my research is closely related to the portrait of Gurung people, I chose ethnography as my research design.

## Study site description and rationale for the selection of the study site

Kaski district (according to census 2001, total population 3,80,527 among it Gurung population 69,083) is known as the local residence of Gurung people. There we still can find the cultural heritage of Gurungs. So my research site was Kaski district. My intention for this study was to find out the mathematical practices in the Gurung community. In this research I don't bind the word practice that implies I captured as much cultural practices as I did. I had captured all the age groups (children, teenager, young, old) and their cultural practices. For this study the concept of culture includes with age old heritage and their everyday activities on the basis of which make meanings.

## Nature and sources of data

According to the nature of my study, I got the primary data from the research field by observing and interviewing the participants. My secondary data sources were the national and

international Ethnomathematical articles, research, articles related to situated cognition and constructivism, text books up to class 5 and the curriculum of primary level. Source of data used were from professional journals, books and websites.

## Sampling procedure

I used purposive sampling for my study. Purposive sampling is the way of selecting the research place because “the researcher handpicks subject on the basis of specific characteristics, building up a sample of sufficient sizes when multiple groups are to be selected, but it is difficult to justify the representativeness of the resulting samples" (Black, 1999). In short, in purposive sampling, researchers intentionally select individuals and sites to learn or understand the central phenomenon" (creswell, 2012, p.206). After reaching my field, I observed and talked with the local people and according to their interest, availability of time, knowledge of culture, I chose the participants for my research. I selected 8 people as my participants for this research. Among them, two were women, two were children and three were men. One woman was 70 years old while the other was 45. Both women had never been to school. My two child participants were studying in class 5. Among the three man participants, the first one was educated; the second one had studied up to class 3 while the third one was from the Indian army. I also chose a teacher as my participant to get the view related to incorporating cultural practices in the formal curriculum. Lastly, I chose a staff from the curriculum development centre who works specially for mother tongue curriculum department. So in this research, to capture the overall mathematical practices I chose participants from different age groups. I chose the mathematics teacher and the member from C.D.C. to link the cultural practices with formal mathematics.

## Data collection techniques/ instruments

To address my research question, I used ethnography as my research methodology. One of the most common methods for collecting data in an ethnographic study is direct, first hand

observation of daily participation. This can include participant observation. Another common method is interviewing, which may include conversation with different levels of form and can involve small talk to long interviews. According to Creswell (2014) observation and interview are the standard process of data collection. So I used observation and interview as my data collection techniques.

**Observation**

Marshall and Rossman (1989) define observation as “the systematic description of events, behaviors and artifacts in the social setting chosen for study” (p.79). According to Cohen, Manion and Morission (2008) "the distinctive feature of observation as a research process is that it offers an investigator the opportunity to gather 'live' data from naturally occurring social situations" (p196). Observation enables the researcher to describe existing situation using the five senses, providing a “written photograph” of the situation under study (Erlandson, Harris, Skipper & Allen, 1993). So it is beneficial to immerse oneself into a community to gain a deep knowledge about the intricacies and inner workings that could not be obtained from literature or a type of method where information is learned second hand. It yields insights into peoples’ lives and customs that they would not be able to tell you if you just asked. As Demunck and Sobo (1998) describe, I took participant observation as the primary method for collecting information. I prepared observation check list and observation sheet before going to the field. My observation started with my presence in that place. I tried to act as a complete participant and took on an insider’s role in the Gurung community. It was easier for me because I am also a member of the Gurung community. I used three phase of participant observation: descriptive observation, focused observation and selective observation (Biehl, Good and Kleinman, 2007). First of all, I tried to capture the practices of Gurungs as much as I could. In the second stage, I turned my focus on the mathematical practices that are useful as per the objectives of my research. During this phase, being a

member of the Gurung community helped me lot and so did my observation check list. Lastly I became more selective and focused more on the mathematical practices that could be incorporated in the primary level curriculum. I also concentrated on the practices which I could relate with Mathematics. After every observation, I filled the observation sheet and I read my own conclusion again and again. By observing the similar practices and by taking interviews with people, I tried to summarize my findings. Observation gave me information about the context and also provided me a context for developing interview guidelines.

**Interview**

Interviewing is an effective method to learn from people what they believe, how they think and how that affects their life. Patton (as cited in Cohen, Monion and Morrison, 2008) outlines four types of interview: informal conversational interview, interview guide approach, standardized open-ended interview and closed quantitative interviews. Interviews will be applied for the understanding of mathematical practices which may not be there in the period of field study. The researcher used open ended interview and guide interview. I met the Gurung people individually. Moreover, I strengthened the bond of relationship with the interviewees with the help of the social worker. I tried to keep in mind the concept of Ben Rafoth (2001), "The first step in getting someone to tell you something you are interested in hearing is to tell them exactly why you want to interview them. When you explain a clear purpose, the person you are interviewing understands what they need to talk about to satisfy you. Without this sense of purpose, they don't know whether you want to hear facts, stories, advice, complaints, or whatever" (p.83). So before taking the interview, I made them clear about my research, purpose of research and importance of their help. I interviewed the selected respondents on the basis of the interview guidelines and on the basis of my observation. The interviews were quite natural because I took their interview wherever I found them. By looking at the context and interest of my participants, I took notes, captured

audio and video of the interview. I tried to ask similar types of question to every participant and I tried to ask the same thing repeatedly to make myself confident about summary I made

## Methods of data analysis

Creswell (2012) suggested the following steps for data analysis. The first step is to organize and prepare the data for analysis. Second, transcribing the data that mean converting audiotape recordings or field notes into text data. Gain a general sense of the information and reflection on the overall meaning. Third, conduct the analysis based on the specific theoretical approach and method involved in coding or organizing the related segments of data into categories. Fourth, generate a description of the setting or people and identify themes from the coding. Search for theme connections. Fifth, represent the data within a research report and finally interpret the larger meaning of the data.

I tried to follow Creswell for data analysis of this research. According to Morse (1998) "The data analysis begins shortly after the data collection commences and continues during data collection and beyond" (p.75). So my analysis process started with my first observation in fieldwork. To make data analysis process easy, I tried to keep record of the primary data. Depending on the situation I recorded my data as field notes, in audio and video mode. After getting the information, I tried to summarize. I didn't finish my summary at one shot. I read the information again and again, and tried to making meaning from that. Before making the final summary for every concept, I observed again and again. I asked questions to my participants again to get the real context. These are the processes I followed during my field visit. After returning from the field, I transcribed the audio and video materials. I tried to sort out the information under different headings. The work for my first research question regarding the mathematical practices of Gurung people had completed with it. But still I had to incorporate Gurungs' mathematical practices into the primary level curriculum of our school mathematics. For that I went through the curriculum of the primary level and different

mathematics text books. I had read some articles and thesis related to incorporating cultural practices to formal practices. I again read all the notes I had made and tried to link those practices with the content of primary level curriculum. In my research, linking the cultural practices to the formal content was the most challenging work. I went through a lot of trouble. I tried to link these practices with formal by observing the cultural practices and the curriculum carefully. Being a mathematics teacher in the school level helped me a lot in this process and my teacher participant also helped me a lot to come up with the result. I sorted all information into different headings and wrote the cultural practices linking them with every class of the primary level. Most of the time of my research was spent in analyzing the data.

## Quality standard

Lincoln and Guba (1985) propose four criteria for 'naturalistic' research. As their work to 'formalize rigor' has been particularly influential in the social science generally, and in the occupational therapy field specifically, it is worth focusing on their categories in depth. Interestingly, they link (or pair) their criteria with four used conventional quantitative inquiry: those of internal validity, external validity, reliability and objectivity.

### Credibility

This concept replaces the idea of *internal validity*, by which researchers seek to establish confidence in the 'truth' of their findings. Lincoln and Guba recommend several techniques inquirers may use to enhance the credibility of their research: prolonged engagement, persistent observation, triangulation, peer debriefing, negative case analysis, progressive subjectivity checks and member checking. To maintain credibility of my research, I tried to spend much time in observation and engaging with different people during their work. After getting information, I wrote notes. At the same time, I asked similar types of questions to other people and tried to find the real practices from that information.

### Transferability

Transferability replaces the concept of *external validity*. This criterion refers to the applicability of findings in one context (where the research is done) to other contexts or settings (where the interpretations might be transferred). To maintain transferability, I explained the mathematical practices found in the Gurung community briefly. I included the photos of different cultural tools and practices in my research. I tried to capture most of the scenario by using thick description of observations, interviews and meaning making.

### Dependability

This concept replaces the idea of reliability. This is the third standard for judging qualitative studies and refers to the stability or consistency of the inquiry processes used over time. To maintain it, I presented the logic used for selecting people and events to observe, interview and include in the study. I tried to maintain credibility and transferability to ensure dependability standard.

### Conformability

A fourth standard is conformability, which refers to the quality of the results produced by an inquiry in terms of how well they are supported by the informants (members) who are involved in the study and by the events that are independent of the inquirer. This is sometimes referred to as the audit trail (a record of how decisions were made throughout the study). Since I am also a part of Gurung community and to maintain conformability before concluding the information, I reviewed that information myself several times and sometimes I confirmed that information with my relatives before reaching the conclusion.

## Ethical Issues

Ethics refer to those "complex ideals showing how individuals should relate to one another in particular situations, to principles of conduct guiding those relationships, and to the kind of

reasoning one engages in when thinking about such ideals and principles" (Smith, 1990, p. 141). My study considered the following ethical issues:

**Informed consent**

Diner and Carndal 1978 (as cited in Cohen, Monion and Marrison 2004) defined informed consent as "the procedures in which individuals choose whether to participate in an investigation after being informed decisions". So I informed the concerned authorities and the informant first. They were getting all the details about the type of data to be collected, the means of collection and usages of my research. The participant would be free to withdraw their consent and to discontinue participation if they were not feeling comfortable.

**Confidentiality**

The researcher should hold all the information that one might gather about the participants in strict confidence, disguising that participants' identity in all records and reports. As a researcher, I notified my respondents about the objective of my research and about what type of information I wanted from them. I didn't reveal the real name of the people or place unless they gave specific permission to do so. They were convinced and I assured them that there would be no harm in taking part in the study.

## Chapter Summary

In this chapter, I discussed the various aspects of the study linked to research methodology. I have discussed my research methodology, the philosophical considerations like ontology, axiology and epistemology, the research method, data collection techniques and data analysis procedure. I have also discussed the quality standards and ethical issues in connection with my research design.

# CHAPTER IV

# MATHEMATICAL PRACTICES FOUND IN GURUNG COMMUNITY

## Chapter Overview

In this chapter I am going to deal with my first research question, "What are the mathematical practices of Gurung community?" Or in other words, I am going to interpret the data I took from my field visits by using qualitative analysis.

## Numbers used by Gurung people

On the second day of field work, I started with the interview with Mr. Til Bahadur Gurung. He used to be the Headmaster of school in the past. I asked him about the numbers used by Gurungs and about the writing script. He smiled a little and asked me, "Don't you know about them being a Gurung yourself?" This question made me nervous because although I am a Gurung, I grew up in a different culture. I said the numbers I can count in Gurung language. He laughed when he heard my pronunciation. It made me feel better. I felt that he was also getting involved in the interview. After that he counted the number in Gurung language; "kri for one, ngi for two, son for three, pli for four, nag for five, tu for six, nai for seven, pre for eight, ku for nine, chyu for ten." For eleven chyu se kri, for twelve chyu se ngi and like this, you can count upto nineteen that is chyu se ku, for twenty. We use ngichyu, ngi means two and chyu means ten. He then asked me if I could tell him eighty in Gurung language." He asked me this question because he found out through our conversation that I had difficulty while counting two digit numbers. He explained to me in an easy way. I replied in his way, "Eighty means eight tens, so that must be prechyu, is I right?" "Oh yes, you are right," he replied with a smile. He further asked me if I could tell hundred in Gurung. I replied 'pra'. He told me that two hundred is ngi pra, where ngi means two and pra means hundred. He further explained to me that similarly we can count up to nine hundred but not more than that.

If we need to count further than that, we need to use Khas[5] bhasa. After talking about numbers, I asked him about the Gurung script. He replied that he had tried finding about it but he wasn't successful. He said, "Gurung language is very much similar to Tamang language, so our script may also be the Sambhota[6] script. This is my interpretation only but there is no more evidence". On the fourth day of my field work, I met Mr. Kush Bahadur Gurung and his family with Mr. Til Bhahadur Gurung. Again we had a discussion related to Gurung names for numbers. At the end of the discussion Mr. Kush Bahadur said, "You know that Gurung language is different from place to place, so the the number names are also different accordingly. For example, Lamjung Gurungs use number names according to the table given below:

| Unit | Name | Ten | Name | Hundred | Name |
|---|---|---|---|---|---|
| 1 | Kri | 10 | Chyu | 100 | Pra kri |
| 2 | Ngi | 20 | Ngichyu | 200 | Pra Nagi |
| 3 | Son | 30 | Sonchyu | 300 | Pra Son |
| 4 | Pli | 40 | Plichyu | 400 | Pra Pli |
| 5 | Nga | 50 | Ngachyu | 500 | Pra Nga |
| 6 | Tu | 60 | Tuchyu | 600 | Pra Tu |
| 7 | Ngi | 70 | Nagichyu | 700 | Pra Ngi |
| 8 | Pre | 80 | Prechyu | 800 | Pra Pre |
| 9 | Ku | 90 | Kuchyu | 900 | Pra Ku |

My participant only counted up to 900 in Gurung language and used the Nepali name for numbers beyond that. But while reading the book named *Tamu Kyuide Chhya-Lubobai*

[5] Khas Bhasa - Local name for Nepali Language
[6] Sambhota Script - A script used by Tamang people

*Chhyoe* written by Mekh sing Kle Tamu, I came across the following names for numbers greater than 100.

| Number | Name |
|---|---|
| 1000 | Hang |
| 100000 | Lang |
| 10000000 | Kang |
| 1000000000 | Ahang |
| 100000000000 | Khang |
| 10000000000000 | Nang |

**Different Number System Used by Gurung People**

On the fifth day of my field visit, I again met Mr. Kush Bahadur Gurung because the day before, he had work and I couldn't finish my interview. I asked him, "How do you add 20 rupees and 12 rupees?" He replied, "Ek bias ni balo chyu se ngi lasi sonchyu se ngi tai". That means, 1 twenty added to twelve equals to thirty two. His way of calculation shows that he used base 20 number system to calculate the numerical problem. While he was answering, I remembered my grandmother who is also a Gurung, used base 20 number system to calculate numerical problems.

On the seventh day of my field visit, Purna took me to meet Mr. Man Kaji Gurung and we talked about the calculation ways he used. He told me that old Gurung scholars used base 20 number system to solve the numerical problems and so does he. At the time of discussion he shared an interesting incident related to base 20 number system. Once at the British camp, he met an old lady who told him that she was Char muri[7] and sat pathi[8] years old. He asked us

[7] Muri - Local grain measuring unit which is equivalent to 20 pathi

"Can you guess the age of that lady?" Purna sir and I became puzzled. He laughed loudly and explained that20 pathi equals to 1 muri. This meant that, char muri means Char bisa which equals to 80 and adding seven to 80, her age was 87. He asked, "Isn't it interesting?" I exclaimed, "Oh it's really interesting!"

Mr. Til Bahadur took me to meet Mrs. Dil Maya Gurung. When we reached her place, there were two more women and an old man with her. Til dai introduced me and let me explain my purpose to them. She hesitated to talk. So I shared the way my grandmother used the number system which was base 20 and also the interesting incident shared by Mr. Kush Bahadur. Then she felt comfortable and said, "Just now I did a calculation using the seeds of corn which are still here with me in my hand." She shared that she had never been to school, so she couldn't solve problems without using something (concrete things to represent number). She mostly used seeds of corn to solve her daily life mathematical problems. When I asked her to count numbers, she took the seeds of corn and placed them on the floor and started counting kri, ngi, up to ngi chyu. She collected them all and placed the seeds of corn in other place by counting kri, ngi. I just interrupted her and asked how much was it all together. Showing the seeds, she replied, "This is one bisa and this is ngi, so this becomes ngichu ngi." Her practice made me think about the primitive stage of counting numbers. This example shows that, especially old scholars used base 20 number system to solve their daily life numerical problems and some Gurung people still use base 20 number system by using grain measuring units. So they may have developed the idea of base 20 number system by using grain measuring units.

Mrs. Padam Gurung explained to me about the way of Gurung people count age. Gurungs have twelve different animal symbols to represent each year and they are:

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[8] Pathi - Local grain measuring units which is equivalent to 8 mana

1. Chyu/Nimyu lho represents rat

2. Lan/ Me lho represents cow

3. Chyen/to lho represents tiger

4. Hyoon/nwara lho represents cat

5. Mupri/ Krwe lho represents vulture

6. Sapri/puri lho represents snake

7. To/ ghodo lho represents horse

8. lu/kyu lho represents sheep

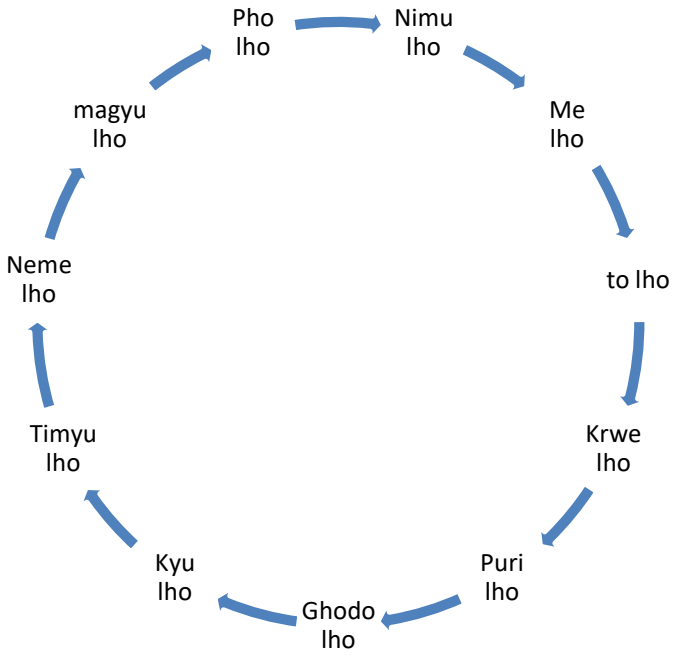
9. Pra/ timyu lho represents monkey

10. Chya/ nemi lho represents bird

11. Khi/ nagyu lho represents dog

12. Pho/ Pha lho represents deer

Every year is represented by one of these animals. For example, if this year is representing by chyu lo, then another year will be represented by me lo and so on in a cyclic order.




The children born in the rat year (chyu lho) are considered as chyu lho. If a child is born in chyu lho, then he/she will become one year old in the me lho year, two year old in the to lho year and so on. He/she will become 12 years old when again chyu lho comes. Another time when chyu lho comes, he becomes 24 years old. For counting age between 12 years to 24 years she/he adds years as counted up to 12. For example, if this year is kyu year, then he/she has passed one lho. So 12 and kyu lho is 7 years older than chyu lho, so he/she becomes 12+7 = 19 years old. This practice shows that Gurung peoples use four types of number system. Because of the uniqueness of an individuals or groups of individuals' experiences, the reasoning occurs in diverse ways. According to Zaslavsky (1999) some African tribes use a base 20 systems similar to Gurungs' but their practices originated from counting toes and fingers. I am unable to find the origin of our number system. According to Saxe (1991) Papua New Guinea tribes employ numbers that are constructed by counting 27 different body parts.

## Numerical Operation

I got a chance to meet Ms. Dil Maya Gurung. Her way of counting and calculating numbers surprised me. Till now she uses kernels of corn to count and solve numerical problems. To measure how much grain she has harvested, firstly she measures with the measuring units like *mana and pathi*. She places one seed of corn after each measure and at last she counts it based on base 20 systems. She keeps these seeds for remembering the amount. I asked her what would happen if she lost the seeds. She replied that sometimes she would go through the process of measuring all over again but other times if one or two seeds are misplaced, it wouldn't lead her into any difficult situation.

After knowing her number system I asked her, "How do you solve addition and subtraction related to daily life? For example if you need to add 25 and 12, what will you do?" She replied, "I use seeds of corn for that. To add 25 and 12, I count 20 seeds and place it in one place, after that I count 12 seeds. Then I group them together and it becomes 1 muri and 17 pathi. She used units like *muri* and *pathi* for solving her numerical problems. This system is base 20 number system because 20 pathi equals to 1 *muri*. Her number systems goes 1 *pathi*, 2 *pathi*,….19 *pathi* and reaches to 1 *muri* . After that 1muri and 1 *pathi*, 1 *muri* and 2 *pathi*…. and so on.

Different cultures develop their tally system based on different things. For example, some communities of Papua new guinea use their body parts for counting numbers (Owens, 2001) and some communities use parts of banana plants for counting ( Josephy 2003). So we can also say that Gurungs use grain measuring units (*pathi* and *muri*) to represent their counting which is based on base 20 systems.

For subtracting 12 from 25, she counts 25 seeds by taking 20 in one place and 5 in other. After than she counts 12 seeds and separates them from 25 seeds and gets the result 13. For multiplication as well she uses the seeds of the corn. For example to multiply 23 by 5, she

counts 23 seeds and keeps them in one place. She counts 23 seeds in five different places and while giving the answer, she groups the five different groups of 23 seeds in one place. So her answer is 5 *muri* and 15 *pathi*. For dividing 25 by 5, she distributes 25 seeds to five different groups and each group consists of 5 seeds, hence her answer is 5.

Observing these ways of solving numerical problems gives us the evidence of how Gurung people use very fundamental properties to solve numerical problems.

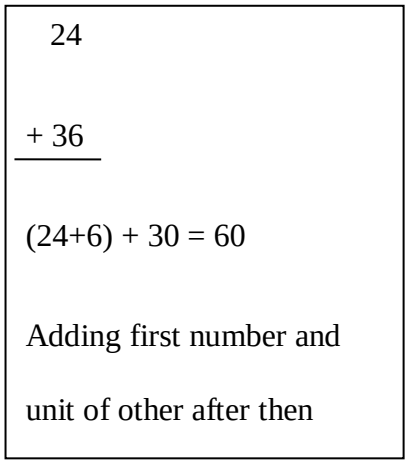
## Another Way

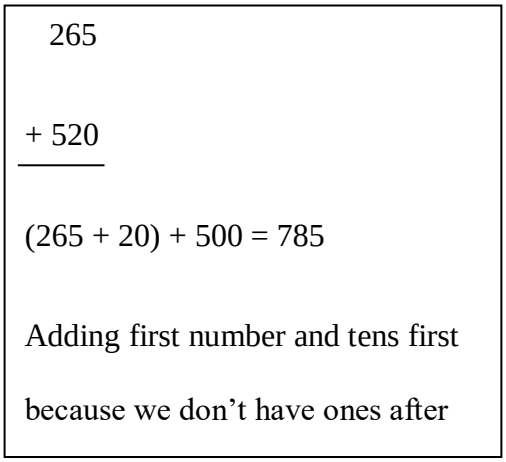
### Addition

I asked Ms. Purna Gurung how she added, subtracted, multiplied and divided numbers that she needed in her daily life. First she told that she didn't know how to solve numerical numbers because she had never been to school. But when I asked her about the word problems related to those operations, she shared her ideas. I asked her, "If one kg of sugar cost Rs. 36 and one kg of flour cost Rs. 24, then how much do you have to pay for both?" She repeated, "If sugar cost 36 rupees and flour costs 24 rupees, then 20 and 30 make 50, 6 and 4 make 10, so the cost must be 50+ 10 = 60 rupees." She asked me if she was right. She solved this problem so fast that it took me by surprise. My mother also surprises me similarly. To confirm her way of calculating, I asked her another related problem. "If one t-shirt cost 265 rupees and one *lungi* cost 520 rupees, then how much do you pay for both? She added 200 and 500 first, 65 and 20 second, 5 and 0 third and all the sums at last and gave me the answer 785 rupees. Let's see it in figure:

| | |
|---|---|
| 24 | 265 |
| + 36 | + 520 |
| (20+30) + (4+6) = 60 | (200+500) + (60+20) + (5+0) = 785 |
| Adding tens first and then ones and both sum at the last | Adding hundreds first, tens second, ones third and all the sums at last |

When I asked the same problem to Mr. Min Bahadur Gurung, his method was a little bit different from the ones mentioned above. For adding 24 and 36 first, he added 24 and 6 which gave him 30. After that the sum (30) and 30 when added together gave him 60 rupees. For adding 265 and 520, he added 265 and 20 first which was 285. After that he added 285 and 500, which amounted to 785 rupees.




According to Shirley (1988) some indigenous people in Nigeria use different ways to find out the sum of 18 and 19. They remove 1 from 18, which leaves 17 and this 1 is combined with 19 which gives 20. Now 17 + 20 gives the same result as 18+19. Schematically:

18 + 19 = …?

18-1 = 17 and 1+19 = 20

17 +20 = 37

**Subtraction**

To find out the notion of subtraction I asked Ms.Purna Gurung, "If you have 500 rupees and you buy a t-shirt which cost 250, then how would you find out how much money the shopkeeper has to return to you?" Ms. Purna Gurung began to count, "If we add 50 in 250, it amounts to 300, and adding 100 to it again amounts to 400. Now 400 and 100 makes 500, so

he has to return 250 rupees to me." She used addition to solve subtraction which is very different from the usual way.

250 has been spent

250 + (50 + 100 + 100) = 500 is the money we had

(50 + 100 + 100) = 250 will be returned

She adds amount of money to make 500 with the money she has spent. Her answer is the money to which she adds.

In other cultures, we find different practices of subtraction than this. To subtract 5 from 62 some people first divide 5 into two parts (2+3); First they subtract 2 from 62 and after than 3 from 60 and the answer is 57 (J.Draisma, 1992).

62 – 5 = ?

62 – 2 = 60

Some other people subtract 5 from 60 and then add 2 to the answer.

62 – 5 = ?

60 – 5 = 55

**Multiplication**

She used a very interesting way for solving problems related to multiplication. I asked her, "If 1 kg rice costs Rs 43, then how much money do we need to buy 7 kg of rice?" She began to calculate, "If 1 kg of rice costs 43, then 2 kg cost (40 + 40 = 80, 3+3 = 6 and 80+ 6 = 86) 86, 4 kg cost 172 (80+ 80 = 140, 6+6 = 12 and 160 + 12 = 172), 6 kg cost 258 (100, 80+ 70 = 150, 6 + 2 = 8 and 100 + 150 + 8 = 258). Now 7 kg cost Rs 301 (200, 40+50= 90, 3+8 = 11 and 200+90 + 11 = 301)." From this practice we can conclude that she can solve her multiplication problem also with the help of addition. She tried to make her calculation simple; she used collection of even times. African women also use the similar way of doing multiplication (J.Draisma, 1992).

**Division**

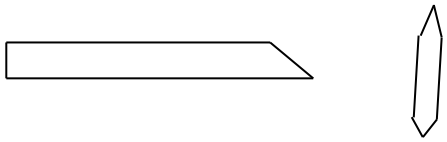
At last she shared with me her way of doing division. I asked her, "If 3 shawls cost 396 rupees, then how much would one shawl cost?" She started with the division of hundred and after that tens and ones. She said, "3 shawls cost 396 that mean we have 300. Then if we divide it in three equal parts, then we get 100 in each. After that, we have 90 left. If we divide by 20 each that makes 60 again, we have 30. So the proper division is 30 per shawl. Now we have 6 rupees that means 2 rupees each. So one shawl cost 100+30+2 = Rs. 132." When she solved this, I asked her how she could divide it properly. She replied to me, "It's all about estimating. Sometimes it easily works and sometimes takes a long time." Some indigenous people in Nigeria also use the similar type of division method. For dividing 45 by 3 they divide 45 into 21 + 21 + 3. Dividing all the terms of this sum by 3 and adding result 7 + 7 + 1 = 15 (Shirley, 1988).

## Games Played by Gurung people

### Thela fallane

This game is considered as the cultural game of Gurungs. According to Mr. Til Bahadur Gurung this game is develop to passing time while looking after animals and for showing strength of men also. In the past, on different occasions, Gurungs played this game and the winner used to be considered as a very prestigious person of that village. Now days, Thela Fallane game is played on a specific festival and during mela (fair) only. Unfortunately there were not any festivals during my field visit, so I couldn't get a chance to observe the real game. It is considered as one of the most important games of Gurung people, so I couldn't ignore it. So I asked the rules of the game to Mr. Kush Bahadur Gurung. According to him, a stone is taken and a line is drawn from where the participant is supposed to throw the stone. It is to be thrown towards a fixed direction from that line. The participant who throws the stone the farthest from that line is considered a winner.

### Dandi Bio



Mr. Til Bahadur Gurung and Kush Bahadur Gurung said that they were fond of *Dandi boi*[9] game. But that time they called *parbat* for *dandi bio*. They mostly used to play this game when they went to the forest to collect firewood or fodder for the cattle. They talked about the rules on how to play *Dandi Bio*. Mr. Kush Bahadur said, "We need at least two people. We need two wooden sticks, one one *bitta*[10] long which is called *bio* and the other one *haath*[11]

[9] Dandi bio - A cultural game, mostly played by boys
[10] Bitta - A local length measuring unit is equivalent to 0.75 feet

long which is called *dandi*. We have to make a small hole in the ground for placing the *bio* and draw a line little away from the hole. The distance between the hole and line is not fixed. It can be made according to the players' need and interest." He further explained, "Suppose. Til and I are playing this game. Til will stand on the line holding the *dandi* and I will place the *bio* in the hole and stand beside it. Til throws the dandi towards the *bio*. If the *dandi* touchs the *bio* then I will out of the game. If not, then he will hold the *dandi* and try to throw the *bio* into the air with the help of the *dandi*. He tries to hit it without letting it fall as well as try to throw it far from the hole. When the *bio* falls to the ground, the distance between the *bio* and the hole is measured with the *dandi*. For example there is 5 *dandi* distance between the *bio* and hole, and then his score is determined on the basis of his hitting the *bio*in the air. If the player hits only once, then his score will be 5, if he hits that twice then his score become 2×5 = 10 and if he hits that thrice then his score would be 3×5=15. There are two ways of being out of the game, one if I catch the *bio* in the air when he has thrown, or while throwing the *dandi* toward bio if the *dandi* touches the bio.

**Gotta**

During my field visit, I found two types of Gotta played by the participants. One day I was just walking around village side when I saw two little girls playing with small pieces of stones. I asked their names. They told me that they had seen me at the school and asked me whether I was a new teacher there. I told them I was a student like them and my name was Mira. After that they told their names, one was Suja and the other was Dina. I requested them to let me also play with them but they needed to explain to me the rules of the game first. They are ready to play with me. Suja started to explain the rules, "Look *didi*, this is a circle and these are called gotta. We need hundred small pieces of stones for playing this game." She took all the pieces of stone in her hands and put them inside the circle. After that, she

[11] Haath - A local length measuring units is equivalent to 1.5 feet (two bitta)

tried to take the stones which were inside of the circle. A stone moved. Then she told, “These are my stones and now it’s your turn to play.” She added that I couldn’t take the stones which go out of the circle. She was small and hardly could pick up only 20 stones. Now I threw the stones inside the circle and I picked up 50 stones. While picking up, the 51st stone fell and another stone moved. Now Dina got the chance to play. She was able to pick up all the rest of the stones. After that, Suja had the least number of stones, so we all collected 20 stone each and again started playing with Dina. In this way we played continued playing the game. After the third round, I won the game.

While we were playing, three other girls came to watch our game. After we finished our game, one of them told us that she knew another way of playing gotta. She said, “This one is very childish”. So I asked her to teach us play that. She collected five stones having similar shape and size and told us that we needed only five stones for this game. First she took all the stones in her hand and then threw them on the ground. After that, her friend pointed to her a particular stone. She picked that and threw it up into air. Meanwhile she picked up one among the four stones from the ground and at the same time managed to catch the stone she had thrown in the air. Similarly she picked up all the remaining stones one by one. After that, round two started. As done earlier, she threw one stone up into the air but this time she picked up two stones at a time from the ground and managed to catch the one in the air also. The other rounds continued followed by picking three stones and then four stones together. After that she placed all the stones on her right palm and threw them up. She turned her hand the other side quickly to let all the stones fall on the back of her hand. Again she threw all the stones upward but this time she caught those stones without turning the hand. In the other round, she threw the stones up and turned her hand again to let them fall on its back. Her friend pointed to one of the stones, which she held between her index finger and the middle finger. She let the remaining stones fall off. She then collected the rest of the four stones in

her fist, threw that stone she had between her index and middle finger into the air and caught it by turning her hand. She placed her middle finger up to index finger and took the middle finger and thumb in ground such that they make whole between palm and ground as new step. After that she placed all the stones one by one by other side of hand by thronging one stone up. The other step was also similar to the previous one. The participant made a cave using her hand and repeated the similar activity. After that the participant took two stones in her hand. She threw one stone into the air during the stone comes down he/she replace the stone in his/her hand with the stone in field one by one. After replacing all stone participant will take one stone in ground by throwing stone up, after then took all the stone at once by throwing one stone up. At last participant through all the stone upward by using one hand and turn her/his hand and tired to keep those thrown stones in his/her hand after than again she/he threw it upward and tried to catch those stones. In this game the score is equal to number of stones caught. For example if the player catches four stones at last, his/her score is four unless the value of one stone is fixed as two or more.

**Chungi**

Boys playing *chungi*

On the fifth day of my field visit, I went to meet my child participant Mr. Samip Gurung. It was evening time He was playing Chungi when I reached his place. Chungi is made with round shaped pieces of cycle tube. When I reached there, he was playing alone. He was just a beginner at this game, so he couldn't make more than 10 points. I chatted with him about the games played by children. He told that among these games, he liked Chungi the most. He liked this game because he can play this game anywhere. I asked about the rules of this game. He replied, "To play his game, we need at least two players. A certain number is fixed first. The player tosses the chungi with his feet in the air without letting it fall. Every toss is counted. If the chungi falls, then the other player gets the chance. The player who scores the greater number of toss is considered a winner. He shared the information to me that his friends can make up to 100 points but since he is small, it is difficult for him. He also added that after some months he would also be able to play like his friends.

**Khoppi**

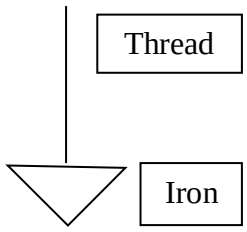
Khoppi is the most popular game among boys. On the second last day of my field visit some children came to play with me after their school. I still remember our first meeting. They hesitated to speak to me, they didn't tell me their name either. But now the scenario had changed a lot. From the second day, they introduced me to different games daily. So that day they decided to play Khoppi they had brought some coins and one flat round shaped stone. We divided the coins equally among the players. After that we collected one coin from each player. One of the boys drew two lines with a distance of nearly two meters between them on the ground. Beyond the second line, he drew a rectangle shape.

Ram stood on the first line and flung all the collected coins towards the second line. All the coins crossed the second line. Another player pointed to a particular coin. After that he threw a bigger coin but it didn't touch the coin that it was supposed to. So now another player got the chance to throw the coins. He threw them but one of his coins couldn't cross the second

line. I asked them if he was out of the game. They replied that he wasn't but if he won, then he wouldn't get t the coin that hadn't crossed the line. One small boy pointed to the 1 rupee coin which was inside the rectangle. After that, Ram tried to hit that coin with the piece of stone but he couldn't. I asked Samip about the importance of the rectangle in this game. He replied me that if none of the coins falls inside the rectangle, then the player am out. Then Samip got the chance to play. He threw all the coins beyond the line. He seemed to be a good player. Ram pointed to a coin and he hit it. He won all the money. At last I got chance to play. I threw all the coins across the line but I couldn't hit the coin. Although I lost the game, I enjoyed it.

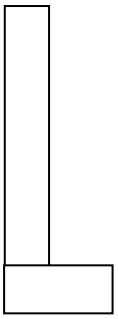
## Application of perpendicular

### Ghanti




Our books teach us the definition of perpendicular and the construction of perpendicular on a paper but don't teach us its application in our real life. If we observe closely, we can see some people using these concepts as their cultural practices. *Ghanti* is one of the tools used by *Dakarmi* (mason) to measure the appropriateness of the wall. It is made with a piece of thread and a piece of iron. The iron is tied at one end of thread as shown in the figure above. To measure the appropriateness of the wall, first one end of the thread is kept on the wall which needs to be measured while the other end with the piece of iron is allowed to fall down. If this piece of iron falls down perpendicularly, then the wall is considered as appropriate.

**Buttom**



A traditional Gurung house has a rectangular base. A rectangle is considered as a strong shape, so different indigenous people used to make houses with a rectangular base. *Buttom* is an instrument used by *Dakarmi* and *Sikarmi* (mason and carpenter) to measure the appropriateness of the corner of a rectangular base house. It has L shape with 90 degree. It is used to measure the appropriateness of the corner while estimating the base for house by a *Dakarmi*. It is also used to measure the appropriateness of the edge of door, window, table etc by a *Sikarmi*.

**Balance**


A man is measuring weight using *darni*

In the past, Gurungs used to engage in sheep rearing. They produced meat and wool from those sheep. While selling or exchanging meat and wool, they used to use these types of

balance. To measure the weight, first a *dhak* was kept and a perpendicular shape was made by moving the thread. After that, they put the things they wanted to measure without moving the thread. They would put things in or put out things until it was perpendicular in shape. Perpendicular represented the appropriate weight.

## Measuring System

### Grain measuring system




***Mutthi*** is the least unit for measuring grain. 5 ***mutthi*** is equals to half ***mana*** and 10 ***mutthi*** is equal to one ***mana***. Mostly ***mutthi*** is used as a measuring unit for cooking rice. Besides ***mana,*** there is another unit which is called ***pathi*** and this equals to 8 ***mana***. For measuring more grain, they use ***muri*** which is equal to 20 ***pathi.***

### Measuring system for valuable solid

Gurung people mostly use gold, *phiru* and silver to make their traditional ornaments. They use different measuring systems for nmeasuring these valuable solids. *Lal* is considering as a unit while measuring these types of solids. Besides Lal, they use suki which is equal to 25 *lal* and tola which is equal to 4 suki/100 lal. They use tel as the largest measuring unit which is equal to 3 tola and 20 lal.

**Liquid measuring system**


To measure liquids like milk, ghee, oil, curd, etc Gurung people use different measuring units. Mutthi is the least measuring unit for liquid. Besides mutthi, they use dewa which is equal to 2 ½ mutthi. 5 mutthi is equal to two dewa. They also use mana which is equal to 4 dewa/10 mutthi. According to Mr. Kush Bahadur Gurung, in the past, they used two types of half tin as measuring unit. They are surye mara and bimara which equal to 8 mana and 6 mana respectively. As shown in the figure, Gurung people are measuring things by using different wooden made measuring pots.

**Length measuring system**

To measure the length of cloths, size of house, fields, paths, etc, they used different length measuring system. Length measuring system used by Gurung people are not different from what other people in the same village used but I would like to include it because in my perspective these types of practices are found in every culture. No one can claim it as their personal practice, so I have included it. *Angul* is the unit of length measuring system. Besides that they use *tika* (distance between tip of the thumb and tip of index finger) for measuring length. Apart from that, they use *Bitta* (distance between tip of the thumb and tip of the middle finger) which equals to 12 *angul*. They use *hata* (distance between tip of middle

finger and ankle of hand) for measuring the length more than *bitta* which is equal to 2 *bitta.* There is other measuring unit called *gaja* which is equal to 2 *hata.* At present the relation between gaja with standard unit is 1760 gaja equal to 1 km. During my field visit I found Gurung people using kosh as a length measuring unit but couldn't get the exact relation. But according to Mr. Gurung, a distance walked by an elephant without taking rest is known as one kosh.

**Construction of Rectangle**


Mr. Gurung is constructing rectangle with the help of thread

Most of the Gurung houses have a rectangular base. They use four stick and thread for making that base. They estimate the area first for making a base. Gurung people also find out the area of a rectangle by multiplying the length and width (they use their hands to measure the length, for example 10 haat length and 8 haat width). Mr. Til Bahadur Gurung taught me the technique of making a proper rectangular base. He demonstrated to make me clear. He placed one and asked me to suppose that a house was to be built there. After that he me that placed two stick in the ground to represent the width of the house. Measure length of house starting with these sticks and place other two stick at end of each length. Stick must be placed

in ground tightly. He placed thread for one stick to other respectively as shown in figure a. Again thread will pace in both diagonals of quadrilateral as given in figure b. he told that now we have to measure length of diagonals, sometimes they are equal, if not then we have to place sticks and have to make equal and we get perfect base (as given in figure c)

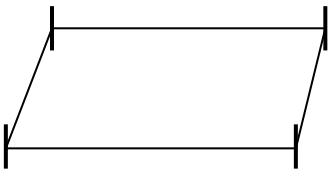


Fig: (a)

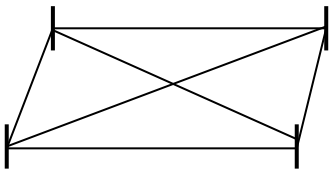


fig: (b)

fig: (c)

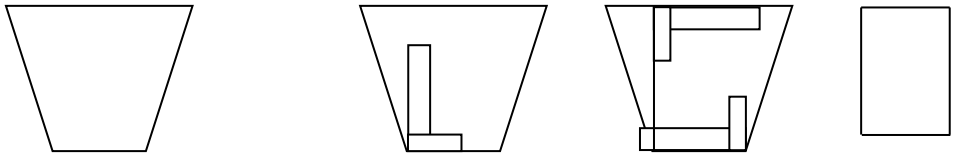
According to Mr. Bikash Gurung we have to make the base properly, if not then house would not be strong and it would be very difficult to estimate the stones for the roof. He uses this method for making the base for new designed houses in the city. Nowadays, he also uses this technique for making the base of house but in the past he used to use *battum* also. He also put four sticks same as previous and thread on sticks also. After that he measured each corner with the help of battum to measure the appropriateness. Until the entire corner matched with the battum, he kept on moving the position of the sticks. After that, he checked the appropriateness by measuring the diagonals (both must be equal for appropriate base).

Zhang and Zhang (2010) include similar two types of practices of constructing rectangular base while making houses which are used by Mozambican peasantry. They use bamboo sticks. They make two sticks equal in length and two sticks having length equal to the width. With the help of these sticks they make quadrilateral and measure the diagonals. They make equal length of diagonals by moving the sticks.

There is another way for making a rectangle. The house builders' start with two ropes of equal length that is tied together at their midpoints. They take two bamboo sticks, with

lengths equal to the width of the house. Both end points of the ropes of the same side are tied to the stick. Then the rope is stretched. New pins are fixed into the ground. These four pins determine the four vertices of the house to be built.

While making the wooden things used by Gurung people, they construct rectangle with the help of *buttom* and measures. To make a rectangular table, first they use *buttom* for making each corner 90 degree. They measure each corner to see whether they are equal or not. So we can conclude that while making rectangular wooden things, we use the properties of a rectangle.



**Problems related to Simple and Compound Interest**

While talking about interest, Gurung people also use common practices as any other cultural group of Nepal does. Gurung people use simple and compound interest in their daily life. While taking a loan the duration of time is fixed when the money would be returned. If a person can pay back the money within that duration, she/he only has to pay simple interest but if that person is not able to pay off the deft as well as interest within the fixed time, a new agreement is drawn combining the money she/he borrowed as well as the interest. According to the Gurung interest system, they consider a month as the time period and not a year like any other formal system. Let us suppose the rate of certain amount of money is 10%. The Gurungs call this mui chu byaj (Rs. 10 interest) or some people call it saye kada das in Nepali. It represents that the interest of 100 rupees in one month is 10 rupees. This system of interest shows that Gurung people have cognition about percentage.

## Chapter Summary

In this chapter I have tried to answer my first research question. I have presented all the mathematical practices I came across during my field visits. I have distributed those practices in different headings and tried to present the real context with the help of in-depth description.

# CHAPTER V

# INCORPORATING CULTURAL PRACTICES IN FORMAL MATHEMATICS CURRICULUM

## Chapter Overview

In this chapter I am going to address my second research question which focuses on the integration or incorporation of the practices in the Gurung community into the primary level of our educational system. . I have divided different practices under different headings and have tried to link them with our formal practices. After that I have discussed about to incorporating those practices into the present primary curriculum of our country.

## Incorporating Gurung practices in formal curriculum

According to Denis Lawton (1983), education can't be value-free. Different value systems or ideologies will generate different curriculum. Malcolm Skilbeck (1976) has suggested that there are at least three basic educational ideologies each of which generates a different type of curriculum theory and they are: Classical humanism, Progressivism and Reconstructionism.

Classical humanism is considered as the oldest educational ideology originating in Greece in the fourth century (Lawton 1983, p. 5). Classical humanism based curriculum focuses on the content, so this type of curriculum is also known as subject-centered curriculum. Most of the mathematics classroom practices and curriculum development activities throughout the world have been dominated by the view that mathematical knowledge is both culture- and value-free knowledge (Bishop, 2004; 1991; Ernest, 1991). These types of curriculum don't give place to necessary local contents that reflect students' own home and cultural background. The situation is same in Nepal as well according to Luitel and Taylor (2006).

Nepal unduly privileges a Western Modern World view and fails to respect and develop the cultural capital of Nepalese students. In other words, these types of curriculum don't give place to daily life mathematical practices within it, so the gap between school mathematics and daily life mathematics is getting huger day by day. Without its application, mathematics is being alienated from students and teachers and hence, the decreasing achievement in mathematics. It has been hypothesized that low attainment in mathematics, especially in the third world countries, could be due to the lack of cultural consonance in the curriculum (Bakalevu, 1998; Ezewu, 1982). Mathematics which is created for solving daily life problems of humans now is creating huge problems for many students. Before being too late we should find a way out for this problem. Consequently, the curriculum emphasis was also in conflict with the commonly accepted educational theory which promotes the view that learning is more effective and meaningful if teaching begins from what the student already know and are familiar with (D'Ambrosio, 2001; Kaleva, 1995; Matang, 1996; Matang, 2005; Matang 2008). Similarly Luitel and Taylor (2006) present a curriculum policy that helps promote culturally contextualized mathematics education, an approach that allows us to incorporate local-cultural practices into mathematics curriculum of Nepal. Cultural aspects contribute to recognizing mathematics as a part of everyday life, enhancing the ability to make meaningful connection and deep understanding of mathematics (Bishop 1988, Boaler, 199; Zaslavsky, 1996). Although few have formally investigated the impact of culturally-based lessons in a general mathematics classroom, some scholars have written in support of it. Claudia Zaslavsky (1997) argues that culturally relevant instruction benefits all students in a variety of ways. First, this instruction helps children become aware of the role of mathematics in their society. Second, students gain appreciation for mathematical contributions of individuals in other cultures and pride for the contributions of people from their own culture. Third, students discover a link between mathematics and other disciplines such as history,

language, and the fine arts. In addition, I would add that culturally based mathematics lessons lead students to discover their untapped inner source of mathematical knowledge. Finally, ethnomathematics lessons might motivate teachers to develop future lessons that are based on the cultures of the students in their classroom.

A goal of ethnomathematics in the curriculum is to help teachers discover the value of culture in the mathematics classroom and to provide a guide for them or their quest to find mathematics in their own and their students' cultures. In addition, students learn that their cultural history plays an important role in their mathematical life. Finally, culturally based lessons are accessible to the students because they place the mathematics in a context, thereby making the number dance.

While applying Ethnomathematical curriculum at present time, we must remember that the gap between our cultural mathematics and formal mathematics is very big. So it is better if we divide this process into two stages. In first stage we can start with students' own cultural knowledge for motivation and introduction. It is better if we can include as many different cultural practices as different students we have. We can continue this for 5 to 10 years. After that we will be ready for the next stage. At this stage, we will have a curriculum as an integration of the mathematical concepts and practices originating in the learners' culture with those of conventional formal academic mathematics are fifth possibilities. Similar to Adam (2004) in this approach, the Ethnomathematical curriculum takes the learner's world or culture and uses it explicitly to integrate these outside experiences into the world of conventional mathematics. At this time, these experiences are used as a part of understanding how mathematical ideas developed, how they are built into systems, how they are formulated and how they are then applied in various way within the culture.

In this chapter I have tried to incorporate cultural mathematics at the formal level based on the first stage. That means I present mathematics as motivation, introduction and practice of certain concept.

## Use of Corn Seeds

### Counting of numbers

Our formal mathematics begins with counting in schools. Normally we write numbers from 1 to 100 on the black/white board. After that we point to the each number, read it aloud and let students repeat it. This is where we start our journey of mathematics abstractly. Our emphasis only lies in symbols but not meanings. While saying this I am not oppose to this process but only want to say that we have to add meaning as well in our mathematics symbols. That would definitely help for meaningful learning of mathematics. When a student joins school, s/he will have developed some concepts of counting at home only. So if we start like the way mentioned above, it will support students' prior knowledge and they find it easy as well. This practice also helps them to develop meaning or value of numbers.

### Operation on Natural Numbers

We normally teach operation of number (addition, subtraction, multiplication and division) with the help of rules only. Although we use these concepts in our daily life, students find them difficult to solve the problems because they can't find any link between them. At this point, I remember one event that took place while I was at Ghandurk for my field work. On the third day of my field work, I saw six children playing. I requested them to tell what game they were playing and the rules of the game as well. Those children were quite clever. They agreed to do so if I bought toffees for them. I told them that I would definitely buy toffees for them if they told me how many toffees they would get with rupees 6 and how many toffees each one would get. One of the boys with a white t-shirt started doing the calculation. 3

toffees cost 2 rupees. Using his fingers, he counted, “We have three 2 rupees in 6, so we have 3+3+3 = 9 toffees”. Another girl said, “Yes, we will get 9 toffees but we are 6, so 1 toffee for each means 6 toffees. Now 3 toffees are left.” Looking at her friends, she calculated mentally. She said, “We have to break the 3 toffees into halves and again distribute each half among six of us.” Another small boy spoke, “No need to break the toffee. We can give one toffee to two people and they will divide it between themselves.” After that I gave them 6 rupees to buy the toffees and two of them went to buy them. I told them that they could have used the division they learnt in their school. One of them said, “Sister, that is so difficult but this is easy. How they can they are related?” Again the boy with the white shirt told me, "Sister, they may not relate to each other. i I can divide easily if I need to. But the division problems in the book are so difficult. I can’t solve them". It was getting dark, so the children went to their homes. Before saying goodbye to me, that boy said, "If it’s the way you say, then why doesn't our teacher relate? If he did, then our school mathematics wouldn't be difficult for me". He smiled and disappeared somewhere in that darkness. The children left the place, and so did I, but the boy with the white t- shirt and his argument remained in my mind. Actually addition, subtraction, multiplication and division are the most common concepts in our daily life but why we can’t link them with our formal education? If we incorporate the corn counting system in our curriculum, then it will be a milestone for our students like the one with the white shirt.

**Addition of Natural Numbers**

While teaching addition of natural numbers normally teacher writes two natural numbers on the board. For example, 3 and 4, the teacher writes 3+4 on the board and draw three short lines at the side and after that, draws 4 more short lines and asks students to count how many lines are there altogether? Students counts and tell that the answer is 7. In my opinion this way is a very popular way for teaching addition of natural numbers. I am in favor of this way

and I also used the same when I teach. After knowing the system of corn counting, it changed my perspective a little bit. We can use any real objects instead of lines for counting. If we use any real objects instead of lines for counting that may be a little bit practical and helps students to generalize that concepts with other real life situations also. For example if we use corn seeds for teaching addition, students can generalize that concept for adding sweets or other real objects. For this before teaching addition, a teacher can place some seeds of corn into two places and let the student find out how many corn seeds are there altogether. The teacher can give lots of similar tasks to students. The teacher can also introduce symbols of addition. The teacher can make two groups of corn seeds and let them write that number of seeds in the form of addition and then find its sum. In this way we can use our cultural practice of corn counting as well as student prior knowledge of counting.

**Subtraction of Natural Numbers**

Currently when a teacher teaches subtraction of natural numbers, first s/he solves some problems on the board and explains the rules for subtraction and lets the students solve that. This type of teaching is not able to carry meaningful learning. So if we use our cultural practice here with real life situation that may be fruitful. Before teaching the concept of subtraction, the teacher can give some seeds of corn and let them count and write the number in their copy. After that a teacher can tell them to separate a certain number of corns from that group. Let the student write that separated number of corn seeds and again ask them to count the remaining number of corn seeds and write that in the notebook. The teacher can give five to six examples like this. After that he or she can give the concept of subtraction and teach the proper way of writing. After this the teacher can let the students to write the earlier subtractions in a proper way or she/he can give new problems related to it.

**Multiplication of Natural Numbers**

Normally for teaching multiplication of natural numbers, a teacher writes multiplication tables of different numbers on the board and asks the students to copy that. The teacher then reads the table some number, some number, ja some number (2, 2 ja 4 for 22 = 4) and makes the students also read the tables until they memorize them all. Then the teacher explains the multiplication concept in the class room. This process is totally an abstract way of teaching multiplication.

We can use seeds of corn to teach multiplication. For example to teach the table of 2, a teacher can take two seeds of corn and say, “I take two seeds one time, so I have two seeds of corn.” After that, the teacher can take four seeds of corn and tell, “I take two seeds two times, so I have four seeds of corn.” Like this, the teacher can show up to ten times. The teacher can allow the students to repeat the same process for 3 and 4. After that, the teacher can explain the relation of addition and multiplication by writing 2 seeds one time equals to 1*2 = 2 and similarly continue with other numbers. The teacher can give project work related to it. For example teacher can let student make the multiplication tables of 2, 3 or above with meaning by using the pieces of corn as well as write that in the usual way also.

If we incorporate corn counting (cultural practice) while teaching multiplication that will be fruitful to students as well as teachers. And other thing is that corn is cheap or no all kinds of school can afford it.

**Division of Natural Numbers**

After teaching multiplication, the teacher starts with division. The multiplication tables of different numbers are key to solving division. While teaching division also, mostly we teach students the process of division carefully by introducing dividend, quotient, divisor and remainder but still we are still far from the meaning of division. I have seen students solving

division problems in their daily life but they find it difficult to solve them in school. But for some students, it is vice-versa. So here I am going to present the incorporation of corn counting for division of natural numbers which can be a milestone for our students and teachers both. Before giving the concept of division, the teacher can distribute some corn seeds to students which can be equally distributed among certain numbers of students. The students may be asked to distribute the seeds of corn equally among certain numbers of their friends. The teacher can give some more examples and then only she/he may give the concept of division linking this practice and other similar practices which we have in our daily life. After that, the teacher can teach the formal process of division.

I still remember my school days, when I could divide numbers but word problems of the same were the most difficult things for me. I always used to be confused as to which number was to be divided by which number. And once my teacher suggested me to compare both the numbers and the greater number was to be divided by the smaller number. This method helped me get the solution at that level. But does it carry the meaning of division and is that way useful for all problems? You can imagine with that knowledge what I must have done with problems related to other mathematical operations. In my opinion this is a serious question related to our teaching learning process. So we can start teaching division with meaning which may be one alternative way. For example let's solve this equation. 15 pencils are shared equally among 3 pupils. How many pencils each of them get? To solve this problem we can replace 15 pencils with 15 seeds of corn and let the student divide that among 3 students. The number of seeds each get is the answer. If we teach this way in the primary level, it would be helpful not only for their higher level but also for their real life situations.

**Even and Odd Numbers**

According to Mr. Kattel "We can use corn seeds to give the concept of even and odd numbers. A teacher can give some seeds of corn and ask the students to count them. After that let them find whether each seed has a pair or not. The teacher can repeat this process several times. Then the teacher can explain that a number with a pair is called even and without one is called odd number". I liked his ideas and the other way may be, a teacher can define even and odd numbers by using corn seeds first. After that we can give some seeds of corn and let them find out whether that number is odd or even. In this way we can give the conceptual knowledge related to odd and even. Counting the corn seeds can help student find out the fact that if one's place digit is odd, then that whole number is odd and if even then that number becomes even.

**Prime and Composite Numbers**

While teaching prime and composite numbers, teacher gives the definition that the numbers having more than two factors are called composite numbers and remaining numbers are called prime numbers. 1 is neither prime nor composite number. This concept may not remain in the minds of students for a long time but if we use corn seeds to teach prime and composite number that would be long lasting. This is because, in this way students learn with their active involvement. For teaching prime and composite number, we can give students a certain number of corn seeds and ask them how many equal groups can be formed with those seeds. If it can distribute different then groups other that (one one seeds) then it will composite numbers if not then prime number. In this way we can give them the concept of prime number and composite number and it will be helpful for practicing these concepts.

**Order of Natural Numbers**

When the teacher gives the idea to the student that the number which comes first is smaller and the other is greater, it becomes difficult for them to understand the order of natural

numbers in their initial period of schooling. We can teach concept of greater numbers and smaller numbers by using the corn seeds up to two digits. First we can write the two numbers on the board ask and ask the students to arrange the corn seeds accordingly. Let them decide which number is greater. We can let them discover the fact that (in two digit number) if the digit in tens place is greater, it is greater than the other number. In my opinion in this way students can learn the order of natural numbers faster and effectively.

**Algebraic Expression**

To teach algebraic expression first we give the concept of like terms and unlike terms. After that explain that we can add and subtract like terms (for example 2x and 3x = 5x) but unlike terms can't be added and subtracted (2x + 3y we can't add because x and y are unlike terms). Students are able to solve the problems when taught this way but most of the student don't understand the proper concept related to x and y. So if we use corn seeds of different grains to teach the concept of algebraic expression and its operation as well would be fruitful. For example we can use corn seeds and beans for teaching algebraic expressions. Teacher can give some number of beans and corn seeds and let the students add and subtract them. After they answer, teacher must ask the reason why their answers are so. Then the teacher can explain by relating the seeds with variable x and y. in this way the teacher can teach like and unlike terms. Teacher can take some number of corn seeds and some number of beans in one place and some numbers of both in another place and ask the students to add and subtract them. Lastly teacher can show the relation between beans and seeds with variable x and y and teach addition and subtraction of algebraic expression.

We can use seeds of corn for teaching equation problems having only variable. For example to teach: x+3 =5. Teacher can pack seeds of corn equal to the values of x in paper and ask student can you find out the number of seeds in this pack if 1 and 3 on it gives me 5. Student guess different answer at last teacher will open the packet and let student count that. Teacher

will show this type of example until student are able to find rules to know that values of x we have to subtract 3 form 5.

If we look at the curriculum of primary level, we find the following:

| Scope | Grade 1 | Grade 2 | Grade 3 |
|---|---|---|---|
| 1. Concept of numbers | 1. Numbers from 1 to 100 ( in Devnagari and Hindu Arabic Numerals)<br>2. Even numbers of two digits up to 100. | | |
| 2. Basic Operations in Mathematics<br>2(a) Addition | 1. Addition of two digit numbers without carryover (up to two addends).<br>2. Simple verbal problems on addition. | 1. Addition of two digit numbers with carryover (up to two addends). | |
| 2(b) Subtraction | 1. Subtraction of two digit numbers (without borrowing)<br>2. Simple verbal problems on subtraction. | 1. Relation of Addition and Subtraction (concept of reversible operation of each other). | |
| 2(c) Multiplication | 1. Relation between Multiplication and Addition.<br>2. Mathematical sentences involving multiplication.<br>3. Problems on Multiplication by figures. | 1. Multiplication tables of 2 to 10.<br>2. Mathematical sentences involving multiplication. | |

| | | | |
|---|---|---|---|
| | 4. Multiplication tables of 2 to 5. | | |
| 2(d) Division | 1. Problems of grouping a maximum of 20 objects into an equal group of 2 to 5. | 1. Meaning of division by grouping of objects and mathematical sentence.<br>2. Division as the form of repeated subtraction.<br>3. Division of two digit numbers of one digit number (without remainder). | |

| Scope | Grade 4 | Grade 5 |
|---|---|---|
| 1. Concept of Number | 1. Prime and composite numbers from 1 to 50<br>2. Multiples from 1 to 99 | 1. Prime and composite numbers from 1 to 100<br>2. Square number from 1 to 10 and cubic number from 1 to 5 as well as square root and cube root of these numbers |
| 2. Algebra | 1. addition and subtraction of like terms (without negative terms) | 1. Simple word problems with addition and subtraction<br>2. equality<br>3. solving linear equation by using equality |

## Incorporating Games in Formal Curriculum

Games provide insight into people's culture, values and interests. Those rich in mathematical content allow students to develop a deeper understanding of mathematics as teachers decide what mathematical specifics they will concentrate on for each game. Student interactions with the games help them "construct personally meaningful understandings for the concepts they are applying" (Barta & Schaelling, 998, p. 393). Ethmathemathematical games, activities that originate from non-Western cultures, help students see how mathematics is influenced by culture and more importantly, understand it is an invented and living field (Barta & Schaelling, 1998). As students see the influence culture has in playing games, they too can see their ability to influence mathematics and how their own culture can influence mathematics (Barta & Schaelling, 1998).

## Incorporating Thella fallne game into the curriculum

Bishop (1991) notes, "mathematics is a cultural phenomenon" (p.3). As part of the phenomenon game playing is foundational work for mathematics development (Bishop, 1991). Involving student's own realities and cultures in mathematics can result in their own mathematical empowerment (Lesser, 2008). So in this part of my thesis I try to incorporate Thella fallne game in the primary level of formal curriculum. Our current process of teaching length measuring units is first by teaching the relation between different length measuring units and based on this the teacher solves problems by sign rule. If we have to change the length in greater units then we divide with relation and if have to change to small unit, we multiply. So these types of teaching are able to give only the theoretical knowledge. While playing Thella fallne game, the children knowingly and unknowingly get the knowledge related to length measurement. So if we incorporate Thella fallne game for teaching length measuring units, it may be fruitful for students. Students can learn measuring length/distance with the help of this game.

Teacher can let students play this game after explaining its rules. Teacher can pair up students such that one student throws the stone and other student measures the distance. In this way student from primary level learns how to measure the length.

We can use any fixed measuring units, for example meter or centimeter. Let the student measure the distance and write that distance (from the group of student before the game begins) and ask them to add all distance of group members. Let them find out the winner group themselves. Ask each group to find out with how much distance they lost the game. In this way we can teach addition and subtraction of length. After measuring distance we can let students convert that distance in terms of meters and centimeters. We can add a new rule to the game, like a student with the longest distance and the correct conversion of distance becomes the winner. In this way, we can make students practice in converting length into different measuring units.

In this game we can let student measure length with the help of different measuring units. For example mm, cm, and km and let them conclude themselves why we need different types of measuring units.

| Scope | Grade 1 | Grade 2 | Grade 3 |
|---|---|---|---|
| 1. Time, Currency, Measurement and Weight<br>a. Distance | 1. Problems on comparison of lengths of objects by estimation. | 1. Relation between centimeter and meter.<br>2. Measurement of the given object in centimeter (simple cases only). | 1. Measurement length using meter and centimeter.<br>2. Conversion of meter into centimeter.<br>3. Addition and subtraction of centimeter and meter without conversion. |

| Scope | Grade 4 | Grade 5 |
|---|---|---|
| 1. Time, Currency,<br>Measurement and Weight<br>a. Distance | 1. Conversion of cm to mm, mm to cm, km to cm and cm to km<br>2. Addition and Subtraction of cm and m , m and km | ……. |

**Incorporating Dandi bio in Curriculum**

Mostly our mathematical classes remain inside the classroom practicing problems in the exercise books. So many students feel bored. After giving concepts to students related to different topics, we can let them play different games to practice the knowledge gained. It will motivate them as well as with the help of games, they can learn it effectively. Dandi bio is a game which we can use to practice addition and multiplication for both integers and decimal numbers in the primary level. During the field visit, I asked students if they could relate Dandi bio with their school mathematics. One of the participants told me, "I think we can get the concept of multiplication". I was surprised with his answer. He had got the answer. It gave me energy to work further. While counting the scores students practice addition and multiplication unknowingly. To make it more practical we can let them calculate their score by wiring in board or copy. We can use this game for giving the concept of measuring units by modifying its measuring score rule. We can let them measure the length by using the different measuring units instead of *dandi*. For example after throwing the *bio* instead of measuring the distance with hand, the teacher can instruct students to measure in inch, feet or meter. While finding the scores, students can practice addition and multiplication of integers. If the length is in decimal then students can practice multiplication of integers and decimals. Students gain concept related to rounding off while measuring length, that is, if the

length is half or more than half, then it can be considered as a full length but not otherwise. . So we can teach them the importance of different measuring units and its conversion with the help of *dandi bio* game. The teacher can tell them to convert their scores into different units. For example if their score is in meter, then they can be asked to change it into inch, feet or cm.

| Scope | Grade 1 | Grade 2 | Grade 3 |
|---|---|---|---|
| 1. Time, Currency, Measurement and Weight<br>a. Distance | 1. Problems on comparison of lengths of objects by estimation. | 1. Relation between centimeter and meter.<br>2. Measurement of the given object in centimeter (simple cases only). | 1. Measurement length using meter and centimeter.<br>2. Conversion of meter into centimeter.<br>3. Addition and subtraction of centimeter and meter without conversion. |

| Scope | Grade 4 | Grade 5 |
|---|---|---|
| 1. Time, Currency, Measurement and Weight<br>a. Distance | 1. Conversion of cm to mm, mm to cm, km to cm and cm to km<br>2. Addition and Subtraction of cm and m , m and km | 1. Multiplication of simple distance with units |

## Incorporating Gotta in the Curriculum

Students when they join school already have the concept of numbers and also can count some digits. In school we normally teach number by showing the representation of number. Instead

of this we can let students play *gotta* and let them find out or count numbers them. To play this game at school the teacher can make a circle with the students and share the rules on how to play it. The students then can be allowed to play. Teacher can make a pair of good and weak student or can make 5 or 6 students play together for easy handling. To play the game, students have to know how to count numbers; hence they learn counting numbers easily with this game.

To win the game students have to collect more stones than his/her friends. So that need unknowingly helps to develop the concept of "is greater than", "is less than" or "is equal to". If we can link this with the fundamental notions of algebra, then it will support learning by doing. To score, a student has to pick up a stone without moving another one. Sometimes students may not be able to pick up any stone and in this case they develop the concept of zero mentally themselves. If a student is able to pick up 10 stones in his/her first turn and in second he/she can pick up any if helps him/her to get concept of 10+0 = 0. So when this happens, the teacher can teach the concept of zero and the facts related to zero which will be very much fruitful to students.

We can use this game to teach addition and subtraction of number having two digits also. Let students play this game and ask them to write their number of *gottas* in their exercise book. Let them add and subtract the *gotta* according to the rule and find out their actual number of gotta. During my field visit, I found that after taking a gotta from the circle,a player keeps that by making a group of 10. If we relate that with the meaning of multiplication, multiples of 10 and base ten number system that would be fruitful to students. This game is helpful for students to be familiar with the shape of a circle. A significant contribution of ethnomathematics is a more complex understanding of the role of games in developing mathematical knowledge (Cook, Morton & Yow, 2013).

| Scope | Grade 1 | Grade 2 | Grade 3 |
|---|---|---|---|
| 1. Concept of numbers | 1. Numbers from 1 to 100 ( in Devnagari and Hindu Arabic Numerals) | | |
| 2. Basic Operations in Mathematics<br>2(a) Addition | 1. Addition of two digit numbers without carryover (up to two addends).<br>2. Simple verbal problems on addition. | 1. Addition of two digit numbers with carryover (up to two addends). | |
| 2(b) Subtraction | 1. Subtraction of two digit numbers (without borrowing) | 1. Relation of Addition and Subtraction (concept of reversible operation of each other). | |

## Incorporating Chungi in the Curriculum

### Counting Numbers

My little participants were playing Chungi when I first saw them. After some days I had a chat with them related to Chungi game. I asked them, "Can this game be helpful for learning mathematics?" One of them replies, “Yes, it’s helpful for learning how to count numbers. First, I felt difficult to count in English but since we started playing Chungi, counting in English has become fun". That little girl won my heart. It made me realize that Chungi game can be used for teaching how to count numbers in the first days of formal school. Counting numbers is very essential to play this game, hence students can learn counting numbers

easily. But playing chungi with foot would be difficult for Nursery students. So we can modify the rule of the game. Instead of foot, they can use a book or an exercise book to play. This game may really be helpful for the students who are learning to count numbers. Teacher can encourage any student to count up to 100 without dropping it down and if he/she drops the chungi, the other student would get the opportunity to play.

**Order of Natural Numbers**

Unknowingly the students learn the concept of "is equal to", "is greater than" and "is less than" while calculating their scores which are known as the fundamental notation in algebra. So teacher can form a group and let students play in turns. After every student's turn, the teacher can say write his/her score on the board and announce the winner at the end of the round. Not only that the teacher can even announce the first runner up, second runner up and the like along with his/her score. Likewise the teacher can ask several questions and let them discover the concept of "is greater than", "is less than" and "is equal to" themselves, or the teacher can explain himself /herself.

**Addition of Whole Number**

While playing games and calculating their scores, children learn the concept of addition of whole numbers. Every new turn and they have to start from where they have left off. In this way, they use the concept of addition unknowingly. Hence the teacher can explain that they are doing addition. Sometimes when a student doesn't score any point, the teacher can introduce the concept of adding zero with another number which doesn't bring any change.

| Scope | Grade 1 | Grade 2 | Grade 3 |
|---|---|---|---|
| 1. Concept of numbers | 1. Numbers from 1 to 100 ( in Devnagari and Hindu Arabic Numerals) | | |

| | | | |
|---|---|---|---|
| 2. Basic Operations in Mathematics 2(a) Addition | 1. Addition of two digit numbers without carryover (up to two addends).<br>2. Simple verbal problems on addition. | 1. Addition of two digit numbers with carryover (up to two addends). | |
| 2(b) Subtraction | 1. Subtraction of two digit numbers (without borrowing) | 1. Relation of Addition and Subtraction (concept of reversible operation of each other). | |

**Incorporating Khoppi in the Curriculum**

While talking about incorporating Khoppi in the Curriculum, my participant Mr. RK presented his ideas in this way, "We can teach problems related to money with the help of this game. For example students can be given coins of 25 paisa and50 paisa and let them find out how much money they have. Let them play the game. We can make a rule that the students have to find out the amount of money they have after each game. In this process, the winner learns the addition of paisa and the other will learn the subtraction of paisa". I extended his idea further. We can mix coins of one rupee and two rupees with coins of paisa. Let the students play as a game. They discover the relation or difference between paisa and rupees by asking their friends or other people around. Calculating their money will help them learn addition and subtraction of money using rupees and paisa. If a student finds it difficult, the teacher can always help him/her. The students may be asked to write the amount of money they have after every game. In this way the student can learn relation of paisa and rupees as well as addition and subtraction of paisa and rupees by the help of this game. We

can use this game to practice conversion of money by making a rule that after each game, they have to convert their money in terms of paisa or rupees. Teacher can ask them to write the process in the exercise book using decimal number for paisa. Counting as well as calculating their money every time using decimal will help students practice addition and subtraction of decimal number. Games help students develop the skills necessary to excel at mathematics and encourage inquiry (Powell & Temple, 2001). So Khoppi may be an innovative way of learning mathematics for many students.

## Possible implication of *chitra* in teaching mathematics

### Measuring Length

In the primary level, students learn how to measure the length of a straight line. I have a sister who she studies in class 3. She always has a problem regarding how to count units. This type of problem occurs because we teach the measurement of length by drawing lines on a paper. But if we use *choya* in place of lines, then that would be simple for students to measure the length.

### Properties of a Rectangle

Most of the students are weak in geometry compared to arithmetic and algebra. The reason behind this is that students find it abstract as well as worth less. Although we use geometry in our daily life, we don't relate it with our formal school education. We only teach geometry theoretically, based on figures and different properties. If we make students learn the properties of geometry by using several things that are available in our local context, it may prove helpful to make them understand the importance of geometry and at the same time, they may learn geometry easily. So here I am going to use chitra to teach the properties of a rectangle. To teach about a rectangle, teachers can provide chitra with a rectangle shape and tell the student that the shape is called rectangle. The teacher then can let them measure the

different sides of a rectangle and let them discover themselves that the opposite sides of a rectangle are equal. Teachers can let students measure the interior angles of different rectangle and let them find out the fact that interior angles of a rectangle measure 90 degree. They can measure the two opposite corners of a rectangle with a thread and again measure the length of other two opposite corners with the same thread. With this task, the students will find that lengths are equal. The teacher can then explain that the lines joining the two opposite corners of a rectangle are called diagonals. In one rectangle we have two diagonals which are equal.

The teacher can let the students make chitra with the pieces of paper according to their wish. The teacher can help them find out the perimeter and area of a rectangle. This work will help students practice in finding perimeter and area with its meaning. They can find out the formula themselves by manipulating the chitra. Students also learn to make chitra which helps to preserve our culture. If we weave chitra having square shapes, then we can use it to teach how to find the area of different figures by counting the squares.

**Percentage**

By using Chitra we can teach the concept of percentage. We can weave chitra having 100 eyes and can use for teaching the concept of percentage. (One part out of 100 parts represents 1%). Teacher can shade some eyes of chitra and let the students write the numbers in terms of percent which represent the shaded windows. The teacher can also give some percentage questions and let students shade the windows accordingly and let them find out the numbers as well.

**Operation on length**

Teacher can weave small chitra having two or three choya for length and breadth. These small chitra can be used for teaching addition of length having cm and mm measuring units.

We can teach addition of such mixed measuring units along with finding the perimeter. We can teach the area and perimeter of a rectangle and square. For this we can weave chitra; one which with rectangular eyes and another with square eyes. We can take different rectangles and squares and find their areas with meaning. After that, we can let the students solve problems themselves. We can let students measure the different rectangles and squares in chitra and let them find their properties themselves.

## Scenario of Mother Tongue Education

I have already mentioned that I chose a member of C.D.C. who works for the mother tongue language department. I chose him so as to understand the present scenario of Gurung language curriculum. After giving my introduction I asked him about the background of mother tongue education. He told me, "The constitution of Kingdom of Nepal (2047) has recognized the rights of all indigenous people. Based on which Shikshya Yen 2049 is modified and similarly Prathamic Shikshya Yen 2049 also changed, providing basic education in mother tongue language". He further added "Education in mother tongue language started with 5 different languages but, at present, it has extended to 22 different language and Gurung language is also one of them". After that he showed me books written in Gurung language. He told me, “These are for class one to five I keep it as a collection to show people like you." He smiled. I looked at those books. They are written in Devnagarik script and the writer is Ratna Bahadur Gurung. I took one book for class one and I got confused. I asked, “Why is there only one book for each class? Aren't all the subjects taught in Gurung language?” He explained that my understanding related to mother tongue education wasn’t not wrong but due to different hindrances, they were not able to achieve their goal. Before meeting him I had thought that mother tongue education means teaching all subjects in the mother tongue but I was surprised when he told me that at present, it is taught as a subject in some of the schools where Gurung students are in majority. After that we

talked about the difficulties of applying the mother tongue education. According to Phyak (2007) there are two types of teachers and parents regarding the language planning policy, the first type takes it as a praiseworthy work and believes that it must be extended up to the secondary level whereas the second type takes it as a hindrance to the students. My participant also shared a similar view that people at policy making level have divided views, so it is very difficult for them to move towards a new direction. I remembered the reasoning of Til dai. He wanted to convert the government school there from Nepali to English medium. They tried a lot but due to lack of manpower, they couldn't succeed. At the same time I asked him about teaching in Gurung medium which is an emerging issue. He replied to me, "We have to respect and preserve our language and culture. For that it is not enough to teach in schools, even parents must be conscious and need to teach these things at home. In schools, they have to learn the skills that will help them internationally. ". I support the notion that if students find it easy, then we must encourage mother tongue education. I believe that everything has two parts and so does mother tongue education. Til dai and me are common Nepali citizens and both have different views regarding mother tongue education and so do the people at policy making level. Mr. Chapagain is not satisfied with the way the government is applying it without doing much homework. According to him the government has not done sufficient amount of research related to mother tongue education, which may be related to its content that needs to teach, evaluation system, its need, outcome etc. According to CRED (2005) there is no training to the teachers to teach mother tongue and no separate quota for teachers to teach mother tongue. According to Mr. Chapagain schools that are using mother tongue education are mobilizing the teacher available in the schools to teach because he also agrees with the fact that there isn’t any special quota for mother tongue teachers. In his observation he has found that Gurung teachers are using Nepali language to teach in the class. Gurungs fall as minority students in the class which is also a problem. The interviews

with my participants have conveyed to me a lot of bitter truths that we ignore. But at the end, he said, "I am still hopeful and we will do something better in the days to come". He furthered shared, "We are planning to have Gurung text books written and similarly do for other languages as well. We are also planning to apply mother tongue up to the lower secondary level as a subject in the days to come". Not only this if we observe the present scenario, and then we find that the interest of students in their mother tongue is very low. Lack of own script and sufficient amount of teaching materials for teaching mother tongue are obstacles for the mother tongue education. As a researcher, I hope one day our government formulates strong policies regarding this matter. Changing only the medium of instruction to Gurung would not be enough but teaching other subjects very much close to their own culture would provide the students with an opportunity of meaningful learning.

## Chapter Summary

In this chapter I tried to answer my second research question: How can we incorporate mathematical practices of Gurung community in the formal primary level curriculum?. I presented the possible ways for incorporating the mathematical practices of Gurung community in the curriculum. I have done this with fixed learning objectives of primary level curriculum. At the end I tried to present the existing scenario of the mother tongue education.

# CHAPTER VI

# FINDINGS OF RESEARCH

## Chapter Overview

This chapter presents the findings of my research according to my research questions. It also concludes my study which I have drawn from Chapter 1 to Chapter 6 and provides some suggestions to the readers.

## Findings

Research is composed of two syllables; a prefix‘re’ and a verb ‘search’. ‘Re’ means again, anew, over again. ‘Search’ means to examine closely and carefully, to test and try to probe. Composition of these two words forms a noun, research which means to describe or a careful and systematic study in some field of knowledge undertaken to establish facts or principles (Grinnell, 1997). Now I have reached the final point of my research and at this point I want to review my journey of research on my topic “Mathematics in Gurung Community”. I belong to Gurung community, so I wanted to do a research related to Gurung people but I couldn’t find any field for research. Then my respected research guide suggested me that finding mathematical practices of Gurung people by using Ethnomathematical concept would be an appropriate field for me. This suggestion was very challenging to me because I used to perceive the word Ethnomathematics in a negative way. At that time I had a concept that Ethnomathematics was mathematics that was contradictory to our formal mathematics, with talks about going back to the culture. In my opinion present mathematics was the most developed version of mathematics which had already passed through different cultures and has come in the form of present structure. I felt there was no use of going back to what we had already passed through. At that time I thought that it was politics of some so-called elite people to gain publicity. But my research guide made me realize that this field is emerging

and many people are following it. So it forced me to review the Ethnomathematical concepts. I read different articles related to Ethnomathematics and with the increasing numbers of articles I read, Ethnomathematics began leaving a strong impression on me. Since I belong to Gurung community, I tried to look into our own cultural mathematics. I remembered my grandmother who used the base 20 system to solve her arithmetic problems and different additions and subtractions my mother did which were different than the formal system. This evidence gave me strength to choose Ethnomathematics as my research field. After choosing the research field, I set the objectives of research and ways to find the mathematical practices of Gurung people. Then I tried to link those practices with the primary level mathematics curriculum in our formal education system. I chose the primary level because it is the basic level in the formal education and Ethnomathematical research in our country is also at the basic level.

I made a roadmap before going for field visits but I found a vast difference between my map and the reality. First four days were very difficult for me to select the participants and make them understand my objectives. Once I was able to make a rapport with them, the rest of the work became easier. To identify the mathematical practices from the cultural practices was a very difficult thing for a novice researcher like me. I had to work really hard to find out the different cultural practices and link them with formal mathematics.

Now I want to present the summarized form of my research findings.. In my research, I have two research questions. First I will present the findings of the first research question and the findings of my second research question follow

1. Gurung people don’t have their own script but they have their own language. Gurung people have their own name for numbers up to ten trillion like our formal number system (Hindu Arabic Number system). Gurung people use four types of number system. They are base 10 (mostly used by young generation as well as educated old scholars), base20 (mostly

used by old scholars for their calculation) and base 12. They use base 10 and base 20 to calculate the numerical problems and base 12 to count age.

2. Some educated Gurung people use formal way of addition and subtraction but rest of the people use the alternative ways. That is, they add and subtract just opposite to the formal way. In the formal way, we add and subtract digit from right to left ( from unit to tens, hundreds, thousands places respectively)but Gurung people solve their addition and subtraction from left to right just opposite to the formal way. Some Gurung people use a method other than these two. For example to add 24 and 36, first s/he adds 24 and 6 which gives 30, then add the sum and the remaining number which gives the answer 60. They add big numbers as well in the similar way.

3. Gurung people subtract with the help of addition also. For instance, once I asked a lady, “If you have 500 rupees and you buy a thing which costs 250. How would you find out how much money the shopkeeper needs to return to you?” She added the amount of money to the money she has spent to make it 500 and gave me the answer.

4. Gurung people solve multiplication also by using addition concept. They make even pairs and try to find their product.

5. Mostly uneducated old scholars use seeds of corn to calculate their numerical problems that comes across in their daily life, where each seed of corn represents a number. For addition they add the seeds of corn, to subtract they remove certain seeds of corn, for multiplication they use addition and similarly for division they divide. They can’t multiply and divide decimal numbers with the help of corn but they can solve very simple problems.

6. Gurung people play different types of indoor and outdoor games where they use different mathematical reasoning and logics. Among the games played by Gurung people, I have listed some of them and they are: Thela fallne, Dandi bio, Gotta, Chungi, Khoppi.

7. Gurung people apply the concept of perpendicular for their different work by making different tools. Ghanti, Balance and Button are the tools which work on the principle of perpendicular.

8. Gurung people have their own way of measuring system for grain, valuable solid, liquid measuring system and length measuring system.

9. Gurung people normally live in a rectangular base house. To make the base of that type of house, they use thread and by using two properties of rectangle (diagonals of rectangle are equal and bisect with each other) they construct a rectangular base. Some people use bottom to make a rectangle where they make a close figure having four corners with 90°.

Now I present the findings of my second research question. For this I have presented my points according to the content of chapter 5.

1. We can incorporate calculation with seeds of corn to obtain different objective of different classes. For class 1, we can use it to teach numbers from 1 to 100 (in Devnagari and Hindu Arabic Numerals).Even numbers of two digits up to 100, addition of two digit numbers without carryover (up to two addends), simple verbal problems on addition, subtraction of two digit numbers (without borrowing), simple verbal problems on subtraction, relation between multiplication and addition, mathematical sentences involving multiplication, problems on multiplication by figures, multiplication tables of 2 and 2 can be taught using the same method. For class two, we can incorporate it again for teaching addition and subtraction with carryover, multiplication tables of 2 to 10, mathematical sentences involving multiplication, meaning of division by grouping of objects and mathematical sentence, division as the form of repeated subtraction, division of two digit numbers of one digit number. For class four and five we can use the same to teach prime and composite number, multiples from 1 to 99, square number from 1 to 10 and cubic number from 1 to 5 as well as

square root and cube root of these numbers, simple word problems with addition and subtraction, equality and solving linear equation by using equality.

2. We can use Thella fallene game to teach different topics. For example to teach problems on comparison of lengths of objects by estimation in class 1, relation between centimeter and meter, measurement of the given object in centimeter in class 2, to teach measurement length using meter and centimeter, conversion of meter into centimeter, addition and subtraction of centimeter and meter without conversion for class 3 and to teach conversion of cm to mm, mm to cm, km to cm and cm to km, addition and subtraction of cm and m, m and km for class 4.

3. By using Dandi Bio game in school, teachers can teach addition and multiplication of integers as well as of decimal numbers and concept related to length and conversion of numbers. For example with the help of Dandi bio game,

a) Grade 2 students can solve problems related to related to centimeter and meter

b) Grade 4 students can solve problems related to conversion of length measurement units

c) Grade 5 students can solve problems related to multiplication of simple distance with units.

4. The most popular game among girls Gotta also can be used as an educational game. With the help of this game we can teach different mathematical concepts to students. Instead of teaching directly natural number we can use this game to teach them natural numbers up to 100. We can give the concept of addition and subtraction till two digit number with or without carryover.

5. In junior class we can teach counting numbers, addition and subtraction with or without carryover with the help of Chungi.

6. We can incorporate Khoppi in the primary level to teach addition and subtraction of money, conversion of paisa to rupees and rupees to paisa, addition and subtraction of decimal numbers.

7. We can use Chitra as teaching material for teaching maths. We can make different sized Chitra according to our topics and use the same to teach measuring length, properties of rectangles and right angled triangle and to teach percentage also.

## Conclusion

The present context of teaching learning process is not satisfactory. Students are viewed as empty vessels and the teachers trying to filling them. I mean, our present teaching learning process of mathematics don't link formal mathematics to daily life mathematics. As a result, interest of students and teachers is decreasing day by day and not only that, the achievement in mathematics in every level is decreasing. Due to the dominating nature of mathematics and teaching learning process, the subject Mathematics which was developed in order to address the problems of humans is now creating huge problems to us. If we don't find solutions out, then mathematics will remain as an alien subject.

We may have several alternatives to overcome this situation. Among them connecting formal mathematics with our daily life is the best one. I know my attempt is like a drop in the ocean but through this research, I have tried to search a link between formal mathematics and daily life mathematics. In my opinion the results are encouraging. I was able to find the different mathematical concepts in different cultural practices. We should conduct research and find mathematics in daily life and incorporate them in at different level of school mathematics. But it should not be limited to paperwork only. It should also be in real practice and this I am sure, is going to help a lot. According to Lave (1991) learning is situated; that is, as it normally occurs, learning is embedded within activity, context and culture. It is also usually unintentional rather than deliberate. If we can link our daily life situation with formal content, then that learning remains for a long period of time. Not only in situated cognition, the context is equally important in Constructivism. According to Constructivism students are not blank slates upon which knowledge is etched. They come to learning situations with already

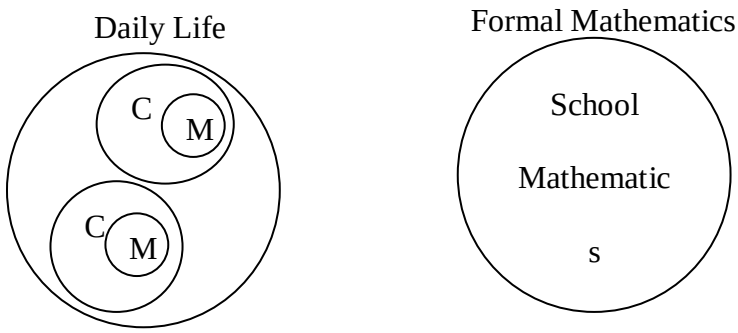
formulated knowledge, ideas, and understandings. This previous knowledge is the raw material for the new knowledge they will create. By standing on these two base and taking ethnomathematics as stairs, we can come out of it. Mathematics doesn't develop in vacuum, so if we try to search its applications, then we will be able to enrich the present mathematics.

## Suggestions

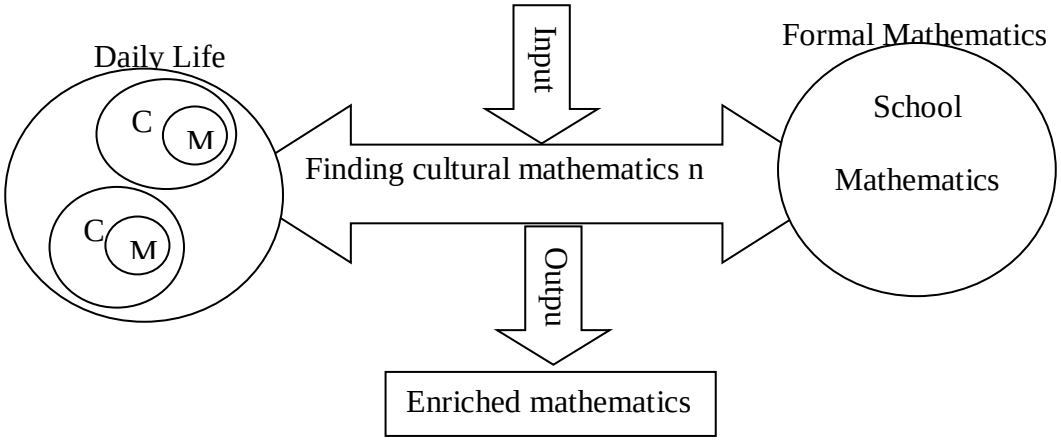
Every path leads to another path. Similarly this research has also given me some ideas which I am going to share as suggestions to others who want to do research in Ethnomathematics.

1. In this research I have only focused on the cultural practices of Gurung within a small context. Other researchers can go beyond one context because we may find different cultural practices within the same community in different places. For example, a researcher can work on the cultural practices of Gurung people in Lamjung district including many villages.
2. I tried to capture the overall practices of Gurungs. Instead of this, we can focus on some specific practices. For example; mathematical practices in cultural game, mathematical concept used in different artifact, concept of algorithm in a culture or different culture etc.
3. Instead of incorporating it in just the primary level, we can extend its area up to the higher level as well.
4. We can pick multicultural practices from the same context as research field.
5. We have to do research on how can we incorporate Ethnomathematics? What may be the challenges and how can we overcome them? What types of changes are needed in the roles of teacher and students? Answers to the aforementioned questions can be very useful insights to the stakeholders of education field.

**Purposed incorporation model of Ethnomathematics in the Primary level of school mathematics curriculum:**




My second research question is: "Which practices can be integrated or incorporated in the primary level of formal educational system?". This question touches the curriculum part as well. So I have presented below the model of ethnomathematical curriculum incorporated with the formal curriculum which is the product of my research. In the present curriculum there is no link between the daily life and formal mathematics. That is how mathematics is being alienated. To improve this situation, we need to have a link between these two. Here in this figure, C represents culture and M represents Ethnomathematics. In a school we have students from different cultures. In their houses, they have different cultural practices. So we have to incorporate different mathematical concepts in the school curriculum. Here at this point, I agree with Begg (2001), Mathematics should start with where the students are so we have to find mathematical concept outside the school and has to link with formal mathematics. If we can take these practices inside the classroom, link them with the related content and take that as input for new processing, then of course, we can give enriched mathematical concepts to student. This model of incorporating Ethnomathematics into school level has some similarity with Lipka's view. Here Ethnomathematical practices are used as motivation, as an introduction, as part of understanding how mathematical ideas develop, how they are built into systems, how they are formulated and how they are then applied in various ways within the culture.


Daily Life
C
M
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Finding cultural mathematics n
Output
Formal Mathematics
School
Mathematics
Enriched mathematics

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# Appendix 1

## Observation Check List

| Cultural practices | Tick after checked | Date of Observation | Remarks |
|---|---|---|---|
| 1. Name of number in Gurung language | | | |
| 2. Number system | | | |
| 3. Calculation Algorithms | | | |
| a. Addition | | | |
| b. Subtraction | | | |
| c. Multiplication | | | |
| d. Division | | | |
| 4. Artefacts | | | |
| a. used in house hold work | | | |
| b. used in farming | | | |

| | | | |
|---|---|---|---|
| c. used in decorating | | | |
| 5. Games inside Gurung people | | | |
| 6. Measuring system | | | |

## Appendix 2

### Observation Sheet

Date:……..

Observation In detail form:

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Possible Mathematical Concept:

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Possible ways to incorporate it:

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Reflection of Observation

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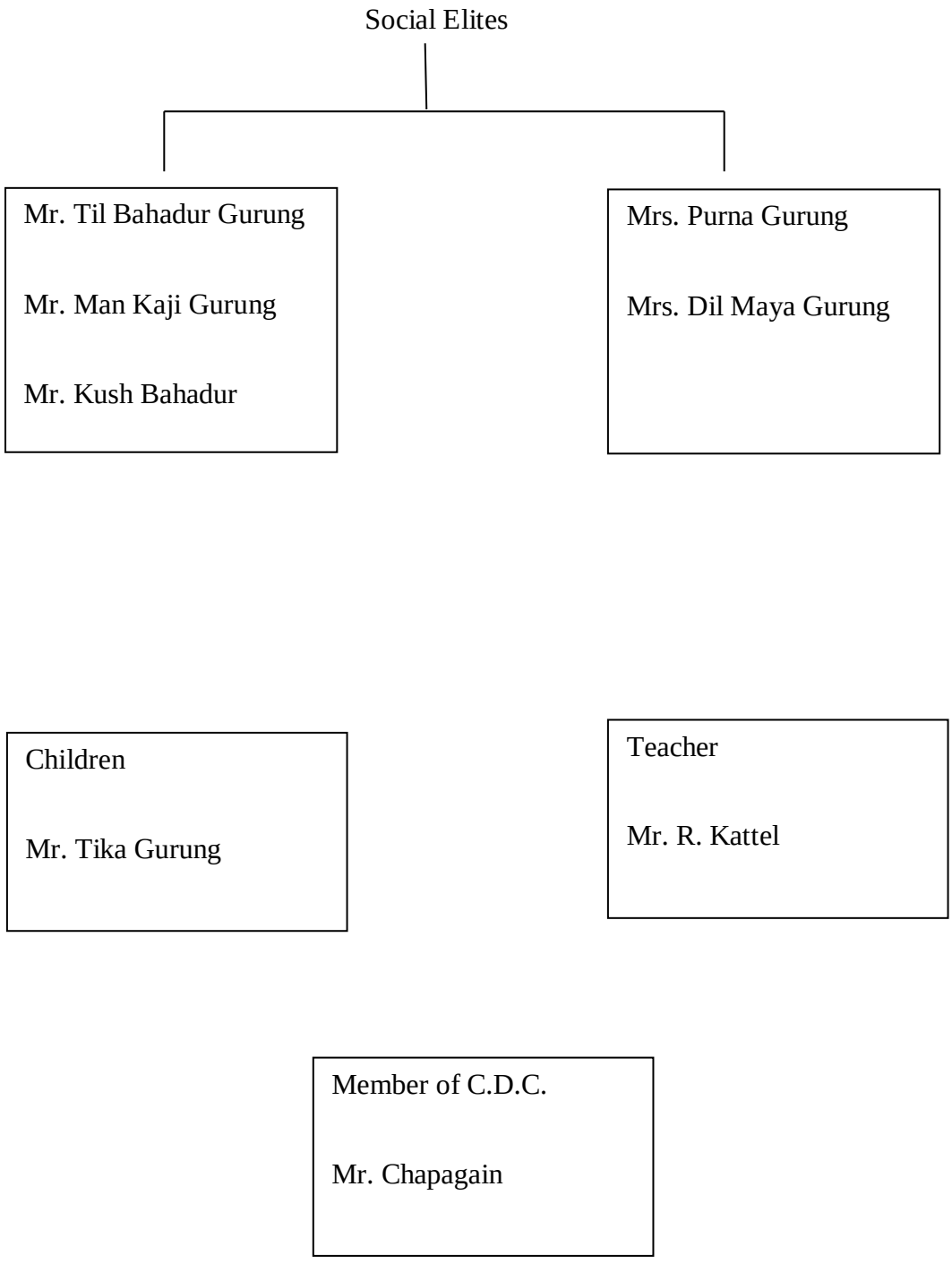
## Appendix 3

### Introduction of Participants



## Appendix 4

Numbers used by Gurung people

| | Name | | Name | | Name | | Name |
|---|---|---|---|---|---|---|---|
| 1 | Kri | 21 | Ngichyu se Kri | 41 | Plichyu se Kri | 61 | Tuchyu se Kri |
| 2 | Ngi | 22 | Ngichyu se Ngi | 42 | Plichyu se Ngi | 62 | Tuchyu se Ngi |
| 3 | Son | 23 | Ngichyu se Son | 43 | Plichyu se Son | 63 | Tuchyu se Son |
| 4 | Pli | 24 | Ngichyu se Pli | 44 | Plichyu se Pli | 64 | Tuchyu se Pli |
| 5 | Nga | 25 | Ngichyu se Nga | 45 | Plichyu se Nga | 65 | Tuchyu se Nga |
| 6 | Tu | 26 | Ngichyu se Tu | 46 | Plichyu se Tu | 66 | Tuchyu se Tu |
| 7 | Ngi | 27 | Ngichyu se Ngi | 47 | Plichyu se Ngi | 67 | Tuchyu se Ngi |
| 8 | Pre | 28 | Ngichyu se Pre | 48 | Plichyu se Pre | 68 | Tuchyu se Pre |
| 9 | Ku | 29 | Ngichyu se Ku | 49 | Plichyu se Ku | 69 | Tuchyu se Ku |
| 10 | Chyu | 30 | Sonchyu | 50 | Ngachyu | 70 | Ngichyu |
| 11 | Chyu se Kri | 31 | Sonchyu se Kri | 51 | Ngachyu se Kri | 71 | Ngichyu se Kri |
| 12 | Chyu se Ngi | 32 | Sonchyu se Ngi | 52 | Ngachyu se Ngi | 72 | Ngichyu se Ngi |
| 13 | Chyu se Son | 33 | Sonchyu se Son | 53 | Ngachyu se Son | 73 | Ngichyu se Son |
| 14 | Chyu se Pli | 34 | Sonchyu se Pli | 54 | Ngachyu se Pli | 74 | Ngichyu se Pli |
| 15 | Chyu se Nga | 35 | Sonchyu se Nga | 55 | Ngachyu se Nga | 75 | Ngichyu se Nga |
| 16 | Chyu se Tu | 36 | Sonchyu se Tu | 56 | Ngachyu se Tu | 76 | Ngichyu se Tu |
| 17 | Chyu se Ngi | 37 | Sonchyu se Ngi | 57 | Ngachyu se Ngi | 77 | Ngichyu se Ngi |
| 18 | Chyu se Pre | 38 | Sonchyu se Pre | 58 | Ngachyu se Pre | 78 | Ngichyu se Pre |
| 19 | Chyu se Ku | 39 | Sonchyu se Ku | 59 | Ngachyu se Ku | 79 | Ngichyu se Ku |
| 20 | Ngichyu | 40 | Plichyu | 60 | Tuchyu | 80 | Prechyu |